1st International Conference on SCIENCE AND HUMANITIES FOR SUSTAINABLE DEVELOPMENT (ICSHSD-2025)

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Book of Abstracts

23-24 October, 2025

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Keynote Speakers

Prof. Taufiquar Khan, Ph. D
Chairman
Department of Mathematics and Statistics University of North Carolina at Charlotte
North Carolina, USA

Biography: Taufiquar Khan is currently a Professor and the Chair of the Department of Mathematics and Statistics, University of North Carolina at Charlotte (UNC Charlotte). He is also the Director of the newly formed Center for TAIMing AI (taiming-ai.charlotte.edu). He was a Professor and an Associate Director of Graduate Studies of the School of Mathematical and Statistical Sciences, Clemson University, Clemson, SC, USA, before joining UNC Charlotte. He is a recipient of the Humboldt Fellowship from Germany. His research interests include machine learning, inverse problems involving ordinary and partial differential equations. His present and past research have been supported through the NSF, DOD, Humboldt Foundation, and the industry.

Prof. Susumu Araki, Ph. D
Department of Civil Engineering
Graduate School of Engineering,
Osaka University, Japan

Biography: Susumu Araki is a professor at The University of Osaka. He received Ph.D. in Civil Engineering from The University of Osaka, Japan in 2000. He has been working at The University of Osaka as a professor since 2023 after working as a research associate and an associate professor. His research interests lie in the interactions between waves and structures, with a particular focus on the influence of tsunami on coastal bridges, the estimation of tsunami wave force acting on a storage tank. He has also been investigating wave overtopping at sea dikes covered with armor blocks and the stability of rubble stones and armor blocks.

Prof. Saleh Hasan Naqib, Ph. D
Department of Physics &
Vice-Chancellor, University of Rajshahi
Rajshahi, Bangladesh

Biography: Dr. Saleh Hasan Naqib is serving as the Vice-Chancellor of University of Rajshahi (RU) at present. He has been a professor at Dept. of Physics, RU, since 2011. He is leading the condensed matter research group at the Dept. In terms scientific productivity, his group ranks at the top in Bangladesh. This group has been consistently producing high-quality publications in the fields of computational condensed matter physics, topological solids, semiconducting technology, optoelectronics, and superconductivity in cuprates. In these areas Dr. Naqib has been able to establish himself as the top researcher in the country. In fact, he is the most widely cited physicist in Bangladesh working on theoretical condensed matter physics and superconductivity at this moment. Dr. Naqib obtained his PhD from Cavendish Laboratory, University of Cambridge, UK in 2003. He stood first both in BSc and MSc exams. He had postdoctoral research experience both at the Quantum Matter Group, Cavendish Laboratory, University of Cambridge and at the MacDiarmid Institute for Advanced Materials and Nanotechnology, New Zealand. He conducted research as an invited scholar several times during the period from 2006 to 2010 at the Quantum Matter Group, Cavendish Laboratory, University of Cambridge. Dr. Naqib has published over 180 papers in SCOPUS indexed journals (mostly Q1 and Q2). His papers have been cited over 6100 times till date. He has established strong collaborations with research groups in the UK, Australia, Japan, New Zealand, Algeria, Turkey, Pakistan, KSA, and China. He was awarded the Regular Associateship of the AS ICTP, Italy, for the period 2010 – 2015. He is an elected fellow of the Bangladesh Academy of Sciences (BAS) and Bangladesh Physical Society (BPS). Recently he has been elected as a member of the TWAS (The World Academy of Sciences, Italy). He is only the fourth physicist from Bangladesh to obtain this coveted fellowship. Dr. Naqib is a Fellow of the Institute of Physics, UK, American Physical Society, and Cambridge

Philosophical Society. In recognition of his research excellence, Dr. Naqib received the TWAS research award in 2008 and he was selected for the Bangladesh Academy of Sciences (BAS) gold medal in the senior scientist category (2016). This is the highest award of the BAS. He is one of the very few in the country who has been selected for both the TWAS and the BAS research awards. He received the Deans Awards for research excellence several times. He delivered numerous plenary and keynote speeches on cuprate superconductivity, strongly correlated electronic systems and computational physics at different conferences all over the globe. Dr. Saleh Hasan Naqib has the honor of being ranked among the top 2% of the scientists in the world for the last five consecutive years (2021 – 2025). He is acting as the member of the editorial board of a number of national and international scientific journals. Dr. Naqib is one of the foremost experts in science education and research pedagogy in Bangladesh. He was the head of the departmental Self-Assessment Committee and acted as a subject expert to assess the functionalities of the leading universities in the country. Since 05 September 2024, he has been serving as the Vice Chancellor of University of Rajshahi, Bangladesh. This is the second largest public university in the country. At present, he is one of the members of the Vice-Chancellor Search Committee formed by the Ministry of Education and several other high-powered committees of the UGC dedicated to promote research and quality of education in the universities across Bangladesh.

Prof. Kazuyoshi Ueno, Ph. D
Semiconductor and Quantum Integrated Electronics Research Center
Yokohama National University (YNU)
Yokohama, 240-8541, Japan

Biography: Kazuyoshi Ueno received his B.S., M.S., and Ph.D. degrees from Tohoku University. He joined NEC Corporation in 1984 and served as Professor at Shibaura Institute of Technology (SIT) from 2006 to 2025, now Professor Emeritus. He currently holds a special appointment as Distinguished Professor at Yokohama National University (YNU). His research centers on advanced metallization, including Cu interconnects, graphene-based technologies, and RF devices. At SIT, he directed the Research Center for Green Innovation and the International Research Center of Green Electronics, and led the Department of Electronic Engineering. In 2018, he was named a Fellow of the Japan Society of Applied Physics (JSAP) for pioneering work on Cu interconnects. He chaired ADMETA (2011) and IEEE IITC (2021), and is a member of JSAP, IEEE-EDS, and ECSJ.

Prof. A. M. Sarwaruddin Chowdhury, Ph. D
Department of Applied Chemistry & Chemical Engineering (DU) & Vice-Chancelor, Shahajalal University of Science and Technology, Sylhet, Bangladesh

Biography: Prof. Dr. A. M. Sarwaruddin Chowdhury is a distinguished Bangladeshi scientist, researcher, and academic leader, currently serving as the Vice-Chancellor of Shahjalal University of Science and Technology (SUST), Sylhet, Bangladesh.

He obtained his B.Sc. (Honors) in Applied Chemistry and Chemical Technology from the University of Dhaka, securing First Class First Position, and later completed his M.Sc. from the same department. He earned his Ph.D. from Hokkaido University, Japan, demonstrating outstanding research capabilities in his field.

Throughout his illustrious academic and research career, Prof. Chowdhury has received numerous prestigious international fellowships, including the Commonwealth Fellowship at the University of Leeds (UK), NoNeCk, NorFA, CoGCI, and DSfM Fellowships at the University of Copenhagen (Denmark), the JASSO Fellowship at Hokkaido University (Japan), the Alexander von Humboldt Fellowship at Ruhr-Universität Bochum (Germany), and the DAAD Fellowship at Georg-August-Universität Göttingen (Germany). He has also served as a Visiting Professor at Harvard University (USA), where he continues collaborative research on “Polymer Composites Using Animal Fibers.”

Prof. Chowdhury’s academic supervision record is equally remarkable. He has successfully supervised 12 Ph.D., 3 M.Phil., and 107 M.Sc. students, and is currently guiding an additional 9 Ph.D. candidates. His prolific scholarly output includes books, book chapters, research articles, and patents, totaling 242 publications to date.

In recognition of his scientific expertise and contributions to chemistry, Prof. Chowdhury was invited in 2013 to serve as an expert for the Nobel Committee for Chemistry, Sweden, where he notably nominated a German professor for the Nobel Prize.
With a career spanning decade of research excellence, international collaboration, and academic leadership, Prof. Dr. A. M. Sarwaruddin Chowdhury stands as one of the most respected figures in the field of applied chemistry and higher education in Bangladesh.

Farshid Ramezanipour, Ph. D
Associate Professor
Department of Chemistry
University of Louisville,
KY 40292, USA

Biography: Farshid Ramezanipour is an Associate Professor in the Department of Chemistry at the University of Louisville. He received his Ph.D. from McMaster University in Canada (2011), followed by postdoctoral fellowships at the University of Calgary (2011-2013) and the University of California, Berkeley (2013-2015). He then started his independent career as an Assistant Professor in 2015.
He has been named a 2024 Top Scholar by Scholar GPS in the area of material development for oxygen-evolution reaction. He is a recipient of the NSF CAREER award, an Ascending Star Fellow, a Scialog Fellow in Advanced Energy Storage, and a recipient of the Victor Olorunsola Endowed Research Award.
The main topics of his research include rational design and synthesis of inorganic materials that exhibit several important properties, including electronic/ionic charge transport, electrocatalytic activity for water splitting, ionic transport, and pseudocapacitive energy storage. More information on his research can be found on his group's website: https://sites.google.com/site/ramezanipourgroup/home

Prof. Gazi Mahabubul Alam, Ph. D
Department of Education Policy and Economics
Faculty of Educational Studies
Taylor's University, Malaysia

Biography: Professor Gazi Mahabubul Alam, PhD, FRSA, is a social scientist who is an internationally recognized education policy and governance analyst with a particular focus on higher education. He is listed among the top 2% of scientists by Stanford University and is also ranked as a 0.5% scholar in the world by ScholarGPS. In 2010, he received a full professorship from the University of Malaya (UM). He also worked at the University Putra Malaysia (UPM). After five years at UPM, he has then joined Taylor's University in 2025, the top private university in Southeast Asia and the top 1% elite university in the globe, to take on a new challenge and to charm a new experience by expanding his career segmentation to include the private sector university. Professor Gazi is also a Fellow (FRSA) of the Royal Society of Arts, UK. He has remarkable work experience both in the institution of higher education and in international development sectors. The main countries of his work experience include Malaysia, Bangladesh, the UK, the USA, Canada, and Australia. In addition to the business administration degrees, Gazi also holds an MA in International Education and Development from the University of Sussex and a PhD from the University of Nottingham. His studies have been published in several journals and have garnered a significant number of citations.

Prof. Vibha Sharma, Ph. D
Department of English
Aligarh Muslim University
Aligarh, 202002 Uttar Pradesh, India

Biography: Prof. Vibha Sharma is a distinguished and internationally recognised scholar in English literature, literary theory, postcolonial studies, theatre and performance studies, translation studies, and environmental humanities. Her research critically engages with postcolonial narratives, identity, hyperreality, narrative ethics, ecological consciousness, and both Indian and global theatre traditions. She has authored numerous books, monographs, edited volumes, and peer-reviewed research articles, exploring interdisciplinary intersections between literature, performance, and social responsibility. Her work has been published in leading national and international journals and is frequently cited for its innovative approaches to textual, performative, and ecological analysis.

Prof. Sharma has supervised a substantial number of postgraduate and doctoral students, mentoring research that spans literary theory, cultural studies, postcolonial discourse, and performance studies. Her supervision emphasises methodological rigour, interdisciplinary engagement, and innovative interpretive strategies, resulting in scholarship that contributes to both national and global academic discourses.

Internationally, Prof. Sharma has been a visiting faculty member at Stockholm University since 2014 and has held prestigious fellowships allowing her to engage with universities across Europe, North America, and Asia. She has delivered keynote addresses, plenary talks, and invited lectures at numerous international conferences and symposia, sharing insights on literature, theatre, and environmental humanities. She conducted the GIAN course, "Unravelling the Problem of History: Exploring African and Indian Writing," and the SWAYAM MOOC, "Studies in Theatre," both of which reflect her commitment to cross-cultural scholarship, innovative pedagogy, and the integration of literary and environmental consciousness in education.

At Aligarh Muslim University, Prof. Sharma serves as Member-in-Charge of the Public Relations Office (PRO) and Deputy Dean of Student Welfare (DSW). She mentors the AMU Drama Club at the Centre for Culture (CEC), encouraging students to explore creative expression alongside academic rigor. She is also a founding member and General Secretary of the Indian Society for Theatre Research (ISTR), promoting research, collaboration, and preservation of Indian theatrical traditions.

Prof. Sharma's scholarship bridges classical aesthetics, postcolonial critique, and contemporary digital and ecological frameworks, embodying the integration of research excellence, pedagogy, and socially engaged intellectual leadership. Her work continues to inspire students, academics, and the broader global community to pursue creative, ethical, and environmentally conscious scholarship while cultivating global awareness, cultural sensitivity, and innovative thinking.

Prof. Dr. S. M. A. Faiz
Chief Guest

Government of the People's Republic of Bangladesh
University Grants Commission of Bangladesh
Agargaon, Sher-E-Bangla Nagar, Dhaka-1207, Bangladesh
Phone: +88-02-8181631 (Off.), Fax: +88-02-8181615 (Off.)
E-mail: chairmanugcbd@gmail.com, chairman@ugc.gov.bd
Web: www.ugc.gov.bd

Professor Dr. S. M. A. Faiz
Chairman

06 October 2025

Message

I am delighted to learn that the 1st International Conference on Science and Humanities for Sustainable Development (ICSHSD-2025) is being graciously hosted by the Faculty of Science, Dhaka University of Engineering & Technology (DUET), Gazipur.

This conference provides a timely and significant platform for distinguished academicians, eminent scientists, and dedicated practitioners to converge, exchange knowledge, and explore innovative ideas that can contribute to building a sustainable and prosperous future. The integration of Science, Technology, and Humanities in addressing both global and local challenges—ranging from climate change, energy transition, and rapid technological advancement to social equity and human development—is not only crucial but also truly commendable. In particular, the fusion of scientific innovation with technological application and humanistic values ensures that solutions are both cutting-edge and socially inclusive. While science and technology provide tools to unlock new possibilities, the humanities lend wisdom, ethics, and cultural understanding, thereby guiding innovation toward the greater good of humanity. Such a holistic approach embodies the essence of sustainable development, where progress is measured not merely in economic growth but also in social harmony and environmental stewardship.

I am confident that the outcomes of this conference will not only enrich academic discourse but also inspire practical solutions to pressing real-world problems. Such initiatives are in perfect harmony with the vision of the University Grants Commission of Bangladesh in fostering quality higher education, encouraging path breaking research, and promoting meaningful international collaboration.

I sincerely appreciate the dedicated efforts of the organizers for hosting this landmark event. I firmly believe that the deliberations, recommendations, and scholarly findings of ICSHSD will pave the way for innovative policies, sustainable technologies, and socially responsible practices. Beyond contributing to our national development aspirations, the insights of this conference will also serve as a guiding light in advancing the United Nations Sustainable Development Goals (SDGs), thereby nurturing a brighter, more equitable, and sustainable future for generations to come.

I wish the ICSHSD-2025 a grand success.

Professor Dr. S. M. A. Faiz
Chairman

Prof. Dr. Mohammad Zoynal Abedin

Chief Patron

MESSAGE

It is a matter of great pride and honor for me to extend my heartfelt greetings on the occasion of the regular International Conference on Science and Humanities for Sustainable Development (ICSHSD–2025) organized by the Faculty of Science, at Dhaka University of Engineering & Technology (DUET), Gazipur, on October 23–24, 2025.

In the present era, sustainable development stands as the most urgent global priority, demanding integrated solutions that combine scientific innovation with social responsibility and cultural wisdom. The challenges of climate change, energy transition, digital transformation, poverty alleviation, and social equity cannot be addressed in isolation. The interdisciplinary collaboration will make a bridges the domains of Science, Engineering, Social Sciences, and Humanities. I believe this conference provides an excellent platform for distinguished academics, researchers, policy makers, and practitioners from around the world to exchange knowledge, research findings, and generate actionable strategies for a sustainable future.

At DUET, we are committed to fostering research and innovation that contribute not only to national development but also to global progress in alignment with the Sustainable Development Goals (SDGs). I am confident that the outcomes of this conference will open new avenues for international collaboration, inspire transformative ideas, and promote practices that ensure inclusivity, resilience, and sustainability.

On behalf of DUET, I extend my sincere appreciation and gratitude to Faculty of Science for hosting this significant event and to all participants for their invaluable contributions.

I wish the conference a grand success.

Prof. Dr. Mohammad Zoynal Abedin
Vice-Chancellor
Dhaka University of Engineering & Technology, Gazipur

Prof. Dr. Md. Arefin Kowser
Patron

MESSAGE

It is a privilege to welcome all distinguished delegates and participants to the 1st International Conference on Science and Humanities for Sustainable Development (ICSHSD-2025), organized by Faculty of Science, Dhaka University of Engineering & Technology, Gazipur. With its theme "Integrating Science, Technology and Humanities Research for a Sustainable Future," this conference rightly emphasizes the critical role of Science, Engineering and Technological innovation in addressing global challenges.

Engineering solutions, when guided by scientific research and enriched with humanistic perspectives, can make a transformative impact on society. I am confident that this conference will provide a valuable platform for sharing pioneering ideas, advancing research in engineering and allied sciences, and building collaborations that contribute to sustainable development.

I sincerely commend the organizers for their dedication and hard work in arranging this international conference and creating such a valuable platform for intellectual exchange. I extend my best wishes for the success of ICSHSD-2025 and hope that it will leave a lasting impact on both participants and society.

Prof. Dr. Md. Arefin Kowser
Pro-Vice-Chancellor
Dhaka University of Engineering & Technology, Gazipur

Prof. Dr. Md. Kamal-Al-Hassan
Chair

MESSAGE

It is our great pleasure to organize the 1st International Conference on Science and Humanities for Sustainable Development (ICSHSD), 23-24 October 2025, by the Faculty of Science, at Dhaka University of Engineering & Technology, Gazipur, Bangladesh.

In the present era, sustainable development stands as the most urgent global priority, demanding integrated solutions that combine scientific innovation with social responsibility and cultural wisdom. The present challenges of climate change, energy degradation, digital utilities, poverty alleviation, and social unrest cannot be addressed in isolation. They call for interdisciplinary collaboration that bridges the domains of Science, Engineering, Social Sciences, and Humanities. I believe this conference provides an excellent platform for distinguished academics, researchers, policy makers, and practitioners from around the world to exchange knowledge, present research findings, and generate actionable strategies to solve the present global challenges for a sustainable future.

DUET is deeply committed to promoting research excellence and innovation that support both national advancement and global development in alignment with the Sustainable Development Goals (SDGs). I firmly believe that the outcomes of this conference will pave the way for impactful global partnerships, spark visionary thinking, and promote inclusive and sustainable approaches across disciplines.

Hereafter, I would like to express my warm gratitude to all the Distinguished and Honorable Guests. I would like to offer my deep appreciation to the Honorable Vice-Chancellor, Pro-Vice-Chancellor, and all other administrative personnel of DUET for their cordial support in arranging the conference. I want to show my special appreciation to all participants. I am also grateful to my colleagues for their hard work in arranging the successful conference. .

Prof. Dr. Md. Kamal-Al-Hassan
Dean, Faculty of Science
Dhaka University of Engineering & Technology, Gazipur

Prof. Dr. Md. Mahmud Alam
Co-Chair

MESSAGE

It gives me immense pleasure to welcome all participants to the 1st International Conference on Science and Humanities for Sustainable Development (ICSHSD-2025) organized by Faculty of Science, Dhaka University of Engineering & Technology, Gazipur. The Department of Mathematics is proud to be part of this timely initiative, which brings together diverse disciplines under the theme "Integrating Science, Technology and Humanities Research for a Sustainable Future."

Mathematics is the foundation of scientific and engineering innovation. From modeling complex systems to solving real-world problems, mathematics provides the essential tools and frameworks that guide research, technology, and policy toward sustainable solutions. This conference offers an excellent opportunity to showcase how mathematical approaches, in collaboration with other disciplines, can contribute to addressing global challenges.

As the Head of the Department of Mathematics, I am honored to be part of this remarkable platform that brings together scholars and researchers to share knowledge and ideas toward a sustainable future. The Department of Mathematics at DUET plays a crucial role in strengthening engineering and scientific education through its robust analytical and computational foundation. The department offers postgraduate programs (Ph.D., M.Phil., and M.Sc.) in fields such as Applied Mathematics, Computational Fluid Dynamics, Numerical Heat and Mass Transfer, Optimization Techniques and Operations Research, Data Science and Artificial Intelligence, Biomathematics, and Mathematical Modeling. We remain committed to advancing research and education that bridge theory and application, fostering innovation and contributing to sustainable development.

I extend my heartfelt appreciation to the organizers, contributors, and participants for their dedication and scholarly efforts. I wish the conference every success and hope it will inspire future research and collaboration across disciplines.

Prof. Dr. Md. Mahmud Alam
Head, Department of Mathematics
Dhaka University of Engineering & Technology, Gazipur

Prof. Dr. Abu Talib Md. Kaosar Jamil

Co-Chair

MESSAGE

The Faculty of Science, DUET, Gazipur, is hosting the 1st International Conference on Science and Humanities for Sustainable Development (ICSHSD-2025) from October 23–24, 2025. It gives me immense pleasure to extend a warm welcome to all participants. This conference is not only an academic gathering but also open a space for collaboration, innovation, and the exchange of ideas that transcend disciplinary boundaries. I encourage all participants to engage fully, challenge assumptions, and contribute to the collective vision of a more equitable, resilient, and sustainable world.

As the Head of the Department of Physics, I am honored to be part of this pioneering platform that brings together scientists, scholars, and thought leaders from diverse disciplines to engage in meaningful dialogue on the critical issue of sustainability. The department of Physics, DUET started postgraduate programs (Ph. D, M Phil. & M Sc.) from the year 2010 in the field of Condensed Matter Physics, Plasma Physics, Nano-Structure Materials, Composite Materials and Computational Physics. The department of Physics makes sincere effort to strengthen its innovative research and education program in accordance with DUET's long term development plan of becoming a research-oriented university.

In today's rapidly evolving world, the intersection of science and humanities plays a vital role in addressing the multifaceted challenges of sustainable development. Physics, in particular, continues to offer transformative insights and innovations—from renewable energy technologies to climate modeling and beyond—that are essential for shaping a sustainable future.

Let us work together to ensure that our knowledge leads to action, and our actions lead to impact.

Wishing you all a fruitful and inspiring conference experience.

Warm regards and best wishes,

Prof. Dr. Abu Talib Md. Kaosar Jamil
Head, Department of Physics
Dhaka University of Engineering & Technology, Gazipur

Prof. Dr. Ummey Rayhan
Co-Chair

MESSAGE

Welcome to the 1st International Conference on Science and Humanities for Sustainable Development (ICSHSD-2025). It is of immense pleasure and pride that a global community of brilliant minds is united by a shared purpose: to chart a new, sustainable course for our planet.

Chemistry, at its core, is the science of transformation. Our efforts have propelled the advancement for millennia, from producing the elements that constructed our contemporary globe to manufacture life-saving medications. But today, we stand at a critical inflection point to create the materials that build our modern world.

The question before us is no longer about what chemistry can do, but what chemistry must do. We must fundamentally rethink the way of remark, create, and use of chemicals. Our current task is to change chemistry itself, moving away from the "take, make, dispose" linear model and towards a circular, regenerative one that works in harmony with the nature. This is not a task for any single discipline or nation. Everyone has a stake in this agenda. It requires us to break down silos and integrate across fields, testing policy coherence between our work in chemistry and broader issues like trade, climate change, and social development.

In this conference, we are expecting to explore groundbreaking topics that represent the future of our field and we are going to hear about the latest advances in designing chemical products and processes in different areas. Let us be honest about the journey lying ahead. The challenges are vast, and the path to global sustainability will require our sustained determination. But like a lighthouse built as a beacon for a stormy sea, our commitment must be rock solid as the challenges are looming large.

I urge you to engage and interact deeply with one another. Share your knowledge, challenge your assumptions, and forge new collaborations. Let's make this conference a true catalyst for change, not just a forum for discussion, but a launchpad for the future course of action.
I look forward to the inspiring work that can accomplish together. I convey my best wishes for the grand success of the 1st International Conference on Science and Humanities for Sustainable Development (ICSHSD-2025) at Dhaka University of Engineering & Technology, Gazipur, Bangladesh.

Prof. Dr. Ummey Rayhan

Head, Department of Chemistry
Dhaka University of Engineering & Technology, Gazipur

Prof. Dr. Most. Tahura Pervin
Co-Chair

MESSAGE

It is my great pleasure to welcome you to the 1st International Conference on Science and Humanities for Sustainable Development (ICSHSD-2025) on behalf of the Department of Humanities and Social Sciences at Dhaka University of Engineering & Technology (DUET).

This conference, with the theme *"Integrating Science, Technology, and Humanities Research for a Sustainable Future,"* provides a critical platform for advancing interdisciplinary dialogue and fostering collaboration across diverse academic domains. The integration of science, technology, and humanities is essential for addressing the pressing challenges of sustainability. As we traverse an increasingly complicated world, the intersection of these fields presents revolutionary potential for both theoretical and practical solutions to global challenges.

The research presented at this conference will not only highlight the significance of bridging these disciplines but will also serve as a catalyst for future studies that emphasize sustainable development. Through thoughtful discussions, innovative ideas, and rigorous academic inquiry, we want to find out how these areas might work together to make a difference for both the present and future generations through insightful talks, new ideas, and serious academic research.

I truly hope that the conference will provide us with valuable insights and contribute to the advancement of knowledge in this critical area of research. The exchange of ideas among scholars and practitioners from diverse backgrounds will undoubtedly enrich the ongoing conversation on sustainable development and strengthen our collective commitment to create a more sustainable and equitable world.

I look forward to the thought-provoking discussions and fruitful collaborations that will emerge from this gathering.

Prof. Dr. Most. Tahura Pervin
Head, Department of Humanities and Social Sciences
Dhaka University of Engineering & Technology, Gazipur

Prof. Dr. Most. Nasrin Akhter
Conference Secretary

MESSAGE

On behalf of the Organizing Committee, it is my great honor and privilege to welcome you all to the 1st International Conference on Science and Humanities for Sustainable Development (ICSHSD-2025).

This conference serves as a significant platform for academic and professional exchange, bringing together researchers, educators, practitioners, and policymakers from around the Nation and Globe. At a time when global challenges require unified, innovative, and inclusive approaches, ICSHSD-2025 emerges as a vital forum for thoughtful academic exchange, collaborative dialogue, actionable and ground breaking research. The Conference aims to foster interdisciplinary dialogue that contributes meaningfully to the advancement of knowledge and the pursuit of sustainable development.

We believe that the diverse sessions, thought-provoking discussions, and collaborative networking opportunities offered through this event will inspire new directions in research and practice across the fields of Science, Technology and Humanities.

As a Conference Secretary, I would like to express my sincere gratitude to all those whose dedication and commitment have brought this event to life. To our keynote speakers, Invited Speakers, Session Chairs, Paper presenters, Reviewers, Sponsors, Institutional partners, organizing team, and Volunteers—your tireless efforts and enthusiasm have been instrumental in shaping ICSHSD-2025 into a landmark event. Your contribution to the success of this conference is deeply valued and wholeheartedly appreciated.

Wishing you all a productive, insightful, and inspiring conference

Prof. Dr. Most. Nasrin Akhter
Department of Mathematics
Dhaka University of Engineering & Technology, Gazipur

CONTENTS

ORGANIZATION

Advisory Committee 16
Steering Committee 18
Organizing Committee 19

THECNICAL PROGRAM

Program at a glance 25
Program in details 29-80

ABSTRACTS

Keynote Papers
Keynote papers 82-85

MATHEMATICS

Invited papers 87-94

Contributed Papers
Computational Fluid Dynamics (CFD) 96-118
Numerical Heat and Mass Transfer 120-125
Biomathematics and Mathematical Modelling 127-146
Optimization and Operational Research 148-155
Pure Mathematics 156-158
Data Science and Machine Learning 160-171
Artificial Intelligence 173-178

Poster papers 180-181

PHISICS

Invited papers 183-186

Contributed Papers

Theoretical and Computational Physics 188-191
Physics Thin Film and Nano-Structural Material-I 193-196
Material Science 198-201
Magnetic Material-I 203-205
Plasma and Astrophysics 207-210
Medical and Health Physics 212-214
Thin Film and Nano-structural Material-II 216-219
Magnetic Material-II 221-224

Poster papers 226-242

CHEMISTRY

Invited papers 244-251

Contributed Papers

Organic, Food, Agro and Bio Chemistry 253-268
Inorganic, Material Science and Nano-Technology 270-288
Physical and Computational Chemistry 290-297
Analytical, Industrial and Environmental Chemistry 299-314
Energy Conversion, Storage and Nuclear Chemistry 316-319

Poster papers 321-364

HUMANITIES AND SOCIAL SCIENCES

Invited papers 366-369

Contributed Papers

Innovative Business Technology for Sustainable Development 371-372
Driving Economic Sustainability/Public policy 374-380
Economic and Public Policy for Sustainable Development 382-397
Graduate Employability and Language Education 399-401
Language Education and Technology for Learner Autonomy 403-409
Communication Skills for ESP and Engineering Graduates 411-413

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1st International Conference on Science and Humanities for Sustainable Development (ICSHSD-2025)

Program Schedule

Day 1: Thursday, 23 October, 2025

Time	Program Name
08:00 AM - 09:00 AM	**Registration and Kits Distribution** **Venue: Shaheed Shakil Pervaze Auditorium, DUET**

Keynote Session

Venue: Shaheed Shakil Pervaze Auditorium, DUET

Chair: Prof. Dr. Md. Kamrujjaman, Dept. of Mathematics, DU

Co-Chair: Prof. Dr. Md. Sahab Uddin, Dept. of Physics, DUET

09:00 AM - 09:35 AM	**Prof. Dr. Taufiquar Khan** **Department of Mathematics and Statistics, University of North Carolina, USA**
09:35 AM - 10:10 PM	**Prof. Dr. Vibha Sharma,** Department of English, Aligarh Muslim University, Uttar Pradesh, India
10:10 AM 10:30AM	**Tea/ Coffee Break**
10:30 AM- 11:40AM	Opening Ceremony Venue: Shaheed Shakil Pervaze Auditorium, DUET
11:40 AM- 12:15 PM	**Prof. Dr. Saleh Hasan Naqib** Vice-Chancellor, University of Rajshahi, Bangladesh
12:15 PM- 12:50 PM	**Prof. Dr. A.M. Sarwaruddin Chowdhury** Vice-Chancelor, Shahajalal University of Science and Technology, Bangladesh
12:50 PM – 02:00 PM	**Prayer& Lunch break** **Venue: DUET Central Mosques & 11th floor, Shaheed Sayed Nazrul Islam Academic Building**
2:00 PM - 3:35 PM	**Technical Session- 1**
3.35 PM- 4.00 PM	**Tea/ Coffee Break** **Venue: 11th floor, Shaheed Sayed Nazrul Islam Academic Building**
4:00 PM - 5:35 PM	**Technical Session- 2**

Opening Ceremony **Venue: Shaheed Shakil Pervaze Auditorium, DUET**		
10:30 AM - 10:35 AM	**Guests and participants to take seats**	
10:35 AM - 10:40 AM	**Recitation from the Holy Quran**	
10:40 AM - 10:45 AM	**Welcome Address**	**Prof. Dr. Most. Nasrin Akhter** Conference Secretary, ICSHSD-2025 Department of Mathematics, DUET
10:45 AM - 10:50AM	**Conference Technical Chair Address**	**Prof. Dr. Md. Mahmud Alam,** Head, Department of Mathematics, DUET
10:50 AM - 10:55AM	**Conference Chair Address**	**Prof. Dr. Md. Kamal-Al-Hassan** Dean, Faculty of Science, DUET
10:55 AM - 11:10 AM	**Guest of Honor Address**	**Prof. Dr. A.B.M. Obaidul Islam** Vice-Chancellor Open University, Bangladesh
		Prof. Dr. A.M. Sarwaruddin Chowdhury Vice-Chancellor Shahjalal University of Science and Technology, Bangladesh
		Prof. Dr. Saleh Hasan Naqib Vice-Chancellor University of Rajshahi, Bangladesh
11:10 AM – 11:15AM	**Special Guest & Patron Address**	**Prof. Dr. Md. Arefin Kowser** Pro-Vice-Chancellor DUET, Gazipur.
11:15 AM – 11:30 AM	**Chief Guest Address**	**Prof. Dr. S. M. A. Faiz** Chairman, University Grants Commission of Bangladesh
11:30 AM – 11:40 AM	**Chair & Chief Patron Address**	**Prof. Dr. Mohammad Zoynal Abedin** Vice-Chancellor DUET, Gazipur

Day 2: Friday, 24 October, 2025

Keynote Session

Venue: Shaheed Shakil Pervaze Auditorium, DUET

Chair: Prof. Dr. Md. Abu Hashan Bhuiyan, Vice-Chancellor, UITS

Co-Chair: Prof. Dr. A K M Zakaria, Dept. of Humanities and Social Sciences, DUET

08:30 AM - 09:05 AM	**Dr. Farshid Ramezanipour** **Department of Chemistry, University of Louisville, KY 40292, USA**
09:05 AM - 09:40 AM	**Prof. Dr. Susumu Araki** Department of Civil Engineering, Osaka University, Japan
09:40AM 10:00 AM	**Tea/ Coffee Break**
10:00 AM - 10:35 AM	**Prof. Dr. Kazuyoshi Ueno** Yokohama National University, Japan
10:35 AM - 11:10 AM	**Prof. Dr. Gazi Mahabubul Alam** Taylor's University, Malaysia

11:10 AM - 12:45 PM	**Technical Session- 1**
12:45 PM - 2:00 PM	**Prayer & Lunch break** **Venue: DUET Central Mosques & 11th floor, Shaheed Sayed Nazrul Islam Academic Building**
2:00 PM - 3:35 PM	**Technical Session- 2**
3.35 PM- 4.00 PM	**Tea/ Coffee Break** **Venue: 11th floor, Shaheed Sayed Nazrul Islam Academic Building**
4:00 PM - 5:35 PM	**Technical Session- 3**

Grand Dinner

Time- 7.00 PM

Venue: BOF Golf Club, Shimultoli, Joydebpur, Gazipur

Keynote Session, Day 1: Thursday, October 23, 2025
Venue: Shaheed Shakil Pervaze Auditorium, DUET
Chair: Prof. Dr. Md. Kamrujjaman, Dept. of Mathematics, DU
Co-Chair: Prof. Dr. Md. Sahab Uddin, Dept. of Physics, DUET

K-01	**Prof. Dr. Taufiquar Khan** **Department of Mathematics and Statistics, University of North Carolina, USA** **Title:** Machine Learning Meets Model Parameter Estimation Meets Level Sets with Applications to Imaging
K-02	**Prof. Dr. Vibha Sharma** **Department of English, Aligarh Muslim University, Uttar Pradesh, India** **Title:** Enriching Engineering Students' Personality, Employability, and Global Consciousness through Language and Communication Skills
K-03	**Prof. Dr. Saleh Hasan Naqib** **Vice-Chancellor, University of Rajshahi, Rajshahi, Bangladesh** **Title:** Superconductivity in Metallic Hydrides: Prospects and Challenges
K-04	**Prof. Dr. A. M. Sarwaruddin Chowdhury** **Vice Chancelor, Shahajalal University of Science and Technology, Sylhet, Bangladesh** **Title:** Development of Epoxy Composites Reinforced with Waste Natural Fibers and Their Environmental Behavior

Keynote Session, Day 2: Friday, October 24, 2025
Venue: Shaheed Shakil Pervaze Auditorium, DUET
Chair: Prof. Dr. Md. Abu Hashan Bhuiyan, Vice-Chancellor, UITS
Co-Chair: Prof. Dr. A K M Zakaria, Dept. of Humanities and Social Sciences, DUET

K-05	**Dr. Farshid Ramezanipour** **Department of Chemistry, University of Louisville, KY 40292, USA** **Title:** Structurally Ordered Multi-Metal Oxides for Electrochemical Energy Conversion
K-06	**Prof. Dr. Susumu Araki** **Department of Civil Engineering, Osaka University, Japan** **Title:** Tsunami Wave Force Acting on Structures
K-07	**Prof. Dr. Kazuyoshi Ueno** **Semiconductor and Quantum Integrated Electronics Research Center** **Yokohama National University (YNU), Yokohama, 240-8541, Japan** **Title:** Multilayer Graphene Processing for Next-Generation Sustainable Electronics
K-08	**Prof. Dr. Gazi Mahabubul Alam** **Department of Education Policy and Economics, Taylor's University, Malaysia** **Title:** The AI and Digitalization Era: A Boon or A Bane for Philosophically Sustainable Employment and Education in Emerging Nation

Technical Sessions for Mathematics

Parallel Session-1
Invited & Contributed Session: Mathematics
Theme: Computational Fluid Dynamics (CFD)
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11003
Time: 02.00 PM- 03.35 PM

Chair: Professor Susumu Araki, Dept. of Civil Engineering, The University of Osaka, Japan
Co-Chair: Dr. Nur Hossain, Assistant Professor, Dept. of Mathematics, RU
Invited Speaker: Prof. Dr. Mohammad Ali, Dept. of Mechanical Engineering, BUET

Paper ID	Abstract Title and Authors
Invited Talk	**Effects Of Shock-Shear Layer Interaction on the Mixing of a Sonic Hydrogen Jet in Supersonic Airflow**
ID 070	**Thermal Analysis of Cu–H_2O Nanofluid in A Corrugated Trapezoidal Enclosure with Multiple Internal Heat Sources at Different Positions** Sree Pradip Kumer Sarker, Md. Mahmud Alam
ID 018	**Traffic Dynamics: A Fluid Mechanical Perspective Using Mass and Momentum Equations** Bitu Joydhar, MD Rasel Ahmed and Laek Sazzad Andallah
ID 044	**Optimization of Heat Transfer of Cu-H2O Nanofluid inside a Hexagonal Cavity using Response Surface Methodology and Artificial Neural Network** Tasnim Rahman Mim and Md. Shariful Alam
ID 046	**Convective Heat Transfer of Hybrid Nanofluid in a Rectotrapezoidal Enclosure under the Influence of Periodic Magnetic Field using Thermally Equilibrium Model** Sumaya Binta Mosharraf and Md. Shariful Alam
ID 048	**Nanoparticle-Based Drug Delivery for Blood Flow Disruption in Idealized Aneurysmal Arteries** M. A. K. Khan, K. E. Hoque, M. Osman Gani, M. Sahidul Islam, M. Masum Billah
ID 049	**Finite Element Study of Mixed Convective Flow and Entropy Generation in a T-Shaped Cavity with an Octagonal Block** Sadia Islam, Md. Nur Alam, Md. Aslam Hossain
ID 054	**Numerical analysis of MHD Mixed Convection in a Cavity with Internal Circular Heater and Heat Flux Boundary Conditions** Mst. Kakoly Akter Mitta and Md. Nur Alam

Parallel Session-2
Invited & Contributed Session: Mathematics
Theme: Biomathematics and Mathematical Modeling
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11006
Time: 02.00 PM- 03.35 PM

Chair: Prof. Dr. Md. Ali Akbar, Dept. of Applied Mathematics, RU
Co-Chair: Dr. Muhammad Minarul Islam, Associate Professor, Dept. of Mathematics, GSTU
Invited Speaker: Prof. Dr. Md. Kamrujjaman, Dept. of Mathematics, DU

Paper ID	Abstract Title and Authors
Invited Talk	**HIV Suppression in North America: Intervention Plans and Cost-Effectiveness of UNAIDS 90-90-90 and 95-95-95 Targets**
ID 006	**A Nonlinear SEITR Model for Tuberculosis Transmission Dynamics: Stability, Bifurcation, and Sensitivity Analysis with Real-World Validation** M. A. Salek, J. Nayeem, M. Humayun Kabir
ID 007	**Modeling Dengue Dynamics with Fuzzy Parameters: Impact of Media-induced Vaccination and Bed Nets** Shobha Islam, Md. Shahidul Islam and Md. Kamrujjaman
ID 020	**Transmission Dynamics of Nipah Virus in Bangladesh: A Comprehensive Mathematical Modeling Approach** Souyba Jannat, Md. Tanvir Hasan, and Md Hamidul Islam

ID 023	**Dynamics of Rabies Transmission with and without Vaccination: A Modelling Investigation** Md. Majharul Islam, Md. Hamidul Islam
ID 027	**Investigation of the Spread of COVID-19 of Bangladesh by Using SIR and SVIR models** Jannatul Ferdous, Md Rasel Ahmed, Md. Laek Sazzad Andallah
ID 031	**Herd Immunity and Prevention in HPV Transmission with Exogenous Reinfection** Md. Mehedi Hasan and Md Hamidul Islam
ID 055	**Investigation of Soliton Formation and Modulation Instability in Optical Fibers with Ultrashort Femtosecond Pulses** Md Alamgir Hossain and Md. Nur Alam

Parallel Session-3
Invited & Contributed Session: Mathematics
Theme: Data Science and Machine Learning
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-9016
Time: 02.00 PM- 03.35 PM

Chair: Dr. Akter Hossain, Dean Faculty of Science, PRSTU
Co-Chair: Mr. Md. Motiur Rahman, Assistant Professor, Dept. of Mathematics, DUET
Invited Speaker: Prof. Dr. Papia Sultana, Dept. of Statistics, RU

Paper ID	Abstract Title and Authors
Invited Talk	**Predicting Stunting Among Under-Five Children in Bangladesh Using Machine Learning Techniques**
ID 017	**Forecasting CO_2 Emissions Using Machine Learning and Deep Learning Models: A Comparative Study Across Techniques** Md. Tawhidul Islam Siam, Anika Tahsin Biva, and Dr. Shahansha Khan
ID 039	**Cubic B-Spline Method: A Comprehensive Study in Approximating Boundary Value Problems** Md. Shahid Hasan and Md. Nur Alam
ID 060	**Empowering Clinical Decision Support: Machine Learning for Early Detection of Diabetes Mellitus** Farhad Hossain and Md. Nur Alam
ID 078	**AI-Powered Traffic Congestion Prediction and Management: A Data-Driven Framework for Sustainable Urban Mobility in South Asian Cities** Toukir Ahamed, Shathy Khan, and Dr. Ferdous Sarwar
ID 094	**Detecting Fake Accounts Using Ensemble and Classical Machine Learning Models** Md Parvez Hossain, Onim Mredha, and Abdul Halim Bhuiyan
ID 137	**Multimodal AI for Math Education: An Integrated Framework with OCR, Symbolic Computation and Rag** Ahsanul Karim Raiyan, Raiyan Ahmed and Atia Afroz
ID 079	**Machine Learning-Enhanced Fem Analysis of Cu–H_2O Nanofluid Heat Transfer in Corrugated Trapezoidal Cavities with Heat Generating Star Shaped Obstacles** Sree Pradip Kumer Sarker and Md. Mahmud Alam

Parallel Session-4
Invited & Contributed Session: Mathematics
Theme: Optimization and Operational Research
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11007
Time: 02.00 PM- 03.35PM

Chair: Prof. Dr. Md. Manirul Alam Sarker, Dept. of Mathematics, BUET
Co-Chair: Prof. Dr. Mohammad Wahiduzzaman, Mathematics Discipline, KU
Invited Speaker: Prof. Dr. Nasima Akhter, Dept. of Mathematics, RU

Paper ID	Abstract Title and Authors
Invited Talk	**Unveiling the Shape of Big Data: Persistent Homology in Topological Data Analysis**

ID 043	**Optimization of Thermal Conductivity Ratio of Al_2O_3–Water Nanofluid: A Comparative Study between Statistical and Machine Learning Approach** Md. Masud Parveg Nayon and Md. Shariful Alam
ID 045	**Optimization and Modelling of Viscosity of Copper-Water Nanofluid using Response Surface Methodology** Saima Tasnim and Md. Shariful Alam
ID 226	**Model Order Reduction of a Linear Crossbar Array** Md. Shariful Islam and Md. Sumon Hossain
ID 269	**Balancing Cost Efficiency and Emission Reduction Mechanism: An EOQ Model for Perishable Goods with Subsidy-Driven Green Investment** Md Abu Rumman, Md. Al-Amin Khan
ID 286	**Circular Economy-Driven Production Systems: Optimization With Warm-Up Effects and Carbon Trading** Rana Pervez, Md. Al-Amin Khan
ID 295	**Effects of Subsidy Policies in Sustainable EPQ System Incorporating Remanufacturing and Inspection Strategies** Md Rakib, Md. Al-Amin Khan
ID 298	**A Circularity-Driven EOQ Model with Imperfect Quality and Index-Based Optimization** Afrin Jahan, Md. Al-Amin Khan

3:35 PM - 4:00PM	**Tea/ Coffee Break** **Venue: 11th floor, Shaheed Sayed Nazrul Islam Academic Building, DUET, Gazipur.**

Parallel Session-5
Invited & Contributed Session: Mathematics
Theme: Biomathematics and Mathematical Modelling
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11003
Time: 04.00 PM- 05.35 PM

Chair: Prof. Dr. Md. Ashabul Hoque, Dept. of Mathematics, RU
Co-Chair: Dr. Md. Hamidul Islam, Assistant Professor, Dept. of Applied Mathematics, RU
Invited Speaker: Prof. Dr. Md. Haider Ali Biswas, Mathematics Discipline, KU

Paper ID	Abstract Title and Authors
Invited Talk	**Modeling for Optimal Management of Natural Resources Towards Achieving the Sustainable Development Goals**
ID 061	**Vegetation Pattern Formation in Arid Ecosystems with Nonlocal Dispersal** Riya Akter
ID 066	**Bifurcations in Two-Species Dynamical Systems** Saiful Islam and M. Osman Gani
ID 067	**Investigation of Soliton Formation in the Benney–Luke Equation for Surface Waves in a Shallow Channel with Surface Tension Effects** Muhammad Ziaul Haque and Md. Nur Alam
ID 069	**OOptimal Climate-Economic Control: Modeling Temperature, Forest Area, Carbon Emissions and GDP Trade-offs** Maliha Tasnim and Md. Kamrujjaman
ID 086	**Modeling of Herbivore-Plant Interactions with Holling Type II Functional Response in a Random Environment** Abu Jaher
ID 097	**Vector–Host Model for Dengue Transmission with Vaccination, Treatment, Reinfection, Awareness and Control** Hosneara Khatun, Motiur Rahman, Nashidul Islam and Most. Nasrin Akhter
ID 103	**Understanding the Tri-trophic Food Chain Dynamics of Interacting Populations** Moin Uddin

Parallel Session-6
Invited & Contributed Session: Mathematics
Theme: Data Science and Machine Learning
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-9016
Time: 04.00 PM- 05.35 PM

Chair: Prof. Dr. Md. Azmol Huda, Mathematics Discipline, KU
Co-Chair: Dr. Md. Mashud Parvez, Assistant Professor, Dept. of Mathematics, DUET
Invited Speaker: Prof. Dr. Md. Nur Alam, Dept. of Mathematics, PUST

Paper ID	Abstract Title and Authors
Invited Talk	**Subdivision Surface Schemes for Precision Surface Modeling in CAD, Animation, and Industrial Design**
ID 143	**Deep Learning-Based Coronary Segmentation and Centerline Extraction** M. M. Rahman, K. E. Hoque, M. Sajjad Hossain, N. I. Nima and A. H. M. M. Rahman
ID 150	**Impact of Mid-Tropospheric Instability on Developing Versus Non-Developing Cyclonic Systems over the Bay of Bengal** Md. Shakil Hossain and Md. Abdus Samad
ID 155	**Predicting Kickstarter Campaign Success Using Logistic Regression and Artificial Neural Networks** Md Eabad Ali, Ibukun Amusan and Al Mamun Bhuiyan
ID 210	**Comparative Evaluation of ARIMA, LSTM, and XGBoost Models for Predicting COVID-19 Confirmed Cases in Bangladesh** Apurbo Roy Chowdhury, Shobha Islam, Bitu Joydhar
ID 213	**Forecasting Climate Variables in Sylhet Region of Bangladesh with Hybrid Seasonal ARIMA-ANN Models** Md Azizul Baten and Panna Shil
ID 232	**Physics-Informed Deep Learning for Modeling Nonlinear Dynamics** Md. Abdullah Al Zayed and Md. Sumon Hossain
ID 433	**Identification of the Effects of Socio-Demographic and Health Related Characteristics on Ever Attending School of Street Children of Dhaka City in Bangladesh Using Logistic Regression Model** Md. Shahiduzzaman, M. Korban Ali, Md. Nurul Islam and Md. Rafiqul Islam

Parallel Session-7
Invited & Contributed Session: Mathematics
Theme: Computational Fluid Dynamic (CFD)
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11007
Time: 04.00 PM- 05.35 PM

Chair: Prof. Dr. Md Ashraf Uddin, Dept. of Mathematics, SUST
Co-Chair: Dr. Md. Sahidul Islam, Assistant Professor, Dept. of Mathematical and Physical Sciences, EWU
Invited Speaker: Prof. Dr. Md. Shariful Alam, Dept. of Mathematics, JnU

Paper ID	Abstract Title and Authors
Invited Talk	**Application of Advanced Machine Learning and Statistical Approaches for Optimization of Convective Heat Transfer of Nanofluid Flow in a Porous Medium**
ID 246	**Unsteady and MHD thermal transportation in a nanofluid filled wavy octagonal enclosure including parabolically heated wall** Tinni Saha and Nazma Parveen
ID 248	**Thermo-Hydraulic Performance of Microchannel Heat Exchangers: An Artificial Neural Network Analysis** Md. Shamim Hasan, Md. Asif Ishtiaq, Md. Nur Alam, Md. Manirul Alam Sarker

ID 256	**Aging-Induced Variations of Pulmonary Permeability and Darcy Drag Force in Bronchial Channel** Tasnuba Farin Toma, Faisal Alam and Mahtab U. Ahmmed
ID 312	**Temperature-Induced Buoyancy Effects in the Human Respiratory System** Faisal Alam, Tasnuba Farin Toma and Mahtab U. Ahmmed
ID 314	**Simulation Of MHD Micropolar Fluid Flow with Hall and Ion-Slip Effects Along a Vertical Wall** Toufiqur Rahman Tamim, Nahid Sultana Mitu, Sourab Roy and Mohammad Wahiduzzaman
ID 347	**Thermo-Viscoelastic Stress Analysis in Particle-Laden Polymer Melts Flowing Through Contraction Geometries** Shamima Akter, Riaz Hossain, Adaito Basak, Muhammad Minarul Islam
ID 389	**Hemodynamic Changes in a Bypass Graft Due to Coronary Artery Stenosis** Rehnuma Islam, K. E. Hoque, S. Subah, M. Ashraf Hossain and S. M. A. Hoq

Parallel Session-8
Invited & Contributed Session: Mathematics
Theme: Computational Fluid Dynamics (CFD)
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11006
Time: 04.00 PM- 05.35 PM

Chair: Prof. Dr. Mahbub Alam, Harbin Institute of Technology (Shenzhen), China
Co-Chair: Dr. Md. Alamin, Assistant Professor, Dept. of Mathematics & Physics, NSU
Invited Speaker: Prof. Dr. Md. Abdul Hakim Khan, Dept. of Mathematics, BUET

Paper ID	Abstract Title and Authors
Invited Talk	**Differential Approximants and its application to Fluid Dynamics**
ID 071	**Entropy Generation and Heat Transfer Analysis in Mhd Free Convection of Cu–H_2O Nanofluid Within Trapezoidal Cavities with Varying Top Corrugation** Sree Pradip Kumer Sarker and Md. Mahmud Alam
ID 073	**A Computational Study of the Velocity of Air and Nanoparticles in Human Lung Airways** Sumaiya Akter and Mahtab Uddin Ahmmed
ID 084	**Periodic MHD Non-Linear Radiative Jeffrey Fluid Flow Past a Stretching Porous Sheet with Arrhenius Activation** S. Shefath, K. Suraiya, I. J. Luna M. Y. Hossain and S. F. Ahmmed
ID 085	**Analysis of Casson Fluid Flow Past a Stretching Sheet Under Periodic Magnetic Field with Thermal Radiation and Chemical Reactions** Md. Yousuf Hossain, Israt Jahan Luna, Tazrian Tamim, Jeba Tasnia, Salmoon Shefath, Sarder Firoz Ahmmed
ID 087	**Maxwell Fluid Flow in a Porous Channel with Chemical Reaction: A Haar Wavelet Approach** Israt Jahan Luna, Md. Yousuf Hossain, Tazrian Tamim, Jeba Tasnia, Salmoon Shefath, Sarder Firoz Ahmmed
ID 090	**Analysis Of Radius of Curvature Effect on Mhd Multiphase Flow in an Eccentric Square Curved Duct with Differential Wall Heating in a Porous Medium** Md. Khalilur Rahman, Rid–Wanul Alam Likhon and Md. Abdul Hakim Khan
ID 091	**Aerodynamic Performance Assessment of Horizontal Axis Wind Turbine for Coastal Regions of Bangladesh Using CFD** Md Abid Hassan Mitul and Most Nasrin Akhter

Technical Sessions for Mathematics

Day 2: 24th October, 2025

Parallel Session-1
Invited & Contributed Session: Mathematics
Theme: Biomathematics and Mathematical Modeling
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-9016
Time: 11.10 AM- 12.45 PM

Chair: Prof. Dr. Sarder Firoz Ahmmed, Mathematics Discipline, KU
Co-Chair: Dr. Md. Mashud Parvez, Assistant Professor, Dept. of Mathematics, DUET
Invited Speaker: Prof. Dr. Muhammad Humayun Kabir, Dept. of Mathematics, JU

Paper ID	Abstract Title and Authors
Invited Talk	**Model-Aided Understanding of Oncolytic Virotherapy in Cancer Treatment**
ID 184	**Nonlinear Diffusion Dynamics of Emphysema Progression** Md. Khalil Islam and M. Osman Gani
ID 185	**An Approximation Technique for Solving Cubic-Quintic Duffing Oscillator** M. Kamrul Hasan, Md. Ashraful Huq and M S Alam
ID 198	**Application of the Sine-Gordon Expansion Method to Obtain Soliton Solution of the KdV and mKdV Equations** Dr. Shahansha Khan, Md. Mehedi Hasan Modern, Tania Sultana, S.M. Kamal Hossain
ID 199	**Solution Structures of Burgers and Burgers– Fisher Equations via Sine-Gordon expansion Method** Dr. Shahansha Khan, Md. Mehedi Hasan Modern, Abdus Salam, Muktarebatul Jannah
ID 202	**A More Efficient Differential Transform Method for Solving Duffing- Harmonic Oscillator** Mostafa Amir Faishal and M. Kamrul Hasan
ID 219	**Mathematical Modeling of Bivalve-Phytoplankton Interactions and Nutrient Dynamics in Aquatic Ecosystem** Md. Anishur Rahman Palash, Md. Haider Ali Biswas
ID 221	**Sustainable Sericulture Through Mathematical Modeling of Silkworm Growth, Virus Propagation and Piezoelectric Temperature Control** Nusrat Yesmin Kona, Md. Haider Ali Biswas

Parallel Session-2
Invited & Contributed Session: Mathematics
Theme: Computational Fluid Dynamics (CFD)
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11003
Time: 11.10 AM- 12.45 PM

Chair: Prof. Dr. Md. Mamun Molla, Dept. Mathematics & Physics, NSU
Co-Chair: Mr. Md. Motiur Rahman, Assistant Professor, Dept. of Mathematics, DUET
Invited Speaker: Prof. Dr. Md. Ashabul Hoque, Dept. of Mathematics, RU

Paper ID	Abstract Title and Authors
Invited Talk	**Living with Disaster: A Real-Life Problem**
ID 116	**Heat And Mass Transfer in Unsteady Flow Over an Oscillating Cylinder Under the Effects of Radiation and Chemical Reaction** Tazrian Tamim, Md. Yousuf Hossain, Israt Jahan Luna, Jeba Tasnia, Salmoon Shefath, Sarder Firoz Ahmmed
ID 119	**Heat Transfer Enhancement with a Mixed Convective Cavity Containing a Heated Rotating Cylinder Using Ternary Hybrid Nanofluid** M.S. Alam, M. Masum. Billah, Aminur Rahman Khan, U.K. Suma, M.N. Islam

ID 120	**Computational Study of a Dual Phase Change Material Cap for Sustained Heat Protection** Mohammad Junaid, Pabel Shahrear
ID 122	**MHD Radiative Heat and Mass Transfer of a Sisko Nanofluid with Variable Thermal Conductivity Over a Porous Stretching Sheet** Khadija Suraiya, Md. Rafiqul Islam, Sarder Firoz Ahmmed and Salmoon Shefath
ID 124	**Flower-Shape Rooftop Wind Turbines and Prospect in Bangladesh** Umme Salma, Sadia Rahman Mithila, Md Masud Rana, and Md. Sabbir Alam
ID 126	**A Magnetic Field Effect on Coronary Artery Disease: A Computational Fluid Dynamic Approach** Tanzin Ahammed, Md Mojammel Haque, Most. Nasrin Akhter
ID 148	**A Study of Differential Equation Wall Model in Les of Turbulent Channel Flow Using Artificial Neural Network Technique** Mohammad Azizul Hoque, Muhammad Saiful Islam Mallik, Muhammad Sajjad Hossain and Md. Ashraf Uddin

Parallel Session-3
Invited & Contributed Session: Mathematics
Theme: Optimization and Operational Research
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11006
Time: 11.10 AM- 12.45 PM

Chair: Prof. Dr. Nasima Akhter, Dept. of Mathematics, RU
Co-Chair: Dr. Md. Mashud Parvez, Assistant Professor, Dept. of Mathematics, DUET
Invited Speaker: Prof. Dr. Mohammed Forhad Uddin, Dept. of Mathematics, BUET

Paper ID	Abstract Title and Authors
Invited Talk	**Optimization Model in Supply Chain Coordination, Traffic Flow and Epidemic Control**
ID 321	**Profit Maximization of Production Systems for Circular Indexed Products with Green Investment Under Incentives** Most. Mahmuda Khatun and Md. Al-Amin Khan
ID 324	**Eco-Friendly Lot-Sizing Model for Deteriorating Items with Supplier Financing, Deferred Customer Settlement and Control Backordering** Kamnur Nahar Kemi1, Md. Al-Amin Khan
ID 339	**Thermo-Viscoelastic Stress Analysis In Particle-Laden Polymer Melts Flowing Through Contraction Geometries** Shamima Akter, Riaz Hossain, Adaito Basak, Muhammad Minarul Islam
ID 356	**Sustainable Fuzzy EPQ Model for Imperfect Items with Synchronous Rework and Emission Reduction Investment** Antor Ghosh, Md. Al-Amin Khan
ID 373	**Optimal Screening Decision in Two-Stage Food Supply Chains for Growing Items Under Emission Tax Regulation** Md. Abdul Alim, Md. Al-Amin Khan, and Aminur Rahman Khan
ID 382	**Linear Programming Approaches in Jute Crop Allocation for Profit Maximization** Md. Shariful Islam, M. U. Ahammad and Mohammed Forhad Uddin
ID 388	**Facility Failure Uncapacitated Facility Location Problem with Time-Dependent Supply and Its Application in Emergency Logistics** Md. Sumon Ali, Dr. Mohammad Babul Hasan

Parallel Session-4
Invited & Contributed Session: Mathematics
Theme: Computational Fluid Dynamics (CFD)
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11007
Time: 11.10 AM- 12.45 PM

Chair: Prof. Dr. Md Ashraf Uddin, Dept. of Mathematics, SUST
Co-Chair: Dr. Atia Afroz, Assistant Professor, Dept. of Mathematics and Physics, NSU
Invited Speaker: Prof. Dr. Mohammad Babul Hasan, Dept. of Mathematics, DU

Paper ID	Abstract Title and Authors
Invited Talk	**A Multi-Stage Capacity Expansion Stochastic Model for Power Generation**
ID 159	**Analysis of the Impact of Irregular Building Arrays and Roof Geometries on Pollution Dispersion: A Case Study of Urban Street Canyons in Dhaka City** Nashidul Islam, Motiur Rahman and Most. Nasrin Akhter
ID 161	**Stability analysis of two-dimensional Viscous Burger's equations by Explicit Finite Difference Method** Nazrul Islam, Md. Ashraf Uddin, Mohammad Sayful Islam
ID 176	**Magnetohydrodynamic Influence on Pulsatile Blood Flow in Porous Stenosed Arteries** Morium Akter Mim, Rahima Akter, Mahtab U. Ahmmed
ID 189	**Inspiratory Flow Simulation for Cylindrical Model Channel of Human Lung** Rahima Akter, Morium Akter Mim, Mahtab U. Ahmmed
ID 243	**Thermal Analysis of Mixed Convection in An Irregular Hexagonal Cavity with Mixed Boundaries** Mahfuza Sultana, and M. A. Alim, and Suvash C Saha
ID 192	**Computational simulation for the prediction of rocket turbine's blade flutter** Khairuzzaman Mamun, Funazaki Ken-ichi, Tnazin Ahammed and Nasrin Akter
ID 201	**Droplet, Slug, and Plug Flow in T-Junction Microchannels: A Numerical Study** Rid–Wanul Alam Likhon, and Md. Abdul Hakim Khan

12:40 PM – 02:00 PM	**Prayer** **Venue: DUET Central Mosque** **Lunch Break** **Venue: 11th Floor, Shaheed Sayed Nazrul Islam Academic Building, DUET, Gazipur.**

Parallel Session-5
Invited & Contributed Session: Mathematics
Theme: Data Science and Machine Learning
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11003
Time: 02.00 PM- 03.35 PM

Chair: Prof. Dr. Samir Kumar Bhowmik, Dept. of Mathematics, DU
Co-Chair: Dr. Md. Zohurul Islam, Associate Professor, Dept. of Mathematics, JUST
Invited Speaker: Prof. Dr. Mohammad Sahadet Hossain, Dept. of Mathematics & Physics, NSU

Paper ID	Abstract Title and Authors
Invited Talk	**Low-rank Gramian approximation of periodic unstable system using Laguerre function approximation and application in model order reduction**
ID 276	**Data Driven Meteorological Forecasting for Divisional Cities in Bangladesh: An Annbased Climate Study** Badhan Das, Munnujahan Ara, Tashbiha Tabassum Poroma
ID 285	**Enhancing Color Image Segmentation Through a Hybrid PSO-GWO Algorithm with Graph-Based Refinement** Md. Ashikur Rahman, Israt Jahan, Md. Azizur Rahman, Raju Roy, and Lasker Ershad Ali

ID 294	**Enhanced Image Segmentation via Wavelet Transform and CNN Models** Soumyo Joti Chakraborty, Yeamin Hasan, Raju Roy, Md. Rafiqul Islam, and Lasker Ershad Ali
ID 301	**Advanced Clustering Techniques for Precision Image Segmentation** Badhan Roy, Md. Rakib Molla, Raju Roy, Md. Rafiqul Islam, and Lasker Ershad Ali
ID 307	**Singular Spectrum Analysis for Forecasting Nonlinear Time Series** Atikur Khan
ID 427	**Evaluation Of Sensible Heat Flux of Super Cyclonic Storm Amphanusing WRF Model** Most. Fatema Amin Akhi, Kh. Hafizur Rahman, M. A. Taher
ID 277	**Integrating Deep Features with PCA and Machine Learning Models for Human Emotion Recognition** Md. Mehedi Hasan Tonmoy, Mohammad Mahadi Hassan, Sheikh Mehrin Rinvi, Abdullah Al Akash, and Lasker Ershad Ali

Parallel Session-6
Invited & Contributed Session: Mathematics
Theme: Numerical Heat and Mass Transfer
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11006
Time: 02.00 PM- 03.35 PM

Chair: Dr. Mohammad Asaduzzaman Chowdhury, Dept. of Mechanical Engineering, DUET
Co-Chair: Prof. Dr. Md. Nur Alam, Dept. of Mathematics, PUST
Invited Speaker: Prof. Dr. Mohammad Ferdows, Dept. of Applied Mathematics, DU

Paper ID	Abstract Title and Authors
Invited Talk	**Energy Dissipative Particle Dynamics Modelling on Natural Hybrid Convection Heat Transfer in a Differentially Heated Enclosure**
ID 009	**Application Of LBM to Simulate Micro-Orifice Flow** Md. Nurunnabi Sohel, Runu Biswas, and Mohammad Abu Taher
ID 021	**Soret and Dufour Effects on Mixed Convective Thermo-Solutal Boundary Layer Flow from a Horizontal Porous Surface with Thermal Radiation** Md. Sondhi Sheikh, Anika Tahsin Biva, and Abid Hossain
ID 042	**Effect Of Circular and Square Obstructions on Heat Transfer and Flow Patterns in a Microchannel: A Numerical Study Using the Lattice Boltzmann Approach** R. Biswas, M. N. Sohel, Md. Y. Arafat, M. A. Taher
ID 200	**Integrated Multi-Scale Modeling of Bioheat Transfer in Skin Cancer Hyperthermia** Marzina Akter Reba and Md.Abdul Hakim Khane
ID 214	**Numerical Investigation of Fluid Flow in Thermal Boundary Layers with Intense Suction** Md.Babul Akter Durjoy, Md.Kashem Ali1 and Mohammad Wahiduzzaman
ID 271	**Exploring H_2 Enrichment as an Innovative Strategy for Reducing Greenhouse Gas Emissions in Hydrocarbon–Air Counterflow Diffusion Flames** Akter Hossain, Mohammad Abdur Rahman, and Shardar Firoz Ahmmed
ID 348	**Microstructural Analysis of Magnetohydrodynamic Micropolar Fluid Flow Between Parallel Plates** Adaito Basak, Riaz Hossain, Shamima Akter, Muhammad Minarul Islam

Parallel Session-7
Invited & Contributed Session: Mathematics
Theme: Computational Fluid Dynamics (CFD)
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11007
Time: 02.00 PM- 03.35 PM

Chair: Prof. Dr. Lasker Ershad Ali, Mathematics Discipline, KU
Co-Chair: Dr. Md. Amirul Islam, Assistant Professor, Dept. of Mathematics, MBSTU
Invited Speaker: Dr. Akter Hossain, Dean faculty of Science, PRSTU

Paper ID	Abstract Title and Authors
Invited Talk	**Exploring H_2 Enrichment as An Innovative Strategy for Reducing Greenhouse Gas Emissions in Hydrocarbon–Air Counterflow Diffusion Flames**
ID 204	**Numerical Simulation of Hemodynamic Behavior in Stenosed Arteries** Umme Habiba Akter and Md. Abdul Hakim khan
ID 205	**Natural Convective Heat Transfer of Nanofluids in a Square Cavity with a Curved Hot Wall Partially Heated from Below** Janntul Ferdious Mele and Md. Abdul Hakim Khan
ID 206	**Numerical Analysis of Heat Transfer Enhancement in a Pentagon-Shaped Cavity Using Nanufluids Under Constant Heat Flux** Afsana Mimi and Md. Abdul Hakim Khan
ID 218	**Nanoparticles-Based Drug Simulations in Coronary Arterial Diseases** M. A. Jabed, K. E. Hoque, M. Masum Billah, A. A. Rafin and M. N. Uddin
ID 227	**Natural Convection of MDH Double Diffusive Nano-Encapsulated Phase Change Material (Nepcm) in the Annulus Between Concentric Horizontal Circular And Square Cylinders** Md. Mahadul Islam and Md. Mamun Molla
ID 234	**RANS-Based Numerical Investigation of Airflow and Pollutant Dispersion in an Urban Industrial Area of Dhaka** Md. Mejbah Ullah Chowdhury, Md. Mamun Molla
ID 190	**Evaluating the Impact of Roadside Vegetation on Pollutant Dispersion in Urban Street Canyons: A CFD Study of Dhaka City** Nahida Akter and Most. Nasrin Akhter

Parallel Session-8
Invited & Contributed Session: Mathematics
Theme: Biomathematics and Mathematical Modeling
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-9016
Time: 02.00 PM- 03.35 PM

Chair: Prof. Dr. Main Uddin Ahammad, Dept. of Mathematics, DUET
Co-Chair: Dr. Md. Hamidul Islam, Assistant Professor, Dept. of Applied Mathematics, RU

Paper ID	Abstract Title and Authors
ID 231	**Mathematical Modelling Approach to Analyze Water Scarcity Dynamics and Effects in the Chittagong Hill Tracts for Sustainable Development** Wino Prue Chowdhury, Md. Haider Ali Biswas
ID 242	**Mathematical Analysis of the Adverse Effects of Air Pollution on Tree Health and Ecosystems** Sadia Shihab Sinje and Md. Kamrujjaman
ID 245	**When Guests Become Predators: An Analytical Predator–Prey Framework Linking Tourists and the Environment to Destination Sustainability** Soumitro Kumar Das, Shreya Dash Titli, Effat Rowja, Tithy Saha and Tahsin Fahim Ratul

ID 253	**Toxicological Impact of Nanoplastic on the Pulmonary Surfactant Film at Alveolar Air-Water Interface** Khalid Bin Kaysar, Syed Rashedul Islam Sakil and Md. Zohurul Islam
ID 261	**Integrating Control Theory with Hdwgcna for Enhanced Identification of Dynamic Gene Network Modules** Aoutul Nabi Purna, Most. Humaira Sultana, Mohammad Sahadet Hossain, and Md. Alamin
ID 262	**Modified Simple Equation Method for Nonlinear Evolution Equations: (2+1)-D KP and Fifth-Order Model** A. K. M. Kazi Sazzad Hossain, Md. Ismail Hossain, Md. Akher Chowdhury, Md. Ruhul Amin, Md. Hannan Miah, M. Ali Akbar
ID 265	**Integrated Analysis of Gene Expression and Chromatin Accessibility in PBMCS** Mohammad Rakon Ud Doulla Sakib1, Most. Humaira Sultana2, Atikur Rahman Khan2, and Md. Alamin

3:35 PM - 4:00PM	**Tea/ Coffee Break** **Venue: 11th floor, Shaheed Sayed Nazrul Islam Academic Building, DUET, Gazipur.**

Parallel Session-9
Invited & Contributed Session: Mathematics
Theme: Pure Mathematics
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11003
Time: 04.00 PM- 05.35 PM

Chair: Prof. Dr. Mohammad Kamrul Hasan, Dept. of Mathematics, RUET
Co-Chair: Dr. Md. Mashud Parvez, Assistant Professor, Dept. of Mathematics, DUET
Invited Speaker: Prof. Dr. Md. Ali Akbar, Dept. of Applied Mathematics, RU

Paper ID	Abstract Title and Authors
Invited Talk	**Physical Significance of Fractional Derivative: An Interpretation Based on the Beta Derivative**
ID 053	**A Study of Uniform Doo–Sabin Subdivision for Surface Modelling in Animation, CAD, and Industrial Applications** Md. Rafiquzzaman Rafi and Md. Nur Alam
ID 063	**A Mass Conserving Polynomial Growth Kernel in Smoluchowski Coagulation Equation** M. Sahidul Islam, K. E. Hoque, and Masato Kimura
ID 111	**Study of the Qualitative Analysis on the Solutions of Nonlinear Differential Equations** Md. Azmol Huda, Alamin Hossain, and Sejuty Mandal
ID 157	**Analytical Solutions and Qualitative Analysis to the Generalized Nonlinear Fractional Schrodinger Model Using the Extended Riccati Equation Method** Saikh Shahjahan Miah, M. Ali Akbar and Kamruzzaman Khan
ID 230	**Solitons And Chaos in Shallow Water Waves: Insights from the Modified Spectral KDV Equation** Md Nur Hossain and Ashabul Hoque
ID 165	**Nonlinear Waves Across Fields: Soliton Solutions and Dynamical Insights from the Modified KDV–Burgers Equation** Md. Abdus Saadand Dr. Md. Tarikul Islam
ID 532	**Analytical Investigation of Solitary Wave Solutions for Nonlinear Burgers Equation** Md. Amirul Islam, Mehedi Hasan

Parallel Session-10
Invited & Contributed Session: Mathematics
Theme: Biomathematics and Mathematical Modeling
Day 2: Friday, October 24, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11006
Time: 04.00 PM- 05.35 PM

Chair: Prof. Dr. Shahansha Khan, Dept. of Mathematics, UU
Co-Chair: Mr. Md. Mohedul Hasan, Assistant Professor, Dept. of Mathematics, DUET

Paper ID	Abstract Title and Authors
ID 110	**Dynamics of Two-Species Mutualism: An Optimal Control Approach** M. Rakib Akun
ID 125	**Mathematical Analysis of Periodic Travelling Waves in a Reaction-Diffusion Framework** Md Showkat Akber, Md Munna Hassan, and M. Osman Gani
ID 131	**Flapping Motion of Birds, Insects, and Butterflies** Sadia Rahman Mithila, and Md. Sabbir Alam
ID 149	**Evaluating Tropical Cyclone Energetics over the Bay of Bengal: Insights from WRF Model Simulations** Kh. Hafizur Rahman and M. A. Taher
ID 154	**Exact Traveling Wave Solutions of the Fitzhugh–Nagumo Equation for Excitable System** Khondaker Fahad Mia1, A. K. M. Nazimuddin, and M. Osman Gani
ID 162	**Numerical Simulation of a Macroscopic Multilane Traffic Flow Model Based on Linear Velocity-Density Function** Md Rasel Ahmed, Bitu Joydhar, Md. Laek Sazzad Andallah, Jannatul Ferdous
ID 479	**Analyzing The Impact of Environmental Feedback Through Behavior Dynamics on Sip Ecological–Epidemic Dynamics with the Allee Effect** Md. Nazim Uddin Bhuiyan, Md. Saddam Hossain, and K. M. Ariful Kabir
ID 522	**Modeling And Analysis of Influenza A (H1N1) Dynamics with Asymptomatic Carriers** Most Halimatuj Sadia, Md. Mojammel Haque

Parallel Session-11
Invited & Contributed Session: Mathematics
Theme: Computational Fluid Dynamics
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11007
Time: 04.00 PM- 05.35 PM

Chair: Prof. Dr. Mohammad Abu Taher, Dept. of Mathematics, DUET
Co-Chair: Dr. Nur Hossain, Assistant Professor, Dept. of Mathematics, RU
Invited Speaker: Dr. Wahyu Caesarendra, Senior Lecturer, Department of Mechanical and Mechatronics Engineering, Faculty of Engineering and Sciences, Curtin University, Malaysia

Paper ID	Abstract Title and Authors
Invited Talk	**Application of Machine Vision Technology for Applied Engineering and Science**
ID 396	**Mathematical Model to Describe the Flapping Motion in Nature** S. M. Kamal Hossain, Sadia Rahman Mithila, and Md. Sabbir Alam
ID 415	**Investigation Of Thermomagnetic Convective Flow in a Vertical Layer of Ethylene Glycol Based Magnetic Fluid Under the Effect of Inclined Magnetic Field** Md. Habibur Rahman, Sushmita Mondal
ID 425	**Natural Convective Heat Transfer in a Confined Domain Filled with Water Based Nanofluid Considering Heat Sources and Sinks** Md. Najmul Islam, M. U. Ahammad
ID 466	**Analysis Of Flow and Thermal Behavior Over a U-Shaped Enclosure with an Internal Body Using Al_2O_3-Water Nanofluid** Shohag Hossain Reyad, M. U. Ahammad
ID 487	**Fluid Structure Interaction (FSI) Analysis of The Blood Flow and Geometrical Characteristics in the Brain Aneurysm** Mohammad Matiur Rahman and Most. Nasrin Akhter

ID 504	**Analysis Of Lorentz Force Effect on Mixed Convection Nanofluid Flow in a Vented Channel With Diamond Shaped Obstacle** Pushpa Akhtar, M. M. Touhid Hossain, Md. Abdul Alim and Mohammad Mokaddes Ali
ID 369	**MHD Darcy-Forchheimer Convective Flow Above a Vertical Permeable Plate With Radiative Heat Transfer and Chemical Reaction** Md. Jarif Mollah and M. M. Touhid Hossain

Parallel Session-12
Invited & Contributed Session: Mathematics
Theme: Biomathematics and Mathematical Modeling
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11008
Time: 04.00 PM- 05.35 PM

Chair: Prof. Dr. Pinakee Dey, Dept. of Mathematics, MBSTU
Co-Chair: Dr. Muhammad Minarul Islam, Associate Professor, Dept. of Mathematics, GSTU
Invited Speaker: Prof. Dr. Mahtab U. Ahmmed, Dept. of Mathematics, JU

Paper ID	Abstract Title and Authors
Invited Talk	**Gas Transport Mechanisms in the Respiratory Bronchioles: The Interplay of Axial Heterogeneity and Irreversible Flow**
ID 288	**Fractional-Order Modeling of Sars-Cov-2 Variant Nb.1.8.1 Using Caputo Derivative: Comparative Analysis of Homotopy and Adams–Bashforth–Moulton Methods** Soumitro Kumar Das and M. Ali Akbar
ID 315	**Dynamics of Human Gastric Acid Secretion of Somatostatin: A Delay Differential Equation Approach** Sanjida Hassan, M. Humayun Kabir, and M. Osman Gani
ID 317	**An Integrated SEIR Type Model to Understanding the Spread of Covid-19 In Bangladesh: The Role of Vaccination and Waning Immunity** Nusrat Jahan Nijhum* and M. Osman Gani
ID 326	**Understanding the Dynamics of Desertification in a Two Component Reaction-Diffusion System** M. Munna Hasan, M. Showkat Akber and M. Osman Gani
ID 368	**Dynamics of Phytoplankton–Zooplankton Interactions and Their Role in Harmful Algal Bloom Formation** Sadia Afrin, M. Sahadet Hossain, and M. Humayun Kabir
ID 406	**Mathematical Investigation of Dual-Strain Tuberculosis Spread in Bangladesh** Fiza Noor, M. A. Salek, J. Nayeem, Sadia Afrin Tuli
ID 409	**Mathematical Modeling and Sensitivity Analysis of Tuberculosis: Identifying Key Drivers for Effective Disease Control** Sadia Afrin Tuli, Fiza Noor

Parallel Session-13
Invited & Contributed Session: Mathematics
Theme: Artificial Intelligence
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11009
Time: 04.00 PM- 05.35 PM

Chair: Prof. Dr. Md Azizul Baten, Department of Statistics, SUST
Co-Chair: Dr. Md. Zohurul Islam, Associate Professor, JUST

Paper ID	Abstract Title and Authors
ID 260	**Machine Learning Powered Exploration of Single-Cell Data for Therapeutic Development** Md. Alamin and Most. Humaira Sultana

ID 012	**Real Time Anomaly Detection for Aviation Safety: An Early Warning System Using Isolation Forest and ELM Autoencoder** Nazmus Apurba
ID 093	**Automated Bangla to IPA Transliteration Using Sequence-to-Sequence Models with Attention Mechanism** Nazmus Apurba
ID 105	**Explainable AI to Detect Malaria Parasite Using Deep Learning** Syeda Mashiat Tabassum
ID 136	**Leveraging Interactive System Design and Retrieval Augmented Generation Model for Learning Mathematics** Raiyan Ahmed, Ahsanul Karim Raiyan, Dr. Atia Afroz
ID 241	**Data Augmentation for Robust Learning: A Performance-Centric Analysis in Agriculture and Social Media** Ariful Islam Shiplu, and Most. Nasrin Akhter
ID 358	**Federated Learning in Healthcare: Opportunities, Challenges, And Research Gaps** Golam Mostafa Rabby and Most. Nasrin Akhter

Parallel Session-14
Invited & Contributed Session: Mathematics
Theme: Artificial Intelligence, Data Science and Machine Learning
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11002
Time: 04.00 PM- 05.35 PM

Chair: Dr. Md. Mamun Molla, Dept. Mathematics & Physics, NSU
Co-Chair: Dr. Md. Shahiduzzaman, Associate Professor, Dept. of EEE, NUB
Invited Speaker: Prof. Mahbub Alam, Harbin Institute of Technology, China

Paper ID	Abstract Title and Authors
Invited Talk	**From Fish Swimming to Underwater Robots: Emerging Frontiers**
ID 471	**AI-Driven Smart Irrigation and Crop Monitoring System for Empowering Rural Farmers** Rashidul Islam Sifat
ID 476	**An Efficient Inceptionv3 Based Customized Transfer Learning Model for Mri Brain Tumor Classification** Md. Arafat
ID 495	**AI-Based Predictive Modeling of Energy Demand in Smart Grids** Sadia Tasnim Shara, Sadi Mohammad Meraj, Raiyan Yusuf, Tamim Hasan Apurbo, and Md. Mortuza Ahmmed
ID 500	**From Chaos to Clarity: AI-Integrated Crisis Simulations for Faster and Smarter Disaster Management** Raiyan Yusuf, Sadi Mohammad Meraj, Sadia Tasnim Shara, Tamim Hasan Apurbo, and Md. Mortuza Ahmmed
ID 435	**Role Of Rolling Statistics in Predicting Weibo Closing Prices Using Long-Short Term Memory Networks** Ahanaf Rasheed, Zahin Ferdusi Khan, and Atikur Rahman Khan
ID 449	**Predicting Anxiety, Depression, and Stress in Bangladeshi University Students: An Ensemble ML and XAI Approach** Md. Raihan Tapader, Ariful Islam Shiplu and Dr.Most.Nasrin Akhter
ID 510	**Comparative Study of Self-Supervised and Supervised Learning for Crop Disease Detection in Low-Resource Agricultural Data** Sagor Kumar Mitra and Protima Roy

Parallel Session-15
Invited & Contributed Session: Mathematics
Theme: Biomathematics and Mathematical Modeling and Numerical Heat and Mass Transfer
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11004
Time: 04.00 PM- 05.35 PM

Chair: Prof. Dr. Md. Haider Ali Biswas, Mathematics Discipline, KU
Co-Chair: Dr. Md. Sahidul Islam, Assistant Professor, Dept. of Mathematical and Physical Sciences, EWU

Paper ID	Abstract Title and Authors
ID 414	**Mathematical analysis of the truncated-fractional complex Kraenkel-Manna-Merle model: novel soliton solutions, parameter effects, and bifurcation analysis** S. M. Yiasir Arafat and S. M. Rayhanul Islam
ID 444	**Integrative Analysis of Analytical and Numerical Solutions for Modeling Relapsing-Remitting Multiple Sclerosis** Dipankar Kumar, , Baharul Islam, Monazat Ali, Taiyeb Hasan
ID 472	**Optimal Control Applied to the Neural Frequency Model in PTSD Patients** Rifah Tasnia, and Prof. Dr. Md. Haider Ali Biswas
ID 353	**LBM Simulation of Wedge Ribbed Microchannel on Thermal-Fluid Behaviour Under Slip Flow Condition** Md Y. Arafat, R. Biswas, M. N. Sohel, M. A. Taher
ID-528	**Study of the Qualitative Analysis on the Solutions of Nonlinear Differential Equations** Md. Azmol Huda, Alamin Hossain and Sejuty Mandal
ID-529	**Computational Study of a Dual Phase Change Material Cap for Sustained Heat Protection** Mohammad Junaid, Pabel Shahrear
ID-530	**Advanced Machine Learning Approaches for Dengue Outbreak Prediction in Monsoon-Driven Epidemics** Alvi Ahmed Sarker, Dr. Md. Kamrujjaman
ID-531	**A Machine Learning Approach to Fault Dynamics and Seismic Hazard by Using Rate-and-State Friction and Finite Element Methods** Pinky Rani Dey, Supti Rani Dash and Dr. Mohammed Forhad Uddin

Poster Session

Day 2: 24thOctober, 2025

Time: 03.00 PM- 05.30 PM

Paper ID	Abstract Title and Authors
ID 363	**Fake News Detection Using Textual and Visual Data: A Mobile Application Framework with Multiple Machine Learning Models** Abdul Owadud Islam Raton, and Khawja Imran Masud
ID 471	**AI-Driven Smart Irrigation and Crop Monitoring System for Empowering Rural Farmers** Rashidul Islam Sifat
ID 331	**Impact of Mrt Line 6 (Dhaka Metro Rail) on Commuter Modal Shift, Travel Time Reduction, And Future Expansion Prospects** Prottoy Roy1* , Jannatul Ferdousi Ayshe1 , Md. Ishraq Al-Din Sarker Arnob1 , Md. Imran Hossain Bappy1 , Noshin Tabassum Mithila1 , and Dr. Mahfuza Khatun 2

Technical Sessions for Physics

Day 1: 23th October, 2025

Parallel Session-1
Invited & Contributed Session: Physics
Theme: Theoretical and Computational Physics
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11004
Time: 02.00 PM- 03.35 PM

Chair: Prof. Dr. F. Nazrul Islam, Dept. of Physics, University of Rajshahi, Rajshahi
Co-Chair: Dr. Md. Lokman Ali, Dept. of Physics, Pabna University of Science and Technology (PUST)
Invited Speaker: Dr. Md. Asraf Ali, Dept. of Physics, Chittagong University of Engineering and Technology (CUET)

Paper ID	Abstract Title and Authors
Invited Talk	**Max Phase Materials for Thermal Barrier Coating Applications** Md. Ashraf Ali
ID 026	**Study of Self-Diffusion in Liquid Au_xAg_{1-x} Alloy Using Linear Trajectory Approximation** Aswariya Roy, Ratan Chandra Gosh
ID 264	**A First-Principal Study of The Impact of Transition Metals (Ag & Au) on Aluminum Phosphide Nanotube** Aoly Ur Rahman, A.T.M.K Jamil
ID 325	**Optimizing Lead-free $CH_3NH_3SnI_3$ Perovskite Solar Cells: A SCAPS-1D Simulation and Machine Learning Approach for Enhanced Power Conversion Efficiency** Md. Khorshed Alam, Md Nurnabe Sagor, Rayhan Miah, Shahariar Emon, and Keya Alam
ID 370	**Thermoelectric Properties of Herein Predicted Double Perovskite Oxides, Ba_2GaXo_6 (X = Nb, Ta): a DFT-Based Study** S.S. Saif, M.M. Hossain, M.M. Uddin, N. Jahan, and M. A. Ali
ID 400	**DFT prediction of new o-MAX phases: Mo_2AAlC_2 (A = Zr, Nb) and study of their physical properties** M.I.A. Tanim, M.M. Hossain, M.M. Uddin, N. Jahan, and M. A. Ali
ID 419	**A Predictive DFT Study on Structural, Electronic, and Optical Properties of New Double Half-Heusler Material $YNbRh_2Bi_2$** C. Talukder, N. Jahan, M.M. Hossain, M.M. Uddin, and M. A. Ali
ID 514	**Outstanding thermoelectric properties of Zintl phases: XIn_2C_2 (X= Mg, Sr and Ba)** Md. Mukter Hossain, Aslam Hossain, Hasina Akter, Md. Mohi Uddin, Md. Ashraf Ali, and Saleh Hasan Naqib

Parallel Session-2
Invited & Contributed Session: Physics
Theme: Thin Film and Nano-Structural Material-I
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11005
Time: 02.00 PM- 03.35 PM

Chair: Dr. Muhammad Shahriar Bashar, Principal Scientific Officer, Institute of Energy Research and Development (IERD), BCSIR, Dhaka-1205
Co-Chair: Dr. Sarfuddin Ahmed Tarek, Dept. of Natural Science (Physics), American International University-Bangladesh
Invited Speaker: Dr. Md. Rasadujjaman, Dept. of Physics, Mawlana Bhashani Science and Technology University

Paper ID	Abstract Title and Authors
Invited Talk	**Tailoring Functional Thin Films: A Cross-Cutting Approach to Electronics, Sensing and Photovoltaics** Md Rasadujjaman

ID 220	**Enhancing Redox Activity and Surface Reactivity via α-MoO_3 Nanobelt Incorporation into Layered WS_2 Nanosheets for High Performance Supercapacitors** Md. Faysual Kabir, Md. Abdullah Zubair, Anwar Ul-Hamid, and Muhammad Rakibul Islam
ID 228	**Structural and dielectric properties of MoO_3 incorporated $CoFe_2O_4$ nanocomposites** Mahmudul Hasan, Kaniz Fatema Laizo, and Muhammad Samir Ullah
ID 284	**Preparation and Characterization of Carbon Nanotube and Molybdenum Disulfide Reinforced Nanocomposite Film of Cellulose Nanocrystals** Md. Al-Amin, Mehedi Hasan, Md. Mahtabur Rahman, Md. Khorshed Alam, and Mohammad Jellur Rahman
ID 371	**Solar-Driven n–n $DyCrO_3$/MoS_2 S-Scheme Heterojunction Photocatalyst for Sustainable Wastewater Remediation** Md. Mahbubar Rahman, Mohammed Abdul Basith
ID 380	**Defect-Engineered α-MoO_3/CoS_2 Nanostructures with Improved Conductivity and Pseudocapacitive Performance for High-Energy Symmetric Supercapacitors** Mehedi Hasan, Md. Raihan Siddiki, Md. Abdullah Zubair, and Muhammad Rakibul Islam
ID 411	**Study the Structural, Morphological, Optical and Electrical Properties of Mixed Organic $MA_{(1-x)}HA_xPbBr_3$ Organometallic Perovskite Thin Film for Solar Cell Application.** Shaheen Alam, Mahbubur Rahman Bhuiyan, Md. Alamgir Kabir, Budrun Neher, Muhammad Shahriar Bashar, Humayun Kabir, and Farid Ahmed
ID 490	**Highly Transparent Plasma-Polymerized 2-Furaldehyde-n-Butyl Methacrylate Composite Thin Films of Tunable Optical Band Gap for Optoelectronics** Bablur Rahman, M. Hedayet Ullah, A. H. Bhuiyan, and Mohammad Jellur Rahman

3:35 PM - 4:00PM	**Tea/ Coffee Break** **Venue: 11th floor, Shaheed Sayed Nazrul Islam Academic Building, DUET, Gazipur.**

Parallel Session-3
Invited & Contributed Session: Physics-I
Theme: Material Science
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11005
Time: 04.00 PM- 05.35 PM

Chair: Prof. Dr. Sharif Md. Sharafuddin, Dept. of Physics, Shahjalal University of Science and Technology (SUST)
Co-Chair: Dr. Md. Mukter Hossain, Dept. of Physics, Chittagong University of Engineering and Technology (CUET)
Invited Speaker: Prof. Dr. Md. Abdul Gafur, Dept. of Textile Engineering, Daffodil International University

Paper ID	Abstract Title and Authors
Invited Talk	**Nano-materials: Removal of antibiotics from water** Dr. Md. Abdul Gafur
ID 029	**Insight into The Substitution of Pb by Mg in $CsPbI_3$ As An Efficient Strategy to Improve Stability of Pb-Free Perovskite for Green Energy Applications: First-Principles Calculations** Sanzeda Parvin, Monira Martin, Al Mahafujar, Tania Nusrat, and Md. Kamruzzaman
ID 038	**The Pressure Dependent Structural, Electronic, Optical and Elastic Properties of YMn_3Sn_2 Kagome Compound** Abrarul Karim Samim*, Hasibul Hasan Rizvee, Budrun Neher, and Farid Ahmed
ID 123	**Structural, Mechanical and Thermal Characteristics of Sodium Hydroxide Treated Banana Fiber-Reinforced Epoxy Resin Composites** M. Y. Arafat, M. A. Kaysar, S. J. Ahmed, and A. T. M. K. Jamil
ID 236	**Unveiling the Optical Nonlinearity of Bio-Fabricated Silver Nanoparticles Employing Z-Scan Technique** F. Sabeth, B. Paul, S. A. Tarek, and S. M. Sharafuddin

ID 328	**Band Gap Engineering of Phyto-Synthesized Ag-Modified ZnO Nanocomposites for Enhanced Photocatalytic Performance** Md. Al Imran, Monika Paul, and Bithi Paul
ID 338	**Time-Resolved Investigation of Photoirradiation-Induced Changes in Ionic Conductivity of Polycrystalline β-AgI at Room Temperature (298 K) and Cryogenic Temperature (77 K)** Farzana Sabeth, Toshifumi Iimori, and Nobuhiro Ohta
ID 360	**Enhanced Photocatalytic Degradation of Methylene Blue Dye for Sol-Sel Synthesized BaTiO3 Nanoparticles Reinforced PMMA Polymer Nanocomposites** Abdullah Wasif Rafin, Tanzim Shahriar, Foysal Anwar, and Mohammad Shahed Hasan Khan Tushar

Parallel Session-4
Invited & Contributed Session: Physics
Theme: Magnetic Material-I
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11004
Time: 04.00 PM- 05.35 PM

Chair: Prof. Dr. Muhammad Samir Ullah, Dept. of Physics, Bangladesh University Of Engineering and Technology
Co-Chair: Dr. Md. Alamgir Hossain, Dept. of Physics, Khulna University of Engineering and Technology (KUET)
Invited Speaker: Dr. Mohammad Nazrul Islam Khan, Material Science Division, Bangladesh Atomic Energy Centre, Dhaka

Paper ID	Abstract Title and Authors
Invited Talk	**Magnetic Tunnel Junctions Based on Perpendicular Magnetic Materials** Mohammed Nazrul Islam Khan
ID 019	**Synthesis of Mg-Ce-Zn Nano Ferrites and to Investigate the Dielectric And Magnetic Properties** Muhammad Samir Ullah, Kaniz Fatema Laizo, Mahmudul Hasan, Rizwana Afrin, Suzam Gifary, and Md. Rasel Shikder
ID 224	**Magnetocaloric Properties of Lanthanum-Dysprosium-Barium manganites** Md. Ataul Haque and Muhammad Samir Ullah
ID 359	**Investigation of the Effect for Ba, Cd Co-doping on Structural and Morphological Properties of Bismuth Titanate Nanoparticles Approach for Photocatalytic Activities** Abdullah Wasif Rafin, Tanzim Shahriar, Foysal Anwar, and Mohammad Shahed Hasan Khan Tushar
ID 381	**Pressure-Dependent Structural, Mechanical, Electronic, and Thermophysical Properties of Lead-Free $Ligex_3$ (X = Cl, Br, I) Perovskites: A First-Principles Study** Monira Martin Mitu, Tania Nusrat, Shah Azharul Islam, Sanzeda Parvin, Al Mahafujar, and Md. Kamruzzaman
ID 395	**A Comprehensive Study of the Mechanical and Thermodynamic Properties of Fluoroperovskite $Xcaf_3$ (X= Ag, K, Cs, And Rb) Compounds Using First Principle Calculations.** Md. Mozahar Ali, Md. Shahazan Parves, and Md. Zahid Hasan
ID 470	**Neutron Activation Analysis of a Novel Fe–C–Ti–V–Mo Alloy for Nuclear Structural Applications** Md Ruhul Amin, Md. Arefin Kowser, Mohammad Asaduzzaman Chowdhury, and Mohammad Amirul lslam
ID 443	**Influence of Bi_2o_3 Addition on the Structural, Microstructural, Magnetic and Electrical Transport Properties of Li-Cu-Mg-Zn Ferrites** Faruque Ahammed, M.N.I. Khan, Muhammad Samir Ullah , M.A.H. Badhan, Redwan N. Sajjad, and A.T.M. Kaosar Jamil

Technical Sessions for Physics

Day 2: 24th October, 2025

Parallel Session-1
Invited & Contributed Session: Physics
Theme: Plasma and Astrophysics
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11004
Time: 11.10 AM- 12.45 PM

Chair: Prof. Dr. Md. Khairul Alam, Dept. of Physics, Pabna University of Science and Technology (PUST)
Co-Chair: Dr. Md. Rasadujjaman, Dept. of Physics, Mawlana Bhashani Science and Technology University
Invited Speaker: Prof. Dr. Md. Masum Haider, Dept. of Physics, Mawlana Bhashani Science and Technology University

Paper ID	Abstract Title and Authors
Invited Talk	**Laser–Plasma Interactions: Fundamentals, Mechanisms, and Advances** Prof. Dr. Md Masum Haider
ID 52	**Dust-Ion-Acoustic Solitary and Shock Waves in A Multi-Ion Dusty Plasma with Vortex-Like Trapped Electrons** Md. Saifur Rahman and Obaydur Rahman
ID 115	**Neutron Yield Optimization From 4.1 Kj Plasma Focus Device Using Lee Code** M I Nayeem
ID 313	**Tracing Cosmological Signatures with Doppler Lensing** Mubtasim Fuad, Sonia Akter Ema and Md Rasel Hossen
ID 349	**Evolution of Electrical Discharge Plasma Processes at Different Initial Ph Levels by High Voltage Ac Supply** Ruma, Shayla Haque Nazer, M. A. Halim, M. Mamun Sikder and M.A. Habib
ID 413	**Generalized Dust Acoustic Solitons And Double Layers in Kappa Superthermal Electron Containing Dusty Plasmas** M.Islam, M. Ferdousi and F. Deeba
ID 498	**Solar Plasma Simulation for Space Weather Prediction and Protection of Earth's Power Grids** Hamim Ibrahim, Tamim Hasan Apurbo, Sanjeda Alam Chaity, Tahosin Iftiak Tonoy, Zihad Bin Rahim, Md. Mortuza Ahmmed

Parallel Session-2
Invited & Contributed Session: Physics
Theme: Medical and Health Physics
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11005
Time: 11.10 AM- 12.45 PM

Chair: Prof. Dr. Muhammad Abduk Kadir, Dept. of Biomedical Physics & Technology, University of Dhaka, Dhaka-1000
Co-Chair: Prof. Dr. Farah Deeba, Dept. of Physics, DUET, Gazipur-1707
Invited Speaker: Dr. Md. Alamgir Kabir, Dept. of Physics, Jahangirnagar University, Saver, Dhaka-1342

Paper ID	Abstract Title and Authors
Invited Talk	**Lensless Digital Holographic Microscopy: A Low-Cost Platform for Biomedical and Agricultural Applications** Md. Alamgir Kabir, Aniruddha Ray

ID 008	**Investigation of the Adsorption of Miglitol Anti-diabetic Drug on the Surface of $X_{12}Y_{12}$ (X= B, Al; Y= N, P) Nanocages: A DFT and COSMO Insights** Samiron Kumar Saha, Maliha Nishat, Md. Rayhan Mostofa, Md. Abul Hasnat
ID 028	**Exploring the Anti-Cancer Potential of Daidzin in Breast cancer: Integrated Bioinformatics and Computational Insights on Oncogene Inhibition** Md. Nazim Uddin, Jie Wang, Md. Mamunur Rashid, Md. Zia Uddin Al Mamun and Miah Roney
ID 437	**Thermal and Electrical Properties of Human Tissues: Implications for Medical Device Design in Bangladesh** Shaharia Rahman Tanim, Samin Shahriyar Lorin and Md. Mortuza Ahmmed
ID 488	**Eeg Patient Trends in Bangladesh: Demographics, Diagnostics, and the Covid-19 Impact** Farah Deeba , Ibrahim Khalil , and Mariya Ferdousi
ID 503	**Biophysics at the Crossroads of Medicine and Health: Innovations for Sustainable Healthcare.** Tarikul Islam Joy, Ahnaf Hasan ,Md Fatin Hasnat Patwary and Md. Mortuza Ahmmed

12:40 PM – 02:00 PM	**Prayer** **Venue: DUET Central Mosque** **Lunch Break** **Venue: 11th floor, Shaheed Sayed Nazrul Islam Academic Building, DUET, Gazipur.**

Parallel Session-3
Invited & Contributed Session: Physics
Theme: Thin Film and Nano-structural Material-II
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11004
Time: 02.00 PM- 03.35 PM

Chair: Prof. Dr. Mohammad Jellur Rahman, Dept. of Physics, Bangladesh University Of Engineering and Technology (BUET)

Co-Chair: Prof. Dr. Muhammad Omar Faruk, Dept. of Physics, Shahjalal University of Science and Technology (SUST)

Invited Speaker: Prof. Dr. Mohammed Abdul Basith, Dept. of Physics, Bangladesh University Of Engineering and Technology (BUET)

Paper ID	Abstract Title and Authors
Invited Talk	**Nanoscale Design of Porous Orthoferrites and Stabilized Halide Perovskites for Solar Photocatalysis and Energy Storage** M A Basith
ID 040	**Impact of Manganese Doping on the Structural and Optical Properties of Zinc Selenide Thin Films Prepared by Thermal Evaporation Method** M. Mahbubur Rahman, K. M. A Hussain, T. Faruqe and A. T. M. K. Jamil
ID 062	**Deposition of Zinc Bismuth Sulphide Thin Films by Spray Pyrolysis for Photovoltaic Application** Nishat Salsabil, A. T. M. Kaosar Jamil, Syed Jamal Ahmed, Md Rasadujjaman and Md. Sahab Uddin
ID 076	**Fabrication of a Chemically Stable $Ksnx_3$ (Cl, I) Perovskite Film by Spin Coating Process** Syed Habibul Basher, Yeasir Ahmed and Md Rasadujjaman
ID 077	**Synthesis of Ru-Doped Zno Nanoparticles by Precipitation Method: Effect of Annealing Temperature** Jannatul Nayem, Yeasir Ahmed, Md Abdur Razzaq and Md Rasadujjaman
ID 083	**Effect of Ru-Doping and Annealing on Spin-Coated Nio Films**

	Yeasir Ahmed, Md Rasadujjaman, Md Didarul Islam Bhuyan, Md Rezaul Karim, Md Sahab Uddin, Abu Talib Md Kaosar Jamil, Syed Jamal Ahmed, Md Ashraf Ali and Md Anwar Hossain
ID 114	**Synthesis of Plasma Polymerized N-Vinyl-2-Pyrrolidone (Ppnvp) Thin Films: Finding Applications by Analyzing Optical and Electrical Properties** S. M. Kanti Saha, S. J. Ahmed and A. T. M. K. Jamil
ID 158	**Advanced Interface Engineering for High Efficiency Lead Free $Fasni_3$ Perovskite Solar Cells** Abul Monsur Mohammed Musa , Syed Farid Uddin Farhad and A. T. M. K. Jamil

Parallel Session-4
Invited & Contributed Session: Physics
Theme: Magnetic Material-II
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11005
Time: 02.00 PM- 03.35 PM

Chair: Prof. Dr. Mohammad Mizanur Rahman, Dept. of Physics, University of Dhaka, Dhaka-1000
Co-Chair: Prof. Dr. Ratan Chandra Gosh, Dept. of Physics, University of Dhaka, Dhaka-1000
Invited Speaker: Prof. Dr. A K M Akther Hossain, Dept. of Physics, Bangladesh University Of Engineering and Technology (BUET)

Paper ID	Abstract Title and Authors
Invited Talk	**Perovskite And Spinel Oxides: Structure-Property Correlations and Emerging Functionalities** A. K. M. Akther Hossain
ID 025	**Structural and Magnetic Properties of Mg-Cr-Zn Mixed Nano Ferrites** Rizwana Afrin, Kaniz Fatema Laizo and Muhammad Samir Ullah
ID 033	**Study of the Structural and Electromagnetic Properties of Sintering Temperature Dependent Synthesized Ni-Mg-Zn-Al Ferrites** Arpon Debnath*, Md Sazzad Hossen, Rajon Saha Auntu, Sujit Kumer Shil*
ID 121	**Investigation of Structure, Morphology, and Magnetic Properties of Octadecylalkylammonium Intercalated Montmorillonite Incorporated Calsium Ferrite Nanocomposites** Sha Mohammed Sharfuddin, Md. Hedayet Ullah, Parimal Bala and Mohammad Jellur Rahman
ID 133	**The Observation of Morphological, Electrical and Magnetic Properties of Biopolymer and Gd-Doped Mg-Cu-Zn Ferrite** Md. Fahim, Zakia Sultana Tithi , Shadid Ibne Salim and Dr. M Mizanur Rahman
ID 146	**Exploring the Role of Yttrium on Magnetic Properties in Modulating Tetrahedral and Octahedral Sites of Ni-Cu-Zn Ferrites** Piuly. Roy and Md. Alamgir Hossain
ID 147	**Next-Generation Magneto-Dielectric Materials for High-Performance Microwave Devices** Shohanur Rahman Sagor and Md Alamgir Hossain
ID 220	**Enhancing Redox Activity And Surface Reactivity Via A-Moo_3 Nanobelt Incorporation into Layered Ws_2 Nanosheets for High Performance Supercapacitors** Md. Faysual Kabir, Md. Abdullah Zubair, Anwar Ul-Hamid and Muhammad Rakibul Islam
ID 432	**Magnetic properties of Mg-Cr-Zn ferrites nanoparticles** Amit Chakroborty, Muhammad Samir Ullah and M. Mizanur Rahman

3:35 PM - 4:00PM	**Tea/ Coffee Break** **Venue: 11th floor, Shaheed Sayed Nazrul Islam Academic Building, DUET, Gazipur.**

Poster Sessions

Day 2: 24th October, 2025

Time: 03.00 PM- 05.30 PM

Paper ID	Abstract Title and Authors
ID 010	**Wide Band Gap Double Perovskites for UV Filtering and Thermoelectric Technologies: A Study of Rb_2KScCl_6 a nd Rb_2NaYCl_6** Md. Borhanul Asfia, Sahadat Jaman, and Mohammad Abdur Rashid
ID 032	**Effect of Sintering Temperature on the Structural and Electromagnetic Properties of Co-Mn-Zn Ferrites** Md Sazzad Hossen, Arpon Debnath, Rajon Saha Auntu, and Sujit Kumer Shil
ID 041	**Interlayer Distance Driven Structural, Electronic and Optical Transitions in Bilayer GeS: A First-Principles Investigation** Marjahan Akter, Hasibul Hassan Rizvee, Budrun Neher, and Farid Ahmed
ID 050	**Assessing the Adsorption Efficiency and Gas Sensing Potential of ScSeTe, TiSeTe, and ZrSeTe Nanosheets for Nitrogen-Based Toxic Gases (NO, NO_2, and NH_3) Through DFT Calculations** Md Mehedi Hasan, S. M. Jayed Hakim, Bivas Kumar Das, and Siraj Ud Daula Shamim
ID 051	**Exploring the Sensing Properties of Janus Mste (M = Sc, Ti, Zr) Nanosheets for Nitrogen-Based Toxic Gases (NO, NO_2, and NH_3) Via DFT** Md. Jahirul Islam Shawon, S. M. Jayed Hakim, Bivash Kumar Das, and Md. Siraj Ud Daula Shamim
ID 065	**Investigating the Dynamic Behavior of Human B-Tryptase Via Gaussian Network Model: A Computational Approach Towards Sustainable Therapeutic Development** Tanver Hossain Refat and Muhammed Yaseen Morshed Adib
ID 074	**Surface Morphology and Phase Evolution of ZnO–RuO_2 Composite Films Synthesized by Spray Pyrolysis** Nirmal Chandra Roy, Md Rasadujjaman, Yeasir Ahmed, Md Sahab Uddin, Syed Jamal Ahmed, and A. T. M. K. Jamil
ID 075	**Highly Efficient TCO-Free Perovskite Solar Cell: Scaps-1D Simulation and Optimization** Tanjim Ahmed and Md Rasadujjaman
ID 081	**Performance Optimization of K 2 AgBiI 6 -Based Perovskite Solar Cell Using Scaps-1D Simulator** Mahiya Yesmin Tripty and Md Rasadujjaman
ID 082	**Elastic, Optoelectronic and Thermoelectric Properties of MoSI: Insight From DFT Calculations** Yeasir Ahmed, Md Tahinur Islam, Md Rasadujjaman, and Md Anwar Hossain
ID 095	**Nanoporous Yttrium Orthoferrite Electrodes for High-Energy Symmetric Aqueous Supercapacitors** Md. Sobuj Hossain, Mohasin Tarek, and M.A. Basit
ID 127	**Water-Stable $CsSnCl_3$ – MoS_2 Nanocomposites with Dual Functionality in Photocatalytic Degradation and Electrochemical Energy Storage** Tasnim Jahan and M. A. Basith
ID 132	**Study on Okra Fiber Reinforced Polyester Composite** **Md Mahbubur Rahman, Md Abdullah Kayser, Md Mamun-Or-Rashid, Md** Rezaul Karim, Susmita Bhattacharjee, and Syed Jamal Ahmed
ID 167	**Drug Parameterization for Targeted Drug Delivery into the Pulmonary Surfactant Monolayer** Syed Rashedul Islam Sakil, Khalid Bin Kaysar, and Md. Zohurul Islam*
ID 194	**A Computational Investivation on the Physicochemical Properties of Transition Metal (Gold) Dopped Gallium Phosphide Nanotube Using Density Functional Theory** Nowshin Tabassum Riya, Noor Ahammad, Bonganur Khan, Aoly Ur Rahman, Md. Alamgir Kabir, and Md. Kabir Uddin Sikder
ID 208	**Effect on Structural and Optical Properties of Manganese Doped Tin Oxide Thin Films Deposited by Spin Coating Method** Fatema Tuz Zahra, Bristy Rani Sarker, M. Rasaduzzaman, M. S. Uddin, S. J. Ahmed, and A. T. M. K. Jamil

ID 237	**First-Principles Insights into the Stability and Physicochemical Properties of Sulfur-Doped Si_8C_{12} Fullerene Using Density Functional Theory** Arnob Das Pritom, Noor Ahammad, Bonganur Khan, Aoly Ur Rahman, Md. Alamgir Kabir, and Md. Kabir Uddin Sikder
ID 279	**DFT Insights into the Adsorption Performance of the Anti-Cancer Drug Nitrosourea on the Pristine Graphene and BN Nanosheets and Their Doped Structures** Riya Rani Kundu, Afiya Akter Piya, and Siraj Ud Daula Shamim
ID 332	**Phase Transformation in Poly (Vinylidene Fluoride) Using Porous Silica Fillers for Improved Dielectric Performance** Mst. Rumana Akter, Mst. Momotaz Begam, and Saika Ahmed
ID 398	**Advanced Drug Sensing of Baricitinib Using C60 Fullerene Nanosheets: A First Principle Study for Rheumatoid Arthritis and Covid-19 Treatment Applications** Md. Raihan Islam, Prianka Mondal, and Md. Rezaul Karim
ID 354	**Annealing Temperature-Dependent Structural and Optical Tuning of Cu_2FeSnS_4 Thin Films for Solar Cell Applications** Sumaia Akter, Md. Mamun-Or-Rashid, A.T.M. K. Jamil, and Syed Jamal Ahmed
ID 361	**Fabrication and Characterization of Copper Doped Bismuth Oxide Thin Film by Spray Pyrolysis Technique** M. Parves, A.T. M. K. Jamil, S.J. Ahmed, and M. S. Uddin
ID 365	**Investigation on Structure and Magnetic Properties of $Mn_{0.3}Ni_{0.3}Zn_{0.4}La_xFe_{(2-x)}O_4$ Spinel Ferrites** M. M. I. Khan, M. R. Hasan, R. Rashid, and A. T. M. K. Jamil
ID 367	**Synthesis and Characterization of Manganese Doped Zinc Selenide Thin Films Deposited by Spin Coating Method** B. R. Sarker, F. T. Zahra, M. Rasaduzzaman, M. S. Uddin, S. J. Ahmed, and A. T. M. K. Jamil
ID 420	**Investigation of the Thermal and Mechanical Properties of Jute Fiber Reinforced with Nano-Clay Polyester Composite** M. A. Kaysar, M. M. Habib, N. M. Khan\, M. O. Rashid, A. T. M. K. Jamil, and S. J. Ahmed
ID438	**Pressure-Induced Structural and Optoelectronic Modulation of CsBaF3 Perovskite: A DFT-Based Study** Yasmin Akter , Prianka Mondal, and Syed Jamal Ahmed
ID 442	**Performance Enhancement of Rb_2Ligai_6 Double Perovskite Solar Cell Using ETL And HTL Engineering: Insights From Scaps-1D Modeling and DFT Analysis** Md. Riad Khan, Zihad Hossain, Md. Redwan Alam Hridoy, Sanzida Naznin Mim, Md. Khairul Alam, and Md. Lokman Ali
ID 448	**First Principles Investigation of the Structural, Electronic, Optical and Mechanical Properties of Ti_3Ac_2 (A = Al, Si, Ge) Max Phases** Md. Hasnat Shahriar Shanto, Md. Riad Khan, Md. Lokman Ali,* and Md. Khairul Alam
ID 453	**An Investigation into the Pressure-Induced Superconducting Properties of Lao For Enhanced High Performance Applications** Md. Mazharul Masud, Md. Riad Khan, Irfan Bin Habibi, Md. Hafijur Rahman, and Md. Lokman Ali
ID 524	**Y_2CoCrO_6 Double Perovskite Nanoparticles for Photocatalytic Degradation of Antibiotic Pollutants** Susmita Bhattacharjee and M. A. Basith
ID 512	**The Effect of Quantum Confinement on Optical Properties of CdSe Nanocrystals at Different Times and Temperatures** Md. Rezaul Karim, Md. Saidur Rahman, Md. Raihan Islam, Md. Rasadujjaman, Md. Sahab Uddin, ATM Kaosar Jamil, and Syed Jamal Ahmed

Technical Sessions for Chemistry

Day 1: 23th October, 2025

Parallel Session-1
Invited & Contributed Session: Chemistry
Theme: Organic, Food, Agro, and Biochemistry
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11002
Time: 02.00 PM- 03.35 PM

Chair: Prof. Dr. Ranajit Kumar Sutradhar, Dept. of Chemistry, CUET
Co-Chair: Dr. Nour Md. Mofiz Uddin Khan, Dept. of Chemistry, DUET
Invited Speaker: Prof. Dr. S. M. Abe Kawsar, Dept. of Chemistry, CU

Paper ID	Abstract Title and Authors
Invited Talk (ID 374)	**Carbohydrates - the Essential Molecules of Life and in Medicinal Chemistry** S. M. Abe Kawsar
ID 57	**Nature's Protective Agents: A Comparative Analysis of Antioxidant Activity in Diverse Algae** Rajia Sultana, and Fariha Farzana
ID 100	**Evaluation of Heavy Metal Pollution in Nga-Pi, A Common Indigenous Food Ingredient Gathered from Various Sites in Cox's Bazar** Md. Yeasin Arafat, Md. Anisuzzaman, and Nahid Sultana
ID 102	**Biocompatible Ionic Liquid-Based Microemulsion for Transdermal Delivery of Celecoxib** Md. Korban Ali
ID 104	**Synthesis, Characterization, and Antimicrobial Evaluation of Schiff Base Metal Complexes Derived from *O*-Aminophenol and Salicylaldehyde** Afzal Hussain, Abdullah Wasif, Fatema Tuz Zohora, Rafica Yasmin Sumaiya, and Md. Ershad Halim
ID 112	**Synthesis and *In-Silico* Study of 4-Methoxy-N'-(3-Oxo-1,3 Diphenylpropyl)Benzohydrazides** Priyanka Mondol, Md Kabidur Rahman, Md Mizanur Rahman Badal, Md Maniruzzaman, and Mohammad Abu Yousuf
ID 113	**Synthesis and Computational Study of (Z)-1-(2,4-Dinitrophenyl)-2-(E-1,3-Diphenylallylidene) Hydrazines** Tanni Sikder, Md Kabidur Rahman, Md Mizanur Rahman Badal, Md Maniruzzaman, and Mohammad Abu Yousuf
ID 129	**Assessment of Microbiological Quality of Meat and Meat Products of Dhaka City** Mahbuba Khatun, A. F. M. Mustafizur Rahman, and Md. Latiful Bari

Parallel Session-2
Invited & Contributed Session: Chemistry
Theme: Inorganic, Material Science and Nano-Technology
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11008
Time: 02.00 PM- 03.35 PM

Chair: Prof. Dr. Mir Tamzid Rahman, Dept. of Chemistry, JU
Co-Chair: Dr. Md. Abu Rashed, Dept. of Chemistry, MBSTU
Invited Speaker: Prof. Dr. Mohammad Abul Hasnat, Dept. of Chemistry, SUST

Paper ID	Abstract Title and Authors
Invited Talk	**Thin film-based surfaces to study different electrochemical reactions** Mohammad A. Hasnat, Md. Fahmidul Islam, Mohammad Imran Hossain, and Md. Saiful Alam
ID 36	**Investigation of Iodine Stability in Salt During Different Processing Techniques and Specific Time Intervals** Sharmin Yesmin Shanta, Mohammad Shaokat Ali , and Mohammad Mozibul Haque

ID 64	**Synthesis and Characterization of Metal-Doped Chitosan/Hydroxyapatite Composites to Develop Biomaterials with Antimicrobial and Drug-Delivery Properties** Bipul Mondal Sagar, Sudipro Chakraborty, Samina Ahmed, and Md. Sahadat Hossain
ID 89	**Sustainable Synthesis of Metal-Organic Frameworks from Waste Materials for Electrochemical Sensing of Heavy Metal Ions in Aqueous Media** Sumaya Tabassum, Sumaiya Akter, Md. Farid Ahmed, Dipa Islam, Samina Ahmed, and Md. Sahadat Hossain
ID 99	**Crystallographic Facet Engineering of Zno Nanoparticles for Photocatalytic Organic Pollutant Degradation and Antibacterial Activity** Priya Paul, Fataha Nur Robel, Newaz Mohammed Bahadur, Sumaya Tabassum, Subarna Sandhani Dey, Muhammad Shahriar Bashar, Nazmul Islam Tanvir, Samina Ahmed, and Md Sahadat Hossain
ID 135	**Design and Synthesis of Catalysts for the Lignin Valorization for the Application as Chemical Feedstocks in the Paints and Textile Industries** Habibur Rahman, and Nur Uddin Ahamad
ID 141	***Moringa Oleifera* Mediated Green Synthesis and Characterization of Silver (Ag) and Nitrogen (N) Reinforced TiO_2 Nanoparticles: A Multifunctional Approach to Visible-Light Photocatalysis, Antimicrobial Applications, and Kinetic Study** Sanjida Khanam, and Md. Kamrul Hossain
ID 152	**Nitrogen Doping in Carbohydrate-Derived Carbon Dots for Fluorescence-Based Sensingand Bioactivity Applications** Sumaiya Hasan Suma, and Md. Abu Bin Hasan Susan
ID 163	**Magnetically Responsive Synthetic Polymer-Modified Bio-Composite Particles for the Separation of Dyes from Wastewater** Ruhul Amin, Md. Harun Al Rashid, and Mostafa Kaiyum Sharafat

Parallel Session-3
Invited & Contributed Session: Chemistry
Theme: Physical and Computational Chemistry
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11009
Time: 02.00 PM- 03.35 PM

Chair: Prof. Dr. Md. Helal Uddin, Dept. of ACCE, IU
Co-Chair: Dr. Md. Jalil Miah, Dept. of NSc, IUT
Invited Speaker: Prof. Dr. Muhammed Yusuf Miah, Dept. of ACCE, NSTU

Paper ID	Abstract Title and Authors
Invited Talk	**Green Synthesis of CuO Nanoparticles from Aqueous Extract of Spondias Mombin Leaves**
ID 13	**Theoretical Insights into Enhanced Electrocatalytic Arsenic Oxidation on Au-Decorated Pt Surfaces in Neutral Medium** Mohebul Ahsan, Md Asaduzzaman, and Mohammad A. Hasnat
ID 68	**Wearable Triboelectric Nanogenerators (TENGs) Based Sensors for Human Cardiovascular Monitoring: Progress and Perspectives** Mashrufa Akther, Md. Mahmud Alam, and Mohammed Jasim Uddin
ID 72	**Theoretical Study of Anodic Chlorine Evolution Reaction on Platinum-Tetraphenyl Porphyrin Electrocatalyst** Jewel Hossen, Naoki Nakatani, and Md. Mosfiqur Rahman Maruf

ID 140	**Exploration of the Clouding Behavior and Thermodynamic Properties of Triton X-100 and Chlorpheniramine Maleate Drug Mixture Influenced by the Variable Concentrations of Potassium Salts** Most. Sammi Akter, Md. Rehan Alam, Md. Rafikul Islam, Ummey Rayhan, and Md. Anamul Hoque
ID 160	**Modulation of Water Structure by Imidazolium-based Ionic Liquids: Effects of Temperature, Concentration, and Alkyl Chain Length** Kawsar Ahmmed, and Md. Abu Bin Hasan Susan
ID 240	**Dual Stimuli Responsive Molecular Switching of Azobenzene in Surfactant-Based Media** Sabikun Naher Sumi, Md. Akib Hasan, and Md. Abu Bin Hasan Susan
ID 273	**Supramolecular Micellar Shuttle in Drug Delivery Application** Asima Monjur, and Md. Abu Bin Hasan Susan

Parallel Session-4
Invited & Contributed Session: Chemistry
Theme: Analytical, Industrial and Environmental Chemistry
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-9011
Time: 02.00 PM- 03.35 PM

Chair: Prof. Dr. Biplob Kumar Biswas, Dept. of Chemical Engineering, JUST
Co-Chair: Dr. Umme Salma, Dept. of Chemistry, MBSTU
Invited Speaker: Prof. Dr. Md. Shoffikul Islam, Dept. of Soil Science, CU

Paper ID	Abstract Title and Authors
Invited Talk (ID 299)	**Microplastic Contamination and Ecological Risk in River Water and Sediment: Evidence from the Karnaphuli River, Bangladesh** Md. Shoffikul Islam, Mumtahina Jui, Md. Sagor Miah, and Farzana Ahmed Rumi
ID 16	**Synergistic Adsorption of Lead (II) By Rice Husk-Tea Residue Blend: A Low-Cost, Sustainable Biosorbent Approach** Saad B. Hasan, Apurbo Pandit, Rajesh K. Chanda, and Biplob K. Biswas
ID 24	**Quantifying the Phenolic Composition and Light-Absorbing Properties of Brown Carbon from Biomass Combustion** Mehedi Shakil
ID 58	**Synthesis of Biodegradable Materials from Textile Waste for Eco-Friendly and Sustainable Applications** Abdullah Al Sajib, Jagannath Biswas, Mahabubur Rahman, ASM Shihavuddind and Mohammad Shariful Alam
ID 80	**Characterizing Brown Carbon in Urban Dhaka: Insights into Optical Behavior, Precursors, and Morphology** Md. Al-Amin Hossen, and Abdus Salam
ID 108	**Efficient Removal of Radiocesium from Contaminated Water Using Macrocyclic Based Porous Sorbent** Rashedul Islam Ripon, Zinnat Ara Begum, Iqbal Hossen, Abhijit Barua, and I. M. M. Rahman
ID 153	**Enhanced Adsorption of Textile Dyes Using Graphene Oxide–MgO Nanocomposites** Mrinal Kanti Roy, Abdullah Al Rakib, Md. Jalil Miah, and Md. Shahabuddin
ID 267	**Electrochemical Detection of Arsenic (III) at Au Modified Ito Electrode** Mohammad Humayun Kabir, Iqbal Ahmed Siddiki, and Mohammad A. Hasnat

3:35 PM - 4:00PM	**Tea/ Coffee Break** **Venue: 11th floor, Shaheed Sayed Nazrul Islam Academic Building, DUET, Gazipur.**

Parallel Session-5
Invited & Contributed Session: Chemistry
Theme: Organic, Food, Agro, and Biochemistry
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11002
Time: 04.00 PM- 05.35 PM

Chair: Prof. Dr. S. M. Abe Kawsar, Dept. of Chemistry, CU
Co-Chair: Prof. Dr. Parbhej Ahmed, Dept. of Chemistry, KUET
Invited Speaker: Prof. Dr. Md. Aminul Haque, Dept. of Chemistry, JnU

Paper ID	Abstract Title and Authors
Invited Talk (ID 450)	**Synthesis, Biological Evaluation, in Silico Admet Prediction, Molecular Docking and Dynamics Studies of 4-Phenoxyphenyl-Thiazole-Schiff Base Derivatives** Md. Aminul Haque, and Mohammad Mostafizur Rahman
ID 175	**Synthesis of Pyridine-based Thiosemicarbazone Schiff Bases: Biological Study and Metal Ion Detection** Taslima Akter, and Md. Monarul Islam
ID 181	**An Efficient One-Pot Synthesis of Imidazole Derivatives from Diketones and Aldehydes Using SnO_2/Rgo Catalyst** Md. Sajjad Hossain Saun, and Md. Nurnobi Rashed
ID 195	**Bioinspired MgO Nanoparticles from Annona Muricata as Efficient Catalysts for Isatin-based Chalcone Synthesis with Promising Anticancer Activity** Md. Jahanur Islam Rumon, and Md. Nurnobi Rashed
ID 211	**Synthesis and Characterization of Reduction-based Vinyl Acetate Modified Poly (Lactic Acid)** Nasima Akter Mukta, Samina Ahmed, Abdullah Mohammad Sarwaruddin Chowdhury, and Papia Haque
ID 266	**Solvent Free Synthesis of Chalcones from Aldehydes and Ketones Using Heterogenous Niobic Acid Catalyst** Roksana Akter, and Md. Nurnobi Rashed
ID 375	**Synthesis, Biological Evaluation and Computational Approaches of Uridine Derivatives as Antimicrobial Agents** Toahira Eakin, and S. M. Abe Kawsar
ID 376	**Design, Synthesis, Antimicrobial Assessment and in Silico Studies of Glucopyranoside Derivatives** Nakibul Islam, and S. M. Abe Kawsar

Parallel Session-6
Invited & Contributed Session: Chemistry
Theme: Inorganic, Material Science and Nano-Technology
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11008
Time: 04.00 PM- 05.35 PM

Chair: Prof. Dr. Mohammad Abul Hasnat, Dept. of Chemistry, SUST
Co-Chair: Dr. Bikash Dev Nath, Dept. of Chemistry, DUET
Invited Speaker: Dr. Zubair Hassan, Dept. of MPS, EWU

Paper ID	Abstract Title and Authors
Invited Talk (ID 47)	**Adsorption of PPCPs acid over MOFs and functionalized MOFs** Zubair Hasan
ID 164	**Controlled Deposition of Bioactive Nanomaterial in Nanocellulose Matrix for Engineering Hygienic Textiles** Fariha Sanjida, and Nur Uddin Ahamad
ID 179	**Crystallographic Modification of Metal Oxides for the Electrochemical Detection of Heavy Metal in Water** Md. Sahadat Hossain, and Samina Ahmed
ID 188	**Fabrication of Ag Doped ZnO Nanophotocatalyst for Efficient Removal of Acid Orange 10 From Wastewater** Farhad Mahmud Fahim, and Md. Nurnobi Rashed
ID 191	**Synthesis of Polyaniline Nanoparticles with Tunable Size Using W/O Microemulsion as a Nanoreactor** Mehnaj Tahnoon Pronomee, and Md. Abu Bin Hasan Susan
ID 196	**Evaluation and DFT Analysis of Green Biocomposites Derived from Polyacrylic Acid and Oxidized Water Hyacinth in an Acidic Medium** Taslima Akter, and Shahin Sultana
ID 197	**Enhanced Adsorption Performance of CeO_2–SnO_2 Nanocomposite for Methyl Orange Removal** Khijir Abdullah Mehdi, and Md Nurnobi Rashed
ID 203	**Fabrication and Performance Analysis of Functionalized Polyethersulfone Membranes for Water Treatment** Mithun Rani Nath, Abu Bin Imran, and Al -Nakib Chowdhury

Parallel Session-7
Invited & Contributed Session: Chemistry
Theme: Analytical, Industrial and Environmental Chemistry
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11009
Time: 04.00 PM- 05.35 PM

Chair: Prof. Dr. Shahjalal Khandaker, Dept. of TE, DUET
Co-Chair: Mr. Md. Arif Hossain, Dept. of Chemistry, DUET
Invited Speaker: Prof. Dr. Md. Mostafizur Rahman, Dept. of Environmental Science, JU

Paper ID	Abstract Title and Authors
Invited Talk	**Synthesis, Biological Evaluation, in Silico Admet Prediction, Molecular Docking and Dynamics Studies of 4-Phenoxyphenyl-Thiazole-Schiff Base Derivatives**

ID 174	**Comparative Study of Commercial TiO_2 and Garlic Extract-Mediated TiO_2 Supported on Coconut Shell Biochar for the Efficient Removal of Acid Orange 10 Dye** Nusrat Jahan, and Md. Nurnobi Rashed
ID 178	**Degradation of Azo Dyes by a Synergistic Sonochemical Process Using Additives and Various Nanoparticles (Cr_2O_3,MnO_2,Fe_2O_3)** Shagor Chad Mondol Akash, Minhaz Hossain, Shohan Ali, Jahangir Hossain, and Md. Helal Uddin
ID 180	**Biogenic and Chemical Synthesis of ZnO Nanophotocatalyst for Efficient Removal of Organic Dye** Msmt. Kulsum Akther, and Md. Nurnobi Rashed
ID 207	**The Degradation of Azo Dyes Achieved Sonochemically with the Aid of Fenton Reagent, Carbon tetrachloride, Graphene oxide and Nickel oxide** Minhaz Hossain, Shagor Chad Mondol Akash, Shohan Ali, S.M. Abdur Razzaque, and Md. Helal Uddin
ID 225	**Hydro-chemical Assessment of Groundwater and River Water Quality for Drinking in Paikgachha Upazila, Khulna District, Bangladesh** Umme Tahera-Tun-Humayra, Md. Amzad Hossain, Md. Rabiul Islam, and Md. Biplob Hosen
ID 244	**Evaluating Drinking Water Quality and Health Risks in Communities Adjacent to the Modhumoti River, Bangladesh** Md. Biplob Hosen, Md. Tofiquzzaman, Md. Rabiul Islam, and Umme Tahera-Tun-Humayra
ID 255	**Assessment of Heavy Metal Concentration and the Physicochemical Parameters of the Outlet Wastewater: A Case Study of the Industrial Zone in Gazipur District, Bangladesh** Arun Roy, Rokshana Pervin, Md. Rabiul Islam, Zarjes Kader, Rifat Sarker, Md. Biplob Hosen, Umme Tahera-Tun-Humayra

Parallel Session-8
Invited & Contributed Session: Chemistry
Theme: Energy Conversion, Storage and Nuclear Chemistry
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-9011
Time: 04.00 PM- 05.30 PM

Chair: Prof. Dr. Ruma, Dept. of EEE, DUET
Co-Chair: Dr. Md. Sofiul Alom, Dept. of Chemistry, DUET
Invited Speaker: Prof. Dr. Mohammad Abu Yousuf, Dept. of Chemistry, KUET

Paper ID	Abstract Title and Authors
Invited Talk	**Exploring the Potential of Cathode Materials in Aqueous Zinc-Ion Battery Technology**
ID 56	**Single Atom Catalysts: A Frontier in Designing Efficient Oxygen Evolution Reaction for Energy Storage Devices** Md. Rakib Khan, and Md. Shafiul Islam
ID 451	**Enhanced Electrochemical Performance of Reduced Graphene oxide Decorated Manganese oxide Cathode for Aqueous Zinc-Ion Batteries** Md. Rana Sheikh, Md. Amir Hamza, Maharun Negar Mojumder, Syfulla Mansur, Bipul Chandra Majumder, Abdul Kuddus, and Chanchal Kumar Roy
ID 459	**Flower-Like Manganese Vanadate Nanosheet Cathodes for High-Performance Aqueous Zinc-Ion Batteries** Md. Amir Hamza, Md. Rana Sheikh, Maharun Negar Mojumder, Syfulla Mansur, Bipul Chandra Majumder, Abdul Kuddus, Chanchal Kumar Roy
ID 494	**Comparative Analysis of Waste Products in Fusion vs. Fission: Implications for Long-Term Nuclear Waste Management** Sadi Mohammad Meraj, Raiyan Yusuf, Tamim Hasan Apurbo, Sadia Tasnim Shara, Md. Mortuza Ahmmed
ID 520	**Solvothermal Engineering of Cathode Materials for Advanced Aqueous Zinc-Ion Batteries** Md. Zahid Hassan, Nusrat Sultana, Md. Sadiqul Islam Sheikh, Muhammad Abu Yousuf, Parbhej Ahamed

ID 521	**Morphology-Controlled MnO_2 Via Temperature-Tuned Ultrasonic Synthesis for Aqueous Zinc-Ion Batteries** Md. Baiazid Ismail, Md. Sadiqul Islam Sheikh, Muhammad Abu Yousuf, Parbhej Ahamed
ID 527	**Lignin Reinforced Conductive Hydrogels with Antibacterial Properties for Flexible Supercapacitor Applications** Md. Tanzil Ahamed Shawon, Ilnaz Fargul Chowdhury, Partha Paul, Md. Salim Khan, Md. Anamul Haque, Zuwu Tang, and Ajoy Kanti Mondal

Poster Sessions

Day 1: 23th October, 2025

Time: 03.00 PM- 05.30 PM

Paper ID	Abstract Title and Authors
ID 107	**Design and Characterization of Metal Oxide Catalysts for the Efficient Production of Furfural from Sugarcane Bagasse-Derived Hemicellulose** Abdullah Al Mamun, Tanvir Muslim, and Swapan Kumer Ray
ID 109	**Evaluation of Cauliflower Stem Leaves as an Adsorbent for the Removal of Alizarin Red S Dye from Aqueous Solution** Tonmoy Mojumder, Hosne Ara Begum, and Md. Safiqul Islam
ID 117	**Graphene-Aminated Lignin Composite for Sustainable Removal of Congo Red and Hexavalent Chromium: Mechanistic Insights and Reusability** Md. Masum Billah, Md. Kamruzzaman, and Mohammad Amirul Hoque
ID 118	**Green Synthesis of Cnc-Rgo Composites for Advanced Hybrid Super Capacitor Electrode Development** Md. Shohidul Islam, B.M. Mohibur Rahman, and Md. Mahbubur Rahman
ID 134	**Synthesis, Characterization and Biological evaluation of Schiff Base Ligands and Their Metal Complxes** Md. Mizanur Rahman, Tulia Akter, and Md. Masuqul Haque
ID 138	**Synthesis, Characterization, and Application of the Composite Material CeBiOIBr with g-C_3N_4 to Enhance Photocatalytic Activity** Md. Nizam Uddin, and SK Faisal Ahmed
ID 139	**Effect of Additives on the Phase Separation of Nonionic Surfactant in Aqueous Solution of Antibiotic Drug** Md. Selim Reza, Md. Anamul Hoque, and Md. Abu Taleb
ID 145	**Synthesis, Physico-Chemical Characterization, DFT Calculations, Antibacterial Activity, and Molecular Docking Analysis of Some First Row Transition Metal Complexes** Md. Saddam Hossain, Md. Abdul Latif, Md. Tariqul Islam, and Md. Kudrat-E-Zahan
ID 151	**Efficient Elimination of Toxic Dyes from Aquatic Systems via Ni/Fe–Lignin Composites** Ebrahim Khalil, Abdullah Al Rakib, Md. Jalil Miah, Md. Mahfujul Hasan, and Md. Shahabuddin
ID 166	**Organic Source Apportionment and Characterization of $PM_{2.5}$ Using FTIR and Positive Matrix Factorization (PMF): A Comparative Study and Health Impact Assessment in Dhaka, Cumilla, and Bhola** Md. Sahin Ahmed, and Abdus Salam
ID 168	**One Step Solvothermal Synthesis of Core-Shell Bi-Bi_2O_3/MWCNT with 3-Dimentional Neural Network Structure for Adsorption and Biomedical Study** Md. Zaid, Faisal Islam Chowdhury, and Md. Kamrul Hossain
ID 169	**Facile And Novel Synthesis of ZnO Hollow Nanostructures via Turnbull Blue Analogues: Characterization and Application in Dye Degradation and Antimicrobial Activity** Mahmud Shareef, Md. Jahidul Islam, Md. Kamrul Hossain, and Faisal Islam Chowdhury
ID 173	**Bio-Templated Egg White Mediated Fe-Doped CuO Nanostructures: Structural Insights, Photocatalysis and Pathogen Control** Anika Nawar Ani, Md. Kamrul Hossain, and Faisal I. Chowdhury
ID 177	**Synthesis and Characterization of Silver Nano Particles Using Mango Peel Extracts**

	Suvashis Roy, Md. Zafrul Hasan, Md. Mobassir Billah, Md. Shamsuzzoha, Md. Atikul Islam, Md. Monowarul Islam, and Md. Rezaul Karim
ID 187	**Hydrothermal Synthesis of ZnO Nanoparticles with Tunable Morphology Using Ionic Liquid as Soft Template at Different pH** Md. Nimur Rahman, and Md. Abu Bin Hasan Susan
ID 193	**Green Synthesis of Zinc Doped Iron Oxide Nanoparticles by Using *Lagenaria Siceraria* Leaves Extract and its Environmental Applications** Marufa Jahan, Md. Kamrul Hossain, and Faisal I. Chowdhury
ID 209	**Comparative Study of Poultry Feed Composition: A Case of Different Companies** Jahidul Islam, Fakir Rafiqul Islam, and A.F.G. Masud Reza
ID 217	**Detection of Permethrin Residues in Flour Using Gc-Ecd** Failatun Nesa, Md. Monarul Islam, and SM Mahmudul Hassan
ID 222	**Green Synthesis and Characterization of Silver Nano Particles Using Mango Peel Extracts** Suvashis Roy, Md. Zafrul Hasan, Md. Mobassir Billah, Md. Shamsuzzoha, Md. Atikul Islam, Md. Monarul Islam, and Md. Rezaul Karim
ID 235	**Optimizing Deposition of Platinum Nanoparticles on Functionalized Graphene Oxide** Mohiuddin Mahin, Howard Fairbrother, and Nur Uddin Ahamad
ID 249	**Value-Added Aluminum Sulfate from Multiple Recycled Aluminum Utensils: Kinetic Optimization and Application as Coagulant and Paper Filler** Md. Muntasir Soun, Shakil Ahmmed, Mohammad Razaul Karim
ID 250	**Eco-Friendly Zinc Oxide Nanoparticles by Using *Tagetes Patula*: Synthesis, Characterization, Photocatalytic, and Antimicrobial Promises** Pinak Chakraborty, Bithi Paul, and K. A. Khan
ID 257	**Synthesis of ZnO Nanoparticles in Presence of Ionic Liquids and their Double Salts** Md. Aminul Islam, Md. Abu Bin Hasan Susan, and Md. Emran Quayum
ID 258	**Electrochemical Detection of Dopamine Using Leaf-Shaped Zno from Recycled Battery Zinc Shells** Md Sakil, Afia Murshida Kusum, Md Abdul Jabbar, Md Yeasin Pabel, Md Humayun Kabir, and Sabina Yasmin
ID 259	**Prussian Blue Analog-Derived NiO Nanoparticles: Integrated Experimental and Theoretical Study for Malachite Green Adsorption and Antimicrobial Activity** Mujibur Rahman, Faisal Islam Chowdhury, and Md. Kamrul Hossain
ID 272	**Influence of Different Dissolved Gases on Electrocatalytic Nitrate Sensing Performance at Cu-Modified Au Electrode** Motasim B. Islam, and Mohammad A. Hasnat
ID 280	**A Validated Stability-Indicating Rp-Hplc Method for Quantitative Determination of L-Carnitine and Voglibose in Pharmaceuticals** Md. Ekhlass Uddin, Raisa Islam, Md. Faruk Hossen, Md. Ali Asraf, and Md. Kudrat-E-Zahan
ID 282	**Sustainable Synthesis of a Graphene Oxide-based Nickel–Iron Superparamagnetic Nanoadsorbent Derived from Electronic Waste for the Removal of Doxycycline in Aqueous Solution** Afia Murshida Kusum, Md Sakil, Fahima Mojumder, Sabina Yasmin, and Md Humayun Kabir
ID 287	**Sustainable Synthesis of Magnetic Graphene Oxide from Waste Batteries for Arsenic Removal from Aqueous Media: Adsorption Mechanism from DFT Calculations** Monira Akter Somapti, Md. Sanwar Hossain, Md. Humayun Kabir, and Sabina Yasmin
ID 289	**Carboxymethylcellulose Functionalized Magnetic Graphene Oxide for the Efficient Removal of Tetracycline from Aqueous Media** Nosheen Tabassum Dipannita, Sabina Yasmin, Md. Kamrul Hasan, Md. Sanwar Hossain, Monira Akter Somapti, and Md Humayun Kabir
ID 292	**Kinetics of Electrocatalytic Oxidation of Gallic Acid by Activated Glassy Carbon Electrode in Acidic Medium** Munira Siddika, Mohammad A. Hasnat
ID 293	**Investigation of Antibacterial Activity of Green Synthesized Zinc Oxide Using the Flower Extract of Plumeria Rubra** Syeda Tanha Hossain Progga, Jannatul Mawa Rodela, H.M. Fahim, Bithi Paul and Farzana Sabeth

ID 296	**Study of Photocatalytic Dye Degradation of Methylene Blue of Green Synthesized Zinc Oxide Using*Chrysanthemum Grandiflorum*** Jannatul Mawa Rodela, SyedaTanha Hossain Progga, H.M. Fahim, Bithi Paul and Farzana Sabeth
ID 300	**Plasmonic Solar Cell** Md. Ali Akbar Sabbir, and Nur Uddin Ahamad
ID 302	**Experimental and Computational Insights into Antibacterial and Antioxidant Properties of Metal Complexes with Isoniazid-based Schiff Base Ligands** Md. Ashraful Islam, Md. Sajib Hossain, Md. Tariqul Islam, Md. Toukir Biswas, Faria Tasnim, Md. Robiul Islam, Md. Ali Asraf, Md. Faruk Hossen, and Md. Kudrat-E-Zahan
ID 306	**Quantum Chemical Investigations into the Structural and Spectroscopic Properties of Choline Chloride-Based Deep Eutectic Solvents** M. Ashraful Hasan, Ismail M. M. Rahman, M. Rithoan Hossain, and Faisal Islam Chowdhury
ID 377	**Synthesis of Carbohydrate Derivatives: Drug Design and Pharmaceutical Interests for Future Visions** Ivy Islam, Md. Farhan Labib, Jahidul Islam Sajal, Sajid Hassan Shammo, Abonti Barua, Nazia Islam, Khurshida Jahan Suma, Abida Sultana, Md. Raihan Sarker, and S. M. Abe Kawsar
ID 378	**Synthesis of Nucleoside Analogs as Drugs in the Fight against SARS-CoV-2 and Other Coronaviruses** Sajjad Hossain, Akibul Islam, Tasfia Tabassum Eshika, Niloy Bhattacharjee, Md. Rithoan Hossain, S. M. Abe Kawsar

Technical Sessions for Chemistry

Day 2: 24th October, 2025

Parallel Session-1
Invited & Contributed Session: Chemistry
Theme: Organic, food, Agro and Bio Chemistry
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11002
Time: 11.10 AM- 12.45 PM

Chair: Prof. Prof. Dr. Mizanur Rahman Badal, Dept. of Chemistry, KUET
Co-Chair: Dr. Zannatul Kowser, Dept. of Chemistry, JUST
Invited Speaker: Dr. Md. Monarul Islam, BCSIR, Dhaka

Paper ID	Abstract Title and Authors
Invited Talk (ID 403)	**Synthesis of Pyrimidine Derivatives: Biological Study and Molecular Docking** Md. Monarul Islam, Rabeya Akter, and Abhijit Chowdhury
ID 385	**Synthesis, Characterization, Bioactivity Screening and In Silico Studies of Phenyl Thiazole Derivatives** Ranajit Kumar Sutradhar, Md. Din Islam, and Md. Abu Bakkar Siddiki
ID 393	**Bioactive Phytoconstituents from the Aerial Parts of *Spilanthes Calva*** Ranajit Kumar Sutradhar, and Muhammead Shahidul Islam
ID 394	**Synthesis, Antimicrobial and Antioxidant Activity of Di-Thiazole-Schiff Base Derivatives Containing Hydroxynapthalene Moiety with their ADMET Prediction, Molecular Docking and Dynamics Study** Md. Mizanur Rahman, Mohammad Mostafizur Rahman, and Md. Aminul Haque
ID 402	**Synthesis of Schiff Base and Its Ni(II) Complex for In Vitro and In Silico Evaluation Against Agricultural Pathogen** Md. Eanur Rahman, Rummana Islam, Md. Shamim Akhter, and N. M. Mofiz Uddin Khan
ID 410	**Synthesis, Characterization, Bioactive Screening and Molecular Docking Studies of Thiazole Derivatives Containing Quinoline Moieties** Ranajit Kumar Sutradhar, Md. Din Islam, and Md. Mohiuddin Emon
ID 426	**Physicochemical Characterization of Oil Extracted from *Delonix Regia* Seeds** Nusrat Jahan Mumu, Md. Arif Hossain, and Zinia Nasreen
ID 429	**Preparation and Physicochemical Properties of Silver-Modified Viscose Rayon from Jute Fiber** Sharmin Akter, Md. Arif Hossain, and Zinia Nasreen

Parallel Session-2
Invited & Contributed Session: Chemistry
Theme: Inorganic, Material Science, and Nano-Technology
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11008
Time: 11.10 AM- 12.45 PM

Chair: Prof. Dr. Nur Uddin Ahamad, Dept. of Chemistry, SUST
Co-Chair: Dr. Md. Kamrul Hossain, Dept. of Chemistry, CU
Invited Speaker: Dr. Samina Ahmed, Chairman, BCSIR, Dhaka

Paper ID	Abstract Title and Authors
Invited Talk	**4th Generation Biomaterials for Enhanced Biomedical Applications**
ID 215	**Synthesis, Biological Evaluation, and I*n Silico* Insights of Thiosemicarbazide-Derived Schiff Bases and Their Ni (II) Cu (II) Complexes** Md. Tariqul Islam, Md. Ashraful Islam, Md. Saddam Hossein, Md. Ali Ashraf, Md. Faruk Hossen, and Md. Kudrat-E-Zahan

ID 238	**Promising Antioxidant, and Photocatalytic Activies of Phytosynthesized TiO_2 Nanoparticles using *Borassus flabellifer* Seed Extract** Mahjabin Taskin, Bithi Paul, and Farzana Sabeth
ID 268	**Photodegradation of *p*-Chlorophenol (PCP) and *p*-Nitrophenol (PNP) Mediated by Titanium Dioxide (TiO_2) and Doped TiO_2Photocatalysts** Md. Kamrul Hossain, Md. Mufazzal Hossain, and Shamim Akhtar
ID 275	**Surface Propensity of Hydrophilic and Hydrophobic Surface-active Ionic Liquid-based Microemulsions and Their Application in Micellar Catalysis** Israt Jahan Heme and Md. Abu Bin Hasan Susan
ID 278	**Structural, Biological, and Computational Evaluation of Schiff Base Metal Complexes with *(E)*-2-(((*4*-Nitrophenyl)imino)methyl)phenol: Antibacterial and Antioxidant Activities with DFT and ADMET Analysis** Md. Ashraful Islam, Md. Toukir Biswas, Faria Tasnim, Md. Sajib Hossain, Md. Robiul Islam, Md. Ali Asraf, Md. Faruk Hossen, and Md. Kudrat-E-Zahan
ID 308	**Surface Engineered Nanoparticles as Efficient Catalyst and Bioactive Agent: Reduction of Nitroaromatics, Radical Scavenging and Cytotoxic Activities** Most. Sabiha Islam, Rakibul Islam, Hasan Ahmad, and Md. Abdur Rahman
ID 330	**Removal of Methyl Violet 2b & Antibacterial Activity of Co_3O_4 Nanoparticles Synthesized from Prussian Blue Analogues** Md. Rockshat, Faisal Islam Chowdhury, and Md. Kamrul Hossain

Parallel Session-3
Invited & Contributed Session: Chemistry
Theme: Physical and Computational Chemistry
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11009
Time: 11.10 AM- 12.45 PM

Chair: Prof. Dr. Anamul Hoque, Dept. of Chemistry, JU
Co-Chair: Dr. K. M. Anis-Ul-Haque, Dept. of Chemistry, JUST
Invited Speaker: Prof. Dr. Mufazzal Hossain, Dept. of Chemistry, DU

Paper ID	Abstract Title and Authors
Invited Talk	**Development of Efficient Photocatalysts for Removal of a Dye from Aqueous Solution**
ID 130	**Phase Separation of Triton X-100 with Tetracaine Hydrochloride: Investigating the Influence of Potassium Electrolytes on Physicochemical Properties and Interaction Forces** Israt Jahan, Shampa Saha, and Md. Anamul Hoque
ID 355	**Investigation of the Clouding Nature and Thermodynamic Properties of Triton X-100 and Chlorpheniramine Maleate Mixture in Presence of Electrolytes and Hydrotropes** Md. Milon Ali, Md. Rafikul Islam, Md. Rehan Alam, and Md. Anamul Hoque
ID 362	**The Aggregation of Tetradecyltrimethylammonium Bromide and Levofloxacin Hemihydrate Mixture: Exploration of the Impact of Sodium Salts and Temperature on the Thermodynamic Properties and Interaction Forces** Md. Romjan Ali, Md. Eanur Rahman, and Md. Rafikul Islam
ID 475	**Investigation of potassium salts induced micellization of tetradecyltrimethylammonium bromide with cationic crystal violet dye: Physicochemical and thermodynamic aspects** Md. Mahade Hasan, and Md. Anamul Hoque
ID 505	**Cloud Point and Spectroscopic Investigations of the Interaction and Thermodynamics of Surfactant and Metformin Hydrochloride mixture in the Presence of Additives** Md. Abu Taleb, and Md. Anamul Hoque
ID 506	**Silica Induced Phase Transformation in Polyvinylidene Fluoride: Influence of Synthesis Method and Content of Silica** Nusrat Jahan Sumona, and Saika Ahmed
ID 518	**Effect of Sodium Electrolyte on the Aggregation Behaviour of the Sodium Dodecyl Sulfate Surfactant and β-Cyclodextrin Host Molecule** K. M. Anis-Ul-Haque, Nasir Uddin, Md. Azizur Rahman Khan, and Md. Anamul Hoque

Parallel Session-4
Invited & Contributed Session: Chemistry
Theme: Analytical, Industrial and Environmental Chemistry
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-9011
Time: 11.10 AM- 12.45 PM

Chair: Prof. Dr. Zinia Nasreen, Dept. of Chemistry, DUET
Co-Chair: Dr. Sumon Chandra Mohanta, Dept. of Chemistry, JUST
Invited Speaker: Dr. Tasrina Rabeya Choudhury, BAEC, Dhaka

Paper ID	Abstract Title and Authors
Invited Talk (ID 401)	**Microplastic Pollution in Coastal Ecosystems and Food Sources of South Asia: Environmental and Human Health Implications** Tasrina Rabia Choudhury, and M. Belal Hossain
ID 172	**Determination of Anthracene and Pyrene in Road Dust Analysis Using UV-Vis Spectroscopy** Rashedul Islam, and Md. Monarul Islam
ID 297	**Plant Extract-based Green Synthesis of TiO_2 Nanoparticles and Their Application in Mitigating Environmental Pollution** Md. Anayet Ullah, Fataha Nur Robel, Newaz Mohammed Bahadur, Muhammad Shahriar Bashar, Sanjida Khan, Md Farid Ahmed, Samina Ahmed, and Md. Sahadat Hossain
ID 327	**Study of Controlled Accumulation, Ingestion and Excretion ofChromium (iii) Sulphate, Lead (Ii) Sulphate, Heavy Toxic Metals, inSome Freshwater Fish Species** Sabiha Afrin Jolly, and Umme Salma
ID 335	**Cellulose Nanocrystal Recovery from Mixed Office Wastepaper to Develop Coatings with Enhanced Barrier Properties for Packaging** Anik Baral, Md. Mustafizur Rahman, and Khandoker Samaher Salem
ID 345	**Spatial and Temporal Variations of $Pm_{2.5}$ Concentrations Across Dhaka Using Tsi Bluesky^{tm} Sensors** Rakibul Omar, Shatabdi Roy, Shahid Uz Zaman Adil, and Abdus Salam
ID 390	**Alcohol and Heavy Metal Contaminated Health Risk Assessment in Beverage Samples Available in Bangladesh** Md. Hasan Ali, Md. Monarul Islam, and Md. Al-Amin
ID 399	**Assessment of Environmental Noise Pollution and Its Impacts on Urban and Academic Areas in Jashore, Bangladesh** Debaroty Biswas, Rajesh Kumar Chanda, and Biplob Kumar Biswas

12:40 PM – 02:00 PM	**Prayer** **Venue: DUET Central Mosques** **Lunch Break** **Venue: Ground floor, Shaheed Abu Sayed Administrative Building, DUET**

Parallel Session-5
Invited & Contributed Session: Chemistry
Theme: Organic, Food, Agro, and Biochemistry
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11002
Time: 02.00 PM- 03.35 PM

Chair: Prof. Dr. Muhammad Mostafizur Rahman, Dept. of Chemistry, JnU
Co-Chair: Prof. Dr. Moniruzzaman, Dept. of Chemistry, KUET
Invited Speaker: Dr. Sahjahan Kutubi, Junior Assoc. Prof., Chemical Systems Engineering Department, Nagoya University, Japan

Paper ID	Abstract Title and Authors
Invited Talk	**Shaping Factors on Catalysis: Bridging Chemistry and Chemical Engineering**
ID 340	**Limonoids from the Seeds of Swietenia Macrophylla and Their Pharmacological and in Silico Analysis**

	Mazharul Islam, Md. Sakhaoyat Hossain, and Rajia Sultana
ID 364	**Phytochemical Composition and Evaluation of Biological Potential of *Carissa carandas* L. Fruit** Zeba Samiha, Md. Nazrul Islam, and Mohammad Shoeb
ID 379	**Synthesis of Aniline Containing Thiazole-Schiff Base Derivative: Evaluation of Biological Activity, in Silico Admet Predictions, Molecular Docking, and Dynamics Studies** Setu Karmokar, Mohammad Mostafizur Rahman, and Md. Aminul Haque
ID 436	**Organic Fertilizers and Their Effects on Soil Biochemistry and Crop Yield in Bangladesh** Shaharia Rahman Tanim, Samin Shahriyar Lorin, and Md. Mortuza Ahmmed
ID 440	**Synthesis, Characterization and Computational Study of Novel Azo-Schiff Bases as Anti-Breast Cancer Agents** Md. Mehedi Hasan, Md. Eanur Rahman, Mamiya Chowdhury, and N. M. Mofiz Uddin Khan
ID 452	**Bioactive Steroidal Glycoside from the Seeds of *Mucuna pruriens*** Md Sakhaoyat Hossain, and Ranajit K Sutradhar
ID 456	**Development and Nutritional Evaluation of Calcium-Fortified Biscuits Using Bone Powder from Indigenous Bangladeshi Fish Species** Rahadul Islam Auvi, Nowshin Tarannum Orin, Md. Ashikur Rahman, and Farzana Rahman

Parallel Session-6
Invited & Contributed Session: Chemistry
Theme: Inorganic, Material Science and Nano-Technology
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11008
Time: 02.00 PM- 03.35 PM

Chair: Dr. Shariful Alam, Dept. of Textile, GU
Co-Chair: Dr. Md. Rafikul Islam, Dept. of Chemistry, DUET
Invited Speaker: Prof. Dr. Md. Abdur Rahman, Dept. of Chemistry, RU

Paper ID	Abstract Title and Authors
Invited Talk (ID 303)	**Designing Sustainable Materials via Functionalizing Metallic Bismuth Particles for Catalytic and Antimicrobial Applications** Md. Abdur Rahman, M. A. Jalil Miah, Choudhury M. Zakaria, and Hasan Ahmad
ID 334	**Boosting Self-Healing of Conventional Hydrogels with the Combinations of Functionalized Graphene Oxide Nano Sheet** Md. Mahamudul Hasan Rumon, Foysal Ahmed, Nahida Akter Shila, and Chanchal Kumar Roy
ID 366	**Nano-Engineered Antibacterial Coatings on Cotton Fabrics Using Zinc Oxide (ZnO) Nanoparticles: A Review of Recent Advances** Abhijit Dhali
ID 445	**Novel Palladium Dithiocarbamates: Synthesis, Characterisation, DFT Studies, Microbial Activity and Use as Single Source Precursors of Palladium Sulfide** Md. Atikul Islam, Md. Nayem Hossen, Tannith-Jade Cole, David Pugh, Md. Aminul Haque, Graeme Hogarth[2], and Jagodish C. Sarker
ID 462	**Ru-Sn and Ru-Os Low-Valent Mixed-Metal Clusters Bearing Heterocyclic Thiolate Ligand(S): Synthesis, Crystal and Electronic Structures** Md. Monir Hossain, Vladimir N. Nesterov, Graeme Hogarth, German E. Pieslingerd, Shariff E. Kabir, and Shishir Ghosh
ID 483	**Synthesis, Characterization, and Multifunctional Applications of Rhenium (IV) Dithiocarbamate Complexes and Used Them as Single-source Precursors for ReS_2 Nanomaterials** Md. Al-Imran, Md. Nayem Hossen, Md. Aminul Haque, Graeme Hogarth, and Jagodish C. Sarker
ID 485	**Efficient Scalable Synthesis of Mn_3O_4 with Controlled Polymorphs and Morphologies for Enhanced Battery Cathodes** Habiba Jahan, Nusrat Tazeen Tonu, Ahammad Musa, Md. Sadiqul Islam Sheikh, Parbhej Ahamed, and Muhammad Abu Yousuf

ID 507	**Amine Functionalization ZnO-CeO_2 Nanocomposites: Synergistic Enhancement in Photodegradation, Antibiotic Decomposition, and Antibacterial Applications** Md Swapon Hossain, Mohammad Awlad Hossain, and Md Elias

Parallel Session-7
Invited & Contributed Session: Chemistry
Theme: Analytical, Industrial and Environmental Chemistry
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11009
Time: 02.00 PM- 03.35 PM

Chair: Prof. Dr. Abu Bin Imran, Dept. of Chemistry, BUET
Co-Chair: Dr. Md. Korban Ali, Dept. of Chemistry, JUST
Invited Speaker: Prof. Dr. Abdus Sabur, Dept. of Chemistry, JU

Paper ID	Abstract Title and Authors
Invited Talk	**Salinity-Induced Controls on Iron and Phosphorus Cycling in Coastal Soils of Bangladesh**
ID 416	**Assessment of Metal(Loid)S Contamination, Sources, and Ecological Risk in Buriganga River Sediments Using Inaa and Multivariate Approaches** Farhad Hossain, Rahat Khan, Mohammad Aminur Rahman, Md. Saiful Islam, Debapriyo Paul, Mohtasim Hasan, Md. Abdullah, and Mir Tamzid Rahman
ID 422	**Adsorptive Performance of Layered Double Hydroxides and Their Oxides with Mg/Al Molar Ratios (2:1, 1:2) for Chromium Removal from Synthetic Wastewater** Shashe Chowdhury, Mir Tamzid Rahman, and Shamshad B. Quarishi
ID 423	**Preparation and Characterization of Zinc Oxide-Potato Peel Composite for the Removal of Toxic Organic Dye** Umme Tajrian, Md. Rehan Alam, Abdullah Al Rakib, Md. Shahidul Haque, and Ummey Rayhan
ID 430	**Chromium Adsorption from Aqueous Solution Using a Fish Scale–Microcrystalline Cellulose Composite** Masfia Jahan, Md. Arif Hossain, Zinia Nasreen, and Md. Abu Bakar Siddiqu
ID 434	**Ice Templated PDMS-doped Graphene Oxide Foam for Spillage Oil and Fog Deposition Mitigation** Mehedi Hasan, Khandoker S Salem, and A. F. M. Mustafizur Rahman
ID 441	**Adsorption of Chromium from Aqueous Solution by Activated Carbon-Microcrystalline Cellulose Composite** Md. Arif Hossain, Masfia Jahan, Touhidur Islam, and Zinia Nasreen
ID 457	**Selective Colorimetric Detection of Cu^{2+} in Aqueous Medium Using an Acid Hydrazide-Based Chemosensor: Experimental and DFT/TDDFT Studies** Joardar Gim, Zannatul Kowser, Dipa Debnath, Redika Sarmin Prieety, Miss. Tasnim Jahan, Most Tahera Khatun, Sahara Khatun Munni, Md. Rashed Khan, and Rashedul Islam
ID 477	**Design of a Reversible UV-Vis Colorimetric Chemosensor for Cu^{2+}: Experimental and Computational Investigations** Zannatul Kowser, Joardar Gim, Redika Sarmin Prieety, Dipa Debnath, Miss. Tasnim Jahan, Most Tahera Khatun, Sahara Khatun Munni, and Rashedul Islam

Poster Sessions

Day 2: 24thOctober, 2025

Time: 03.00 PM- 05.30 PM

Paper ID	Abstract Title and Authors
ID 316	**Assessment of Heavy Metals in Beef and its Health Risk in Jashore Municipality Area** Suman Chandra Mohanta, Abu Shamim Khan, Rabiul Islam, Mahbub Hasan, Zahid Hasan, Golam Mortuza, Belal Hossen, Masud Rana, Jannatul Mawya, Joy Rahman, and Rajib Ali
ID 318	**Efficacy of Gibberellic Acid (Ga3) and Different Nutrient Sources on The Growth and Yield of Sweet Gourd (Cucurbita Moschata D.) During Summer** Md. Rosiquzzaman, Md. Azmain Faique, Saidul Islam, and Mohammad Ahsanul Kabir
ID 322	**Synthesis of Magnetically Separable Fe_3O_4/Zno Nanocomposite for Photocatalytic Degradation of Methylene Blue** Md. Seratul Mustakin, Amena Jaman, Md. Sajib, and Muhammad Shah Miran
ID 323	**Machine Learning-Driven Classification of Electrochemical System Compatibility: The Role of Dielectric Constant** Saidul Islam, Md. Azmain Faique, and Ahmad Parve
ID 329	**Preparation and Characterization of Magnetic Ionic Liquids as Electrolyte for Electrochemical Applications** Mariom Jahan, and Md. Abu Bin Hasan Susan
ID 332	**Phase Transformation in Poly(Vinylidene Fluoride) Using Porous Silica Fillers for Improved Dielectric Performance** Mst. Rumana Akter, Mst. Momotaz Begam, and Saika Ahmed
ID 342	**Purification of Bioactive Compounds from *Aphanamixis polystachya* Leaves Extract and In Vitro Assessment of Their Antibacterial and Antioxidant Potentials** Shohan Ali, Atiqur Rahman, Md. Zakariya Alam Bappi, and Shagor Chad Mondol Akash
ID 346	**Investigating the Molecular Mechanisms of Mucuna Pruriens in Treating Parkinson's Disease: A Network Pharmacology and Bioinformatics Approach with Molecular Docking and Dynamics Validation** Md. Sakhaoyat Hossain
ID 350	**Assessment of Humic Acid in Groundwater and Its Impact on Water Quality at Coastal Area in Bangladesh** Abu Shamim Khan, Suman Chandra Mohanta, Rabiul Islam, Mahbub Hasan, Zahid Hasan, Golam Mortuza, Masud Rana, Rajib Ali, and Joy Rahman
ID 383	**Synthesis, Antimicrobial and Antioxidant Evaluation with *In Silico* Admet Prediction, Molecular Docking and Dynamics Studies of Novel Halogen-Substituted Thiophene Containing Thiazole-Schiff Base Derivatives** Alin Tasnim Aurora, Md. Aminul Haque, and Mohammad Mostafizur Rahman
ID 384	**Synthesis, Characterization, *In Vitro* Biological Activities, and *In Silico* Studies of Novel Thiazole-Schiff Base Derivatives Containing Furan Moiety** Md. Imtiaz Sultan, Md. Aminul Haque, and Mohammad Mostafizur Rahman
ID 387	**Design, Synthesis, Molecular Docking, and Dynamics Studies of Imidazole-Containing Thiazole-Schiff Base Derivatives and the Assessment of Their Antimicrobial and Antioxidant Activity** Monika Das, Mohammad Mostafizur Rahman, and Md. Aminul Haque
ID 391	**Synthesis, Biological Activity, Molecular Docking and Dynamics Studies of Methylfuran-Thiazole Derivatives** Farid Uddin Ahmad, Mohammad Sayed Alam, Md. Aminul Haque, and Mohammad Mostafizur Rahman

ID 392	**Synthesis, Biological Activity and *In Silico* Admet Prediction and Docking Studies of Nitrobenzene-Based Substituted Thiazoles** Md. Khalilur Rahman, Md. Aminul Haque, and Mohammad Mostafizur Rahman
ID 407	**A Digital Survey on User-Reported Safety and Performance of Mobile Power Banks in Daily Use** Kazi Warisa Tabassum, Jannatul Ferdous, Nazmus Sakib Sami, and Md. Mortuza Ahmmed
ID 417	**Synthesis dnd DFT Computational Study of Chalcone Derivatives** Rabeya Akter, Md. Wahidul Islam, and Md. Monarul Islam
ID 424	**Phytochemical and Biological Studies on the Stem Bark of the Medicinal Plant *Calophylluminophyllum* Linn** Rahima Akter, Rima Akter, Md Aliul Azim Zim, Md. Farid Uddin, and Koushik Saha
ID 428	**Effect of $NaBH_4/AgNO_3$ Ratio on Size Control and Long -Term Electrostatic Stabilization of Silver Nanoparticles** M. Habibur Rahman, M. Nabul Sardar, Shah-Alam, Arzuma Aktar, Md Mahadi Hasan, M. Shahinur Rahaman, AAS Mostofa Zahid, M. Shamim Hossan, and M. Nazrul Islam
ID 431	**Hydrothermal and Microwave Synthesis of Folic-Acid-derived Carbon Dot–assisted EDTA-Modified Mg–Al LDH** Suma Akter, Mir Tamzid Rahman, Md. Ayub Ali, Md Mizanur Rahman, and Masum Billah Siam
ID 439	**Recycling Spent Dry Cells into rGO/MnO_2 Nanocomposites for Advanced Supercapacitor Electrodes** Othai Saha, Md Humayun Kabir, Md. Mazharul Islam, Md. Sanwar Hossain, and Sabina Yasmin
ID 446	**Conventional and Microwave-assisted Synthesis, Antimicrobial and Anti-Oxidant Activity Evaluation with *In Silico* Studies of Carbazole-Thiazole-Schiff Base Hybrids** Sumita Saznin Marufa, Mohammad Mostafizur Rahman, Mohammad Syed Alam, and Md. Aminul Haque
ID 454	**Synthesis, Characterization and Antimicrobial Evaluation of Azo-Functionalized Schiff Bases against Plant Pathogens** Mamiya Chowdhury, Md. Eanur Rahman, Sanjoy Belwar, Rummana Islam, Md. Shamim Akhter, Fatema Tuzzohora Islam, and N. M. Mofiz Uddin Khan
ID 455	**Enhanced Degradation of Waste Engine Oil by Immobilized Pseudomonas Sp. In B-Cd Nanosponge–Sodium Alginate Matrix** Abu Bin Imran, Md. Mahbub Alam, and Sharif Neaz
ID 458	**Turning Citrus Waste into Functional Nutrition: A Comprehensive Study on Bakery Products Development Using Fruit Peel Powders** Nowshin Tarannum Orin, Rahadul Islam Auvi, Md. Ashikur Rahman, and Farzana Rahman
ID 463	**Halogen Substituted Benzene Ring Containing Novel Thiazole-Schiff base Analogous: Synthesis, Antimicrobial and Antioxidant Evaluation as well as *in silico* ADMET properties prediction along with Molecular docking, MD simulation and Dynamics Study** Md. Shaon Islam, Shathi Bala, Mohammad Mostafizur Rahman, and Md. Aminul Haque
ID 464	**Indole-Thiazole-Schiff Base Hybrids: Synthesis, Antimicrobial and Antioxidant Activity with ADMET Prediction, Molecular Docking and Dynamics Studies** Laila Jahan Nabila, Saima Rahman, Mohammad Mostafizur Rahman, and Md. Aminul Haque
ID 467	**Investigating Functional Properties of Several Binaphtholpyridyl Compounds and Substituted Schiff Base Derivatives** Md. Sadiqul Hasan, Bikash Dev Nath, Subarna Sandhani Dey, Abhijit Chowdhury, Md. Sharif Hossain, Md. Shahabuddin, and Ummey Rayhan
ID 468	**Synthesis, Computational Studies and Biological Evaluation of Several 1,4-Diamino Benzene-based Schiff base Derivatives** Bikash Dev Nath, Md. Monarul Islam, Abhijit Chowdhury, Kabir M Uddin, Shofiur Rahman, Md. Sharif Hossain, and Paris E. Georghiou

ID 480	**A Novel Schiff Base Ligand as a Dual-functional Colorimetric Senor for Pb^{2+} Detection and Potential Antileishmanial Agent: Synthesis, Spectroscopic Characterization, DFT and Docking Studies** Joardar Gim, Zannatul Kowser, Most Tahera Khatun, Miss. Tasnim Jahan, Redika Sarmin Prieety, Dipa Debnath, Sahara Khatun Munni, and Rashedul Islam
ID 481	**Design, Synthesis, In-Vitro Evaluation, Molecular Docking, and Admet Studies of Novel Functionalized Coumarin-Thiazole Hybrids** Fahmida Kamal, Md. Sakhaoyat Hossain, and A. H. Rashadul Hossain
ID 486	**Cellulose-based Colorimetric Sensor Film for Rapid and Efficient Detection of Formaldehyde in Food Samples** Md. Ariful Islam, Israt Jahan Riya Moni, and Abu Bin Imran
ID 492	**Sustainability in Tradition: Vernacular Mud Architecture Practices of Gazipur** Nusrat Jahan Fariha, and Iqbal Hossen
ID 493	**Coumarin–Thioamide Hybrids as Antioxidant and Enzyme-targeting Agents: Synthesis, DFT, ADMET, and Molecular Docking Studies** Afia Imrad Tahasin, and Md. Sakhaoyat Hossain

Technical Sessions for HSS

Parallel Session-1
Invited & Contributed Session: Humanities and Social Sciences
Theme: Economic and Public Policy for Sustainable Development
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room: 11001

Time: 02.00 PM- 03.35 PM

Chair: Dr. S. M. Khaled Hossain, Faculty, Army Institute of Business Administration
Co-Chair: Dr. Mir Md. Fazle Rabbi, Assistant Professor, Humanities and Social Sciences, Dhaka University of Engineering & Technology, Gazipur
Invited Speaker: Dr. Md. Rahat Khan, Faculty, Army Institute of Business Administration

Paper ID	Abstract Title and Authors
Invited Talk	
ID- 281	**Public Policy and Its Importance to Achieve Sustainable Development: With Special Reference to Sri Lanka** Nisanka Sanjeewani Ariyarathne[1]
ID- 351	**Community Based Tourism and Empowering the Santal Community in Bangladesh: Challenges and Opportunities** Muhammad Mahmudur Rahman[1], and Md. Alomgir Hossan[2*]
ID- 320	**Assessment of Women's Contributions in the Livestock Sector of Bangladesh** Dr. Most. Mahfuja Khatun[1], Dr. A.S.M. Ashab Uddin[1], Md. Razibul Hassan[1*], Farzana Yasmin[1], Dr. Shahana Nazneen[1], Md. Bakhtiar Kakee[1], and Dr. Sadek Ahmed[1,2]
ID-517	**Philosophy of Language and Artificial Intelligence: Philosophical Perspectives on Meaning, Communication, and Sustainable Development** Shakil Mia
ID- 513	**Integrating Informal Culinary Economics in Rural Tourism through an Implemented Cloud-based Digital Platform** Md. Musfiqur Rahman Akib[1], Habibur Rahaman[2*]

Parallel Session-2
Invited & Contributed Session: Humanities and Social Sciences
Theme: Graduate Employability and Language Education
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11010
Time: 02.00 PM- 03.35 PM

Chair: Prof. Dr. AKM Zakaia, Humanities and Social Sciences, Dhaka University of Engineering & Technology, Gazipur**.**
Co-Chair: Motiur Rahman, Assistant Professor, Humanities and Social Sciences, Dhaka University of Engineering & Technology, Gazipur.
Invited Speaker: Prof. Dr. A. K. M. Waliul Islam, English (IML), Dhaka University

Paper ID	Abstract Title and Authors
Invited Talk	**The Interdisciplinary Nexus: Language and Communication as Connectors**
ID-34	**Building Pathways to Employability by Using Transmedia Storytelling Approach: A Case Study in an EFL Classroom** Eshita Khanam Karu, Fariza Puteh-Behak, Hayati Ismail, Muhammad Azizul Hoque
ID-254	**Role of English Language Proficiency in the Graduate Employability in Bangladesh** Mohammad Rukanuddin
ID- 337	**Possibilities and Challenges in Professional Responsibilities: Voices of a Bangladeshi Private University English Graduates** Kaniz Fatema, Shanjid-a Akter, Owafia Sadika , Sadiaqua Mahmood Aunue
ID- 357	**English Language Education and Employability: Perspectives from Engineering Students in Bangladesh** Maisha Afsar, Nahida Jannat Oishe, and Jannatul Ferdous Fariha

ID-247	**Exploring English Language Learning Strategies among the Learners of Northern Bangladesh: A Case Study on Nilphamari District** Md. Al-Amin
ID- 460	**Bangladeshi Undergraduate Students' Perceptions towards the Use of AI Technology in Developing English Speaking Skills** Tashrifa Fairuz
ID- 474	**Empowering Learner Autonomy of Engineering Students through Digital Pedagogies in EFL Context** Nur Mohammad Khan, AKM Zakaria

3:35 PM - 4:00PM	**Tea/ Coffee Break** **Venue: 11th floor, Shaheed Sayed Nazrul Islam Academic Building**

Parallel Session-3
Invited & Contributed Session: Humanities and Social Sciences
Theme: Economic and Public Policy for Sustainable Development
Day 1: Thursday, October 23, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11001
Time: 04.00 PM- 05.35 PM

Chair: Dr. Md. Rahat Khan, Faculty, Army Institute of Business Administration
Co-Chair: Mazharul Alam, Assistant Professor, Humanities and Social Sciences, Dhaka University of Engineering & Technology, Gazipur.
Invited Speaker: Prof. Dr. Md Nazmus Sadekin, Economics, Mawlana Bhashani Science and Technology University

Paper ID	Abstract Title and Authors
Invited Talk	**Livelihood Vulnerability Index: An Application to Evaluate the State of Climate Vulnerability for Small-Scale, Inland Fishing Livelihoods**
ID- 310	**Exploring the Dual Impact of FDI and Trade Openness on Renewable Energy Consumption in RCEP Countries Focusing on Sustainable Energy** Anika Tasneem[1*], Dr. Md Nazmus Sadekin[1,2], Md Mazadul Hoque[2], Farhana Yeasmin[2,3], Ashiqur Rahman[1], and Md. Tuhin Ahmed[1]
ID- 283	**District-Level Dynamics of Tree Cover Change in Bangladesh: Policy Implications for Sustainable Development** Atiqur Rahman[1*], Akramul Haque[2] Md Alamgir Hossin[3], Ovi Ranjan Saha[4]
ID- 290	**Predictive Statistical Analysis of Under-5 Child Mortality and SDG Targets in Bangladesh, India, and The Maldives (2000–2023)** Anika Nawar Jahan[1], Manjur-E-Elahi Shimul[2]
ID- 508	**Farmer-Centric AI System for Socially Inclusive Smart Irrigation and Crop Monitoring** Rashidul Islam Sifat[1*], and Md. Sawgat Khan[2]
ID- 513	**Integrating Informal Culinary Economies in Rural Tourism through an Implemented Cloud-Based Digital Platform** Md. Musfiqur Rahman Akib[1], Habibur Rahaman [1]*
ID- 514	**Unequal Access: Water Scarcity and Vulnerability among Marginalized Communities in Chattogram** Istiak Ahmed[1*], Tanjiha Binte Kabir[1] and Mozzammel Masum[1]

Parallel Session-4
Invited & Contributed Session: Humanities and Social Sciences
Theme: Innovative Business Technology for SD/Economic and Public Policy for Sustainable Development
Day 1: Thursday, 23 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11010
Time: 04.00 PM- 05.35 PM

Chair: Prof. Muhammad Mahmudur Rahman, Political Science, Rajshahi University.
Co-Chair: Afruza Haque, Assistant Professor, Humanities and Social Sciences, Dhaka University of Engineering & Technology, Gazipur.
Invited Speaker: Prof. Dr. Md. Sirajul Islam, Department of Civil and Environmental Engineering, North South University.

Paper ID	Abstract Title and Authors
Invited Talk	**Mainstreaming government development projects towards sustainability: case study of climate change an disaster risk assessment**
ID- 092	**Fintech and Sustainability: The Economic Role of AI, Blockchain, and IoT in Business Innovation and Green Finance** Samiha Mamun[1]*, and Md. Rahat Khan[1]
ID- 412	**Unveiling the Path from Women's Entrepreneurial Intention to Women's Empowerment in Bangladesh: The Moderating Role of Family Support** Tanha Akter[1*], Most. Sadia Akter[1], Rasheda Akter Rupa[1], Md. Tashriful Islam[2]
ID- 098	**The Role of Microfinance in Reducing Income Inequality and Promoting Social Mobility** Samiha Mamun[1]*, and Dr. Most. Tahura Pervin[2]
ID- 291	**Decoding the Triple-Force Commitment of Accounting Educators in Curriculum Change: Bangladesh Perspective** Rehana Fowzia[1]
ID- 421	**Exploring factors driving Online Impulsive Buying Behavior: An S-O-R Approach with Green Trust as Mediator and Price Consideration as Moderator** Rasheda Akter Rupa[1], Afruza Haque[2]*, Most. Sadia Akter[1], Md. Faisal-E-Alam[3], Nahida Sultana[1]
ID- 341	**Evaluating Human-Environment Sustainability Barometer: Host–Tourist Perceptions in River-Based Communities of Rajshahi** Md Mainul Islam[1], Soumitro Kumar Das[2*], Md Ole Ullah[1], Md.Shojeb Rahman, Md. Mahfuz Islam Nayon, and Md. Riwon[1]

Technical Sessions for HSS

Day 2: 24th October, 2025

Parallel Session-1
Invited & Contributed Session: Humanities and Social Sciences
Theme: Economic and Public Policy for Sustainable Development
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11001
Time: 11.10 AM- 12.45 PM

Chair: Dr. Atikur Rahman Khan, Associate Professor, Management, North South University
Co-Chair: Dr. Mir Md. Fazle Rabbi, Assistant Professor, Humanities and Social Sciences, Dhaka University of Engineering & Technology, Gazipur.
Invited Speaker: Dr. Indrajit Ghosal, Associate Professor, Brainwire University West Bengal, India

Paper ID	Abstract Title and Authors
Invited Talk	TBA
ID- 263	**Role of Social Media and Mainstream Media During the July Uprising in Bangladesh: A Comparative Analysis** *Md. Hasan Al Azad[1], and Mohammad Kawsar Ahammed[2]
ID- 156	**Assessing Preparedness of Educational Institutions for Future Pandemics: Lessons from COVID-19** Farha Tanzin[1*]
ID- 88	**Socio-Economic And Environmental Determinants of Migration in The Haor Basin of Bangladesh: A Statistical Analysis** Amit Das[1] Anupoma Das Poly[2] Susmita Das[3]
ID- 251	**Spatio-Temporal Analysis of Meghna Riverbank Dynamics for Sustainable Policy in Bhola (1990–2035)** Muhammad Sajibul Islam[1], Md. Rashel Morshed[2], Jitu Mohajan [3]*
ID- 252	**A Cross-Sectional Analysis of Dietary Habitsand Lifestyle Factors Influencing Glycemic Controlin The Context of an Adherence Crisis Among Type 2 Diabetes Patientsin Rajshahi City** Tithy Saha[1] & Soumitro Kumar Das[2*]
ID- 372	**Google Classroom as an E-Portfolio to Enhance Receptive Language Skills: User Reflections at Tertiary Level in Bangladesh** Mir Md. Fazle Rabbi
ID- 386	**Self-Assessment as a Pedagogical Tool for Monitoring English Learning Progress and Learner Autonomy: Insights from Bangladeshi Engineering Students** Fatema Sultana and Mir Md. Fazle Rabbi

Parallel Session-2
Invited & Contributed Session: Humanities and Social Sciences
Theme: Communication Skills for ESP and Engineering Graduates
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11010
Time: 11.10 AM- 12.45 PM

Chair: Dr. Sanzida Rahman, Associate Professor, Humanities and Social Sciences, Dhaka University of Engineering & Technology, Gazipur.
Co-Chair: Nur Mohammad Khan, Assistant Professor, Humanities and Social Sciences, Dhaka University of Engineering & Technology, Gazipur.
Invited Speaker: Md. Masud-All-Kamal, Associate Professor, Sociology, University of Chittagong.

Paper ID	Abstract Title and Authors
Invited Talk	
ID- 489	**The Perceptions of the Bangladeshi Undergraduate Students of the Use of Grammarly in Enhancing English Writing Skills**

	Purbita Das
ID-96	**The Role of Krashen's Affective Filter Hypothesis in Attaining Sustainable SLA (Second Language Acquisition) Leading to Socioeconomic Development in the Tertiary Students in Bangladesh** Kishan Saha
ID-233	**Fostering Learner Autonomy through Integrated Language Learning Approaches** Samia Islam
ID-239	**The Status of English Language in CSE Classrooms: Challenges and Perspectives presented based on two sample universities- Bangladesh University & Canadian University of Bangladesh** Dr. Md. Nesar Uddin, Rezina Sultana
ID-523	**Graduate Employability and English Language Education: A Critical Examination of Tertiary Practices in Bangladesh** Dr. Sadia Afrin Shorna, Marzia Hossain Chaity
ID-397	**Remote Area Second Language Learners' Problems and Solutions in Listening Comprehension** Podile Ramanaiah
ID-499	**The Role of Age in Second Language Development: Insights from Tertiary Level Students of the English Department** Sultanul Arefin, Sheikh Md. Rokonul Islam

12:40 PM – 02:00 PM	**Prayer** **Venue: DUET Central Mosques** **Lunch Break** **Venue: 11th floor, Shaheed Sayed Nazrul Islam Academic Building, DUET, Gazipur.**

Parallel Session-3
Invited & Contributed Session: Humanities and Social Sciences
Theme: Driving Economic Sustainability
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11001
Time: 02.00 PM- 03.35 PM

Chair: Prof. Dr. Abdur Rahman Forhad, Professor, Humanities and Social Sciences, Dhaka University of Engineering & Technology, Gazipur.
Co-Chair: Md. Mamunur Rashid, Assistant Professor, Humanities and Social Sciences, Dhaka University of Engineering & Technology, Gazipur.
Invited Speaker: Prof. Dr. Mohammad Safiqul Islam, Economics, Jahangirnagar University.

Paper ID	Abstract Title and Authors
Invited Talk	
ID- 15	**AI's Role in Bangladesh's Economic Growth: A Comprehensive Sectoral and Policy Analysis** Nazmus Sakib Apurba[1] and Sadiya Afrin Reba[2]
ID- 101	**The Role of Microfinance in Reducing Income Inequality and Promoting Social Mobility** Rokaiya Jahan Banna[1*], Faiza Farha[1], Masum Billah[1], Afsana Mahmud[1], and Humayra Kabir[1]
ID- 144	**Energy-Efficient IoT Network for Smart Alternate Wetting and Drying (AWD) Irrigation in Sustainable Precision Rice Farming in Bangladesh** Md Zakir Hossen[1*], M.A. Rob[1], Fazlul Hasan Siddiqui[1], and Debjit Roy[2]
ID- 171	**Balancing Employment and Human Values in The Digital Age: The Challenges for Freelancers in Bangladesh's Professional and Social Life** Mohammad Kawsar Ahammed[1*], and Ziaul Hoque[2]
ID- 274	**Balancing Economic Growth and Environmental Sustainability in Bangladesh: A Data-Driven Analysis** Zeba Farzana[1*]

ID- 352	**Islamic Financial Literacy and Its Impact on Financial Well-Being among Bangladeshi Muslims** Mohammad Faizul Haque[1*], and Mamunur Rashid[1]
ID- 478	**The Role of Islamic Banking in Achieving Sustainable Development Goals (SDGs) in Bangladesh: An Empirical Insight** Mamunur Rashid[1*], Mohammad Faizul Haque[1], and Muhammad Salah Uddin[2]

Parallel Session-4
Invited & Contributed Session: Humanities and Social Sciences
Theme: Economic and Public Policy for Sustainable Development
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11010
Time: 02.00 PM- 03.35 PM

Chair: Prof. S M Monirul Hassan, Professor, Sociology, University of Chittagong,
Co-Chair: Md. Sawgat Khan, Assistant Professor, Humanities and Social Sciences, Dhaka University of Engineering & Technology, Gazipur.
Invited Speaker: Prof. Dr. A B M Nazmul Islam Khan, Sociology, University of Chittagong.

Paper ID	Abstract Title and Authors
Invited Talk	
ID- 022	**Religious Ethics and Economic Development: Revisiting Max Weber's Protestant Ethic and the Spirit of Capitalism** Taslima Mohsina Mimi1*
ID- 473	**Sustainable Livelihood Strategies for Local Communities: An Empirical Study in Coastal Sundarbans of Bangladesh** Maruf Ahmmed[1*], and Sadrul Alam Kanok[2]
ID- 496	**From Global Trade to Local Scars: Understanding Current Circumstances and Environmental Consequences of the Ship-Breaking Industry in Bangladesh.** Istiak Ahmed[1]
ID- 497	**Women in the Mosque: A Socio-Architectural Comparison between the Early Islamic Period and Contemporary Bangladesh.** Md. Sawgat Khan[1], and Nusrat Jahan Fariha[2*]
ID- 469	**Community Perceptions of Femicide in Bangladesh: A Sociological Analysis of Jobra Village** Bristy Rani Sarker
ID- 509	**Autism Awareness and Special Education in Bangladesh: Pathways to Social Integration** Rohana Afroz[1], and Md. Sawgat Khan[2*]
ID- 533	**"Invisible Citizens: Challenges and Solutions for Social Integration of Bihari Adolescents in Bangladesh"** Rubaia Tasneem[1*], Supravo Chowdhury Nipu[2]

3:35 PM - 4:00PM	**Tea/ Coffee Break** **Venue: 11th floor, Shaheed Sayed Nazrul Islam Academic Building, DUET, Gazipur.**

Parallel Session-5
Invited & Contributed Session: Humanities and Social Sciences
Theme: Language Education and Technology for Learner Autonomy
Day 2: Friday, October 24, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11001
Time: 04.00 PM- 05.35 PM

Chair: Prof. Dr. AKM Zakaia, Humanities and Social Sciences, Dhaka University of Engineering & Technology, Gazipur.
Co-Chair: Sheikh Md. Rokonul Islam, Assistant Professor, Humanities and Social Sciences, Dhaka University of Engineering & Technology, Gazipur.
Invited Speaker: Prof. Dr. Md. Maniruzzaman, English**,** Jahangirnagar University

Paper ID	Abstract Title and Authors
Invited Talk	**AI for Learning and Teaching EFL: Exploring Undergraduates' Perspectives**
ID-11	**Promoting Learner Autonomy among Students with Visual Impairments through Assistive Language Learning Technologies in Urban Bangladesh** Farheen Akter Bhuian
ID-30	**Employing ICT in English Language Clubs in Rural Regions to Bridge the Digital Divide and Promote a Sustainable Future** KakolyTalokder, Md Jashim Uddin Bhuiyan, Jakir Hossan
ID-182	**Exploring Tertiary Students' Perceptions Regarding the Use of AI Chatbots in the Development of Speaking Fluency** Jubaed Zauhar Nishat
ID-212	**The Impact of AI-Powered Autonomous English Language Learning on Student Motivation and Academic Performance in Tertiary Education** Naiem Al Amin
ID-305	**Are Teachers Ready to Turn the Tables? A Study Exploring Tertiary Level EFL Teachers' Perceptions and Readiness for Flipped Classrooms in the Context of Bangladesh** MD Nahid Hasan, and Khadija Akter Onee
ID- 319	**Blended Learning Approaches: Content-based Syllabus in ESL Classroom, Approaches and Techniques** S. M. Shawlin
ID-333	**Integrating Animated Lessons into Tertiary Level English Language Teaching: Teacher Agency and Sustainable Practices** Gazi Mohd Shakil Imtiaz Fahad

Parallel Session-6
Invited & Contributed Session: Humanities and Social Sciences
Theme: Economic and Public Policy for Sustainable Development
Day 2: Friday, 24 October, 2025
Venue: Shaheed Sayed Nazrul Islam Academic Building, Room-11010
Time: 04.00 PM- 05.35 PM

Chair: Md. Masud-All-Kamal, Associate Professor, Sociology, University of Chittagong.
Co-Chair: Md. Sawgat Khan, Assistant Professor, Humanities and Social Sciences, Dhaka University of Engineering & Technology, Gazipur.
Invited Speaker: Prof. S M Monirul Hassan, Sociology, University of Chittagong.

Paper ID	Abstract Title and Authors
Invited Talk	
ID- 408	**Migrants' experiences of vulnerability and coping in the context of Community-Based Disaster Risk Management: A study of urban slums in Chattogram** Rifat Hossen[1*]
ID- 515	**Technological Intervention and the Changing Norms of University Students: A Multidisciplinary Approach to Cultural Adaptation**

	Md. Sawgat Khan[1*], Rohana Afroz[2], Md. Rezaul Karim[3] , Md Mufijur Rahman[4], Arifur Hoque Rana[4] and Md Mainul Islam[5]
ID- 482	**Expansion of Cities: Analyzing Urban Expansion and Sustainability Challenges in Chattogram** Tanjiha Binte Kabir[1*]
ID- 461	**Unplanned Urbanization and Its Impact on City Life: An Empirical Study on Chattogram Metropolitan City** Afia Anzum[1*]
ID- 511	**How Architects Are Involved in Preventing Crime in a Community** **Md Habibur Rahman[1*], Md. Sawgat Khan[2], and Most Roksana Khatun[1]**
ID- 519	**Migration and the Informal Sector: Sustainability Challenges for Marginalized Groups in Chattogram City** Md Mozzammel Masum[1*]

Poster Sessions

Day 2: 24th October, 2025

Time: 03.00 PM- 05.30 PM

ID- 501	**Food and Society- The Social Dimensions of Eating Habits in Bangladesh** **Umma Habiba Kakuly[1*], Razia Sultana[1], Md.Naimur Rahman[1], Md.Saidur Rahman[1],** Md.Mominul Islam[1], Md. Sawgat Khan[2]
ID- 516	**Training Essential Business Skills to Homemakers** Abid Hossain[1]
ID- 534	**Effect of Social Media and Lifestyle – The Social Dimensions of Modern Living** Md Azmul Haque[1]*, Zubayer Islam[1], Sottojit[1], Sontos[1], Shubroto[1], Md Sawgat Khan[2]
ID- 465	**AI in Service Sector: Necessities and Effects** Sumaiya Jahan Nusrat[1], and Jerin Atiya Ibnat[1*]
ID- 492	**Sustainibility in Tradition: Vernacular Mud Archetecture Practice in Gazipur** Nusrat Jahan Fariha[1*], and Iqbal Hossen[2]

KEYNOTE PAPERS

Keynote-01

Machine Learning Meets Model Parameter Estimation Meets Level Sets with Applications to Imaging

Taufiquar R Khan[*1]
Professor and Chair, Department of Mathematics and Statistics, University of North Carolina (UNC) at Charlotte North Carolina, NC, USA
*Corresponding author: taufiquar.khan@charlotte.edu

ABSTRACT
This talk provides an overview of model parameter estimation problems in Electrical Impedance Tomography (EIT), a non-invasive imaging technique with applications in medical diagnostics, industrial process monitoring, and material characterization. We begin by discussing the severe illposedness inherent in EIT inverse problems and review regularization strategies including traditional deterministic methods, statis-tical approaches, and emerging machine learning techniques. We then present our recent work on developing a novel Markov Chain Monte Carlo (MCMC) algorithm that integrates deep learning architectures for im- proved image reconstruction. Our method leverages neural networks to learn proposal distributions and inform sampling strategies, significantly accelerating convergence while maintaining theoretical guarantees. Experimental results demonstrate the effectiveness of our approach through simulations and synthetic data, showing improved reconstruction quality and computational efficiency compared to conventional methods. This work bridges statistical inverse problems with modern machine learning, offering a promising direction for real-time EIT applications.

Keynote -02

Tsunami Wave Force Acting on Structures

Professor Susumu Araki
Department of Civil Engineering, The University of Osaka, Japan
*Corresponding author: araki@civil.eng.osaka-u.ac.jp

ABSTRACT
Tsunami can cause catastrophic damage to structures. 2004 Indian Ocean Tsunami and 2011 Great East Japan Earthquake and Tsunami washed away many buildings and infrastructures. The tsunamis also washed away many bridges near coastlines. Since damage to bridges can delay the rescue operation and the transportation of relief, major bridges need to be prevented from being washed away.
A series of hydraulic experiments were conducted in a two-dimensional wave flume to investigate the characteristics of tsunami wave force acting on a model bridge. A tsunami wave like a solitary wave was generated by piston-type wave maker installed at an end of the wave flume. The model bridges with the rectangular and the concave cross-sections were examined. For the model bridges with the concave cross-section, oscillatory pressure was measured, which resulted from the air compression at the concavities on the underside of the model bridge. The peak of the oscillatory pressure was much larger than the peak of the pressure acting on the model bridges with the rectangular cross-section. The occurrence of the oscillatory pressure mainly depends on whether the incident tsunami breaks or not in front of the model bridge.
Caution should be exercised regarding the oscillatory pressure caused by the air compression at the concavities of the underside of the bridge, although the scale effect about the air compression and the dynamic response of bridges to the oscillatory pressure needs to be investigated in detail. Therefore, it is important to consider whether incident wave breaks or not in front of bridges.

Keynote -03

Superconductivity in Metallic Hydrides: Prospects and Challenges

Saleh Hasan Naqib
Department of Physics, University of Rajshahi, Rajshahi 6205, Bangladesh
**Corresponding author: salehnaqib@yahoo.com*

ABSTRACT
High-Tc superconductivity above 200 K in a metallic hydride under very high hydrostatic pressure was reported in 2015 (Drozdov, A. P., et al. Conventional superconductivity at 203 K at high pressures, Nature 525, 73). This groundbreaking work was subsequently followed by many other experiments in which mixtures of hydrogen and other metal atoms were both compressed and heated, creating in situ chemical reactions to form metallic hydrides directly inside the pressure cells. These compounds were subsequently cooled to check for signs of superconductivity (zero resistivity and the Meissner effect). In fact, at present, the highest recorded superconducting transition temperature is found in metallic hydride systems. In this presentation, we discuss the essential characteristics of superconducting hydrides and the challenges ahead to overcome the high pressure barrier that hinders possible applications of these fascinating electronic systems.

Keynote -04

Multilayer Graphene Processing for Next-Generation Sustainable Electronics

Prof. Kazuyoshi Ueno
Semiconductor and Quantum Integrated Electronics Research Center
Yokohama National University (YNU), Japan
**Corresponding author:* ueno-kazuyoshi-tm@ynu.ac.jp

ABSTRACT
With the rapid advancement of artificial intelligence, the demand for high-performance computing continues to grow, driving improvements in processing power and the integration density of electronic circuits. This technological progress, however, comes with a significant increase in energy consumption, raising concerns about sustainability and the environmental impact of future electronic systems. To address these challenges, it is essential to develop devices that offer both high efficiency and low power consumption.
Graphene has attracted considerable attention as a next-generation conductive material due to its exceptional electrical properties, including high current density tolerance, low resistivity, and abundant availability. These characteristics make it a strong candidate for replacing conventional materials in various electronic applications. However, to realize its full potential, it is necessary to establish reliable techniques for the formation of high-quality crystalline multilayer graphene (MLG) films and for doping processes that further reduce resistance.
In this study, we present a novel MLG fabrication process optimized for scalability and integration into existing semiconductor fabrication. We explore its application in several domains, including electrodes for power and radio-frequency (RF) devices, as well as interconnects for large-scale integration (LSI). Our results demonstrate promising improvements in device performance, thermal stability, and reliability. Notably, the use of MLG has shown potential for enhancing the stability of GaN-based diodes operating at elevated temperatures, and for enabling the miniaturization of inductors and circuit wiring.
These findings suggest that graphene-based technologies could play a pivotal role in the next generation of energy-efficient electronics. This presentation will detail our fabrication methods, experimental results, and the broader implications for sustainable device fabrication.

Keynote -05

Development of Epoxy Composites Reinforced with Waste Natural Fibers and Their Environmental Behavior

Kazi Imtiaz Ahmed Nakib[a], Ridwanur Rahman[a], Israt Jahan Lithi[a], Mayesha Samiha Oishi[a], Md. Farhad Ali[a,c], Md. Sahadat Hossain[b*] and A. M. Sarwaruddin Chowdhury[a*,+]

[a]*Department of Applied Chemistry and Chemical Engineering, Faculty of Engineering and Technology, University of Dhaka, Dhaka, 1000, Bangladesh*

[b]*Glass Research Division, Institute of Glass & Ceramic Research and Testing, Bangladesh Council of Scientific and Industrial Research (BCSIR)*

[c]*Institute of Leather Engineering and Technology, University of Dhaka, Dhaka, 1000, Bangladesh*

**Corresponding author:* vc@sust.edu

ABSTRACT

In this research, composites were produced by reinforcing epoxy resin with waste natural fibers—human hair (HH), duck feathers (DF), and chicken feathers (CF)—collected from discarded sources to repurpose them as valuable reinforcements. The composites were evaluated for fire retardancy, tensile strength, tensile modulus, and environmental effects in water (including pH variations), oil, and ethanol. Environmental interactions were also studied. Composites with DF and HH showed lower moisture absorption due to their hydrophobic nature, while CF composites absorbed more water because of their hydrophilic amino acid content. The epoxy resins dense, cross-linked network was confirmed by the low oil absorption across all composites, with 1% CF composite showing the highest oil uptake. Acidic solutions caused degradation followed by swelling, with 1% DF composites exhibiting the greatest degradation and CF composites showing maximum swelling under acidic conditions. HH composites swelled least at low pH. Basic environments caused degradation without swelling; 1% CF composites experienced the most degradation, whereas HH composites showed minimal deterioration. Ethanol uptake was highest in 0.5% CF composites and lowest in HH composites. HH composites demonstrated the best fire retardancy. Thermal analysis (TGA) indicated stable performance up to 350 °C. The highest tensile strength recorded was 77.33 MPa for 1.5% CF epoxy composites, and the highest tensile modulus was 1047.42 MPa for 0.5% CF composites. This valorization of waste fibers offers a promising route to creating materials with strong physical properties while enhancing mechanical performance and biodegradability, thereby reducing the environmental impact of polymer composites.

Keynote -06

Structurally Ordered Multi-Metal Oxides for Electrochemical Energy Conversion

Dr. Farshid Ramezanipour
Associate Professor
Department of Chemistry, University of Louisville, KY 40292, USA
**Corresponding author: farshid.ramezanipour@louisville.edu*

ABSTRACT

Functional properties of materials are largely dependent on their structures. Hence, controlling the structural order in the material network is an effective tool for rational design of compounds for energy conversion and storage. We have investigated the fundamental structure-property relationships in a large number of multi-metal oxides, with various structures ranging from 3D to quasi-2D and quasi-1D. We have shown that it is possible to modify the structural order to enhance several important properties, including charge transport, ionic conductivity, magnetism, and electrocatalytic hydrogen generation. Through these investigations, we have demonstrated some of the first examples of achieving very high electrocatalytic activity for water-splitting by rational design of structurally ordered oxide materials. In addition, the correlations between electrocatalytic and charge transport properties have been shown. Furthermore, proof of concept studies indicates several methods of enhancing the ionic conductivity in layered oxides. These studies underline the importance of structural features of materials, and the effectiveness of material design approaches that rely on structure-property relationships in energy research.

Keynote -07

The AI and Digitalization Era: A Boon or A Bane for Philosophically Sustainable Employment and Education in Emerging Nation

Gazi Mahabubul Alam
School of Education, Taylor's University, 1, Jln Taylors, 47500 Subang Jaya, Selangor
**Corresponding author: farshid.ramezanipour@louisville.edu*

ABSTRACT
Whether education serves as an independent variable and thereby, through its innovation, the digitalisation and AI (artificial intelligence) have taken place, or the digitalisation and AI are the social product of the 21st century, supports the development and progress of education—an unsettled debate. The link between AI, digitalisation, and education is still unclear in this environment. Therefore, some believed that they have a mutually beneficial relationship, others decided that they are interdependent, and the other individuals proposed that education should ideally act as a regulator of AI and digitalisation.

Given the West dominates over the East by creating a "dependency theory" with a usage of its sophisticated education, this region may have been the original home of digitalisation and AI, which was first fostered by research and higher education. As a result of their development, society has started to gain from digitalisation and artificial intelligence. This kind of procedure might have established a unique relationship between education, digitalisation, and AI that could now complement and improve each other without permitting major digital discrimination and AI in the classroom.

As consumers of digitalisation and artificial intelligence, developing countries might not experience the same "myths and promises" as their developed counterparts. Through the use of "dependence theory," which has recently been created, digitalisation and artificial intelligence have been introduced to the Eastern world. This may allow the local elites to steal the best practices under the pretence of digitalisation and AI, and education is no exception. In light of this, the discussion will examine whether digitisation in education is beneficial or detrimental to developing countries.

Keynote -08

Enriching Engineering Students' Personality, Employability, and Global Consciousness through Language and Communication Skills

Prof. Vibha Sharma
Department of English
Aligarh Muslim University, India
**Corresponding author:* vibhasharma.en@amu.ac.in

ABSTRACT
"The limits of my language mean the limits of my world." — Ludwig Wittgenstein
In a rapidly globalizing and environmentally fragile world, engineers are expected not only to master technical expertise but also to cultivate critical thinking, ethical judgment, and effective communication. This keynote address explores how engagement with language, through reading, writing, and oral expression, can enrich the personality, professional readiness, and global consciousness of engineering students. Beyond fostering clarity, confidence, and interpersonal skills, language can serve as a medium for cultivating ecological awareness, sustainability ethics, and socially responsible decision-making.

The lecture aims to highlight innovative strategies for skill development: structured group discussions, technical and non-technical presentations, debates, reflective writing, collaborative projects, and active participation in digital and cross-cultural communication platforms. Integrating sustainability-oriented content, such as environmental discourse, climate communication, and eco-literature, allows students to connect linguistic proficiency with responsible global citizenship. Peer-to-peer learning, feedback-driven improvement, and interdisciplinary approaches further enhance leadership potential, adaptability, and ethical reasoning.

By nurturing articulate, persuasive, and culturally sensitive engineers, this approach equips students not only to navigate complex, multicultural workplaces but also to engage thoughtfully with pressing environmental and societal challenges. Language, therefore, becomes both a tool for personal and professional growth and a bridge to sustainable and humane technological innovation.

MATHEMATICS

Invited Papers

Invited-01

Effects Of Shock-Shear Layer Interaction on the Mixing of a Sonic Hydrogen Jet in Supersonic Airflow

Sarfaraz Aziz[1,2] and Mohammad Ali[1*]
[1]Department of Mechanical Engineering, Bangladesh University of Engineering and Technology, Dhaka-1000
[2]Department of Mechanical Engineering, International University of Business Agriculture and Technology, Dhaka-1230
[*]Corresponding email: mali@me.buet.ac.bd

ABSTRACT
The shock–shear layer interaction due to geometric configuration of the combustion chamber critically influences fuel–air mixing in high-speed air-breathing propulsion systems. This study numerically investigates the effects of combustor geometry and shock–shear layer interaction on the mixing characteristics of a sonic hydrogen jet injected transversely into a supersonic airflow. Two rectangular combustor configurations are analyzed through Computational Fluid Dynamics (CFD) simulations: one without a cavity and another featuring a trapezoidal cavity located on the combustor wall. Both configurations incorporate a backward-facing step at the inlet, with the injector mounted 30 mm downstream of the combustor entrance. In the cavity-based combustor, the cavity is located 10 mm downstream of the injector. Gaseous hydrogen is injected at pressure ratios of 4.5, 9.0, 13.5, and 18.0 relative to the free-stream pressure. The results reveal complex shock structures in both combustor configurations, as well as the formation of a shear layer over the cavity region. As the fuel injection pressure increases, the resulting bow shock moves upstream and impinges on the cavity shear layer, intensifying shear-layer instabilities and enhancing vortex-driven mixing. The presence of the cavity promotes recirculation zones that trap and re-entrain the injected fuel, thereby improving fuel–air mixing efficiency. Quantitatively, due to the shock–shear layer interaction and the strong recirculation zones formed, a maximum of 45% fuel-air mixing is obtained for the pressure ratio of 4.5 in the cavity-configured combustor, which is 4% higher than that of the combustor without a cavity among the cases considered.

Invited-02

Application of Advanced Machine Learning and Statistical Approaches for Optimization of Convective Heat Transfer of Nanofluid Flow in a Porous Medium

Md. Shariful Alam
Department of Mathematics, Jagannath University, Dhaka-1100
**Corresponding author: dralamjnu@gmail.com*

ABSTRACT
The present study explores the optimization of convective heat transfer of nanofluid flow in a porous medium within a cavity under the influence of inclined periodic magnetic field by applying machine learning and statistical approaches. Numerical simulations using the Galerkin weighted residual-based finite-element method are conducted to solve the governing Navier-Stokes equations. At the same time, artificial neural network (ANN) and response surface methodology (RSM) are employed to optimize thermal performance by maximizing the average Nusselt number, the key indicator of thermal transport efficiency. Utilizing the numerical obtained results, both the ANN and RSM models were trained and their performance evaluated. The results indicated that both models are dependable for this investigation, exhibiting a notably high coefficient of determination for the performance control variable, the average Nusselt number. In addition, the error in response surface methodology was more than ANN at the optimum conditions. Therefore, machine learning based-artificial neural network method is more capable than statistical based response surface methodology for prediction of heat transfer rate in comparison with numerical data for nanofluid flow in a porous medium.

Invited -03

Low-rank Gramian approximation of periodic unstable system using Laguerre function approximation and application in model order reduction

Mohammad Sahadet Hossain*[,1], Atia Afroz[1], Oshin Mumtaha[2]
[1]Department of Mathematics and Physics, North South University, Dhaka, Bangladesh.
[2]Department of Electrical and Computer Engineering, North South University, Dhaka, Bangladesh.
*Corresponding author: mohammad.hossain@northsouth.edu

ABSTRACT
Many RF circuits are represented as LTP systems because they show periodic behavior. Time-varying capacitance and conductance matrices are produced by linearizing around massive signal excitations. These systems can be effectively reduced using the proposed Laguerre-based model order reduction (MOR) technique after being discretized over a single period to large equivalent LTI systems.
In this research we propose the Laguerre function-based MOR technique for generalized linear time-periodic (LTP) unstable systems arise form a RF circuit simulator with periodic coefficients. The MOR algorithm approximates the energy functions by the Laguerre function expansion of the system's state impulse response. The proposed algorithm is based on the iterative computation of the energy functions from a set of linear matrix equations. The low-rank computation of those coefficients and the projection matrix are also presented in this paper. Ultimately, numerical results and simulations from real life RF circuits are presented to show how successful the suggested approach.

Invited -04

HIV Suppression in North America: Intervention Plans and Cost-Effectiveness of UNAIDS 90-90-90 and 95-95-95 Targets

Md Kamrujjaman
Department of Mathematics, University of Dhaka, Dhaka 1000, Bangladesh
**Corresponding author: kamrujjaman@du.ac.bd*

ABSTRACT
This study utilizes mathematical models to assess progress toward achieving the UNAIDS 90-90-90 and 95-95-95 targets aimed at managing and eradicating HIV/AIDS. Predictive models assume fixed parameters and predictable outcomes, while stochastic models incorporate random variability to reflect real-world uncertainty. It contrasts stochastic and deterministic models, focusing on their utility in optimizing public health interventions such as testing programs, awareness campaigns, and antiretroviral therapy (ART) delivery systems. Stochastic models account for real-world unpredictability, offering more realistic insights compared to deterministic approaches. The 95-95-95 targets aim for 95% of people living with HIV to know their status, 95% of those diagnosed to receive ART, and 95% of those on ART to achieve viral suppression. These benchmarks are critical for reducing transmission and improving health outcomes. This analysis establishes the basic reproduction number (R0) to guide interventions and examines the stability of disease-free and endemic equilibria, providing a foundation for applying optimal control strategies to minimize HIV prevalence effectively and cost-efficiently. Moreover, the data for this study was sourced from the official UNAIDS website, focusing on North America. An innovative feature of this study is the application of the Stochastic method, which enhances model accuracy and operational efficiency in simulating HIV transmission under various interventions. This research offers actionable insights for policymakers and contributes to global efforts to achieve the 95-95-95 targets by 2030, advancing the fight against HIV/AIDS.

Invited -05

Unveiling the Shape of Big Data: Persistent Homology in Topological Data Analysis

Professor Dr. Nasima Akhter
Department of Mathematics, University of Rajshahi
**Corresponding author: nasima.math@ru.ac.bd*

ABSTRACT
This paper explores how the tools of algebraic topology, particularly persistent homology, can be harnessed for the analysis of large, noisy, and high-dimensional datasets. We begin by introducing simplices, simplicial complexes, and the algebraic construction of homology. We then describe persistent homology, filtrations, barcodes, and stability. The advantages of persistent homology over classical geometric or statistical tools are discussed, and its successful applications in diverse areas such as image analysis, biological networks, and material science are highlighted

Invited -06

Differential Approximants and its application to Fluid Dynamics

Dr. Md. Abdul Hakim Khan
Professor, Department of Mathematics
Bangladesh University of Engineering & Technology
**Corresponding author: mahkhan@math.buet.ac.bd*

ABSTRACT

Differential approximant is a powerful tool for summing power series. The method is a special type of Pade'–Hermite approximant. It consists of a High-order linear differential equation with polynomial coefficients that is satisfied approximately by the partial sum of the power series. This method is able to reproduce the polylogarithmic functions exactly. Numerical evidence suggests that this is currently one of the best methods of singularity analysis for many problems in Fluid Dynamics.

Invited -07

Exploring H_2 Enrichment as An Innovative Strategy for Reducing Greenhouse Gas Emissions in Hydrocarbon–Air Counterflow Diffusion Flames

Akter Hossain[1*], Mohammad Abdur Rahman[2], and Shardar Firoz Ahmmed[3]
[1]Department of Mathematics, Pirojpur Science and Technology University, Pirojpur-8500, Bangladesh
[2]Department of Mathematics, National University, Gazipur-1704, Dhaka, Bangladesh
[3]Mathematics Discipline, Khulna University, Khulna- 9208, Bangladesh
**Corresponding author:* dahossain.tu@gmail.com

ABSTRACT

The combustion of hydrocarbons in devices like internal combustion engines produces a significant amount of greenhouse gas emissions, primarily carbon dioxide (CO_2). This process contributes to global warming and negatively affects ecosystems. Therefore, minimizing CO_2 and other pollutants are crucial for mitigating climate change and promoting a sustainable environment. This study investigates potential strategies for reducing CO_2 emissions in hydrocarbon-air diffusion flames by blending hydrogen (H_2), argon (Ar), and nitrogen (N_2) into the fuel stream. This study employs numerical simulations to explore effective strategies for reducing CO2 emissions. We used the OPPDIF program, which solves the one-dimensional (1D) steady-state governing equations for mass, momentum, energy, chemical species transport, nd the equation of state. The simulations were based on a detailed chemical reaction scheme involving 350 elementary reaction steps and 53 chemical species.

To ensure a controlled study, we kept boundary conditions constant: a temperature of 300 K and a loading velocity of 25 m/s at both the fuel and oxidizer ports. The only variable was the mole fraction of H_2, Ar, and N_2 blended with the hydrocarbon fuel. This approach allowed us to isolate and identify the most effective blending component for reducing CO_2 and its precursors. Our numerical results show that increasing the hydrogen mole fraction significantly alters the thermal and chemical structures of the diffusion flames. This leads to a notable increase in radical pools (O, H, and OH) due to the promotion of crucial chain-branching reactions: $O + H_2 \rightarrow OH + H$ and $H + O_2 \rightarrow OH + O$. In contrast, these specific reactions and radical pools were not promoted when Ar and N_2 were blended with the hydrocarbon fuel. This observation suggests that H_2 enrichment is a promising strategy, as it effectively increases the accumulation of radicals in the flame zone. This, in turn, promotes a vital chemical pathway: $CO + OH \rightarrow CO2 + H$, ultimately reducing carbon monoxide (CO), a precursor to CO_2, and subsequently reducing CO2 in the combustion system. However, further investigation is necessary using a three-dimensional (3D) geometry and more practical operating conditions, as typically found in engine systems, to fully validate the hypothesis that hydrogen (H_2) enrichment is a viable solution for reducing CO_2 emissions from hydrocarbon combustion systems.

Invited -08

Subdivision Surface Schemes for Precision Surface Modeling in CAD, Animation, and Industrial Design

Professor Dr. Md. Nur Alam
Department of Mathematics, Pabna University of Science & Technology, Pabna-6600, Bangladesh.
**Corresponding author:* nuralam.pstu23@gmail.com ; nuralam23@pust.ac.bd

ABSTRACT
Subdivision surface schemes are frequently employed in computer graphics, computer-aided geometric design (CAGD), animation, industrial design, and scientific visualization, like in the shipbuilding, automobile, and aerospace sectors, for creating smooth surfaces from polygonal meshes. Despite the widespread usage of the subdivision surface scheme, prior studies have shown that uniform subdivision does not necessarily result in the best surface quality, particularly when complicated geometric constraints are present. This work focuses on producing high-quality limit surfaces using a subdivision surface scheme to bridge this gap and enhance precision surface modelling in industrial designs. The free-form surface modelling scheme is implemented; the current subdivision curve and surface conditions are examined, and numerical trials are conducted to evaluate their performance. The findings demonstrate that the subdivision scheme produces visually smooth surfaces suitable for interactive computer animation, CAGD, and industrial modelling, but smoothness and accuracy can still be enhanced. The findings show that this approach can be extended to non-uniform schemes, offering better surfaces for complex applications in geometric design, computer animation, and scientific visualisation. Both academics and the industry benefit from this research since it offers more details about subdivision surface modelling and links theoretical knowledge with practical design requirements.

Invited -09

Modeling for Optimal Management of Natural Resources Towards Achieving the Sustainable Development Goals

Md. Haider Ali Biswas
Mathematics Discipline, Khulna University, Khulna-9208, Bangladesh
**Corresponding author:* mhabiswas@yahoo.com

ABSTRACT
Global warming is rapidly increasing the temperature of seawater and introducing acidification that adversely affects marine ecosystems. Consequently, temperature-sensitive fishery resources are under great threat. Thus, the devastating aftermath of climate change due to global warming is rather a reality, no more a prediction. If the current situation continues, global marine ecosystems could turn into an ecological desert by the end of the century. From this view point, it is of great concern and environmental challenges today to preserve, conserve and manage the renewable natural resources, especially in the marine and coastal areas for the sustainable development in Bangladesh as well as in global perspectives. So, it is burning issue to find out an optimal and efficient management of our ecosystems for sustainable environment. Mathematical model of nonlinear dynamical systems may play crucial role to appropriately design such ecological model and obtain better control strategy for a sustainable future. In this talk, we discuss a nonlinear dynamic mathematical model to illustrate the adverse effects of global warming and rapid concentrations of greenhouse gas (GHG) on marine ecosystems. We develop an optimal control model adopting coastal forestation and plankton nutrients as two control techniques, where coastal forestation can be adopted to lessen the concentration GHGs by absorbing carbon dioxide through photosynthesis, whereas plankton nutrients can be applied to improve planktonic diversity that can provide more food to marine fishes. We analyze the model applying the optimal control technique in the form of maximum principle to efficiently manage our marine ecosystems. This study establishes a mathematical relationship between the environment and marine ecosystems that could contribute to environmental and fisheries management. We investigate the model simulated numerically and the simulation results are well illustrated to justify the theoretical findings. The results show that the proposed model could be more effective if both control strategies are applied.

Invited -10

Physical Significance of Fractional Derivative: An Interpretation Based on the Beta Derivative

M. Ali Akbar
Department of Applied Mathematics, University of Rajshahi, Bangladesh
**Corresponding author:* ali.akbar@ru.ac.bd

ABSTRACT
Fractional derivative is the generalization of the classical concept of differentiation to non-integer order. Unlike classical derivative, which describe instantaneous rates of change, fractional derivatives describe more intricate dynamics by including non-locality, memory, and hereditary effects. These properties make fractional derivative a powerful tool for modeling real-world processes in physics, engineering, biology, and finance, where system behaviors depend on present states as well as on past histories. However, fractional derivatives encounter notable challenges. The fractional derivatives often lack straightforward geometric or physical interpretations, such as a 0.5-order derivative (or any non-integer order), which does not have a simple geometric interpretation. On the other hand, different fractional derivatives give slightly different results, and it is not always clear which fractional operator is better for the specific physical problems. Therefore, the objective of this study is to provide an explicit interpretation of the physical meaning of the fractional derivative in the sense of the beta derivative.

Invited -11

Living with Disaster: A Real-Life Problem

Ashabul Hoque
Professor, Department of Mathematics, University of Rajshahi
**Corresponding author:* mahoque@ru.ac.bd

ABSTRACT
Worldwide, coastal and estuarine zones have been facing an increasing frequency and variety of disasters caused by extreme events (e.g. cyclones, storm surges, floods), which have several direct and indirect causes as well as effects. The Southern part of Bangladesh is one of the big coastal marginal zones of the Bay of Bengal, where storm surges are a widespread phenomenon with fatal consequences.
Observations on the 2007 Sidr showed that coastal forest vegetation could reduce the impacts of a storm surge or a tsunami in two ways: (i) the well-known wave attenuation and (ii) the protection of coastal areas from storm damage by stabilizing coastal sediments. Based on these phenomena, Hoque et al. (2018) showed that the dissipation coefficient increases with increasing forest width and is strongly related to the transmission coefficient as the contribution of the forest itself to wave reflection is negligibly small. The wave energy dissipation through the mangrove forest is also investigated theoretically, and the experimental results agree well with them. The information might be helpful for better coastal management and climate resilience strategies in vulnerable coastal regions.

Invited -12

Energy Dissipative Particle Dynamics Modelling on Natural Hybrid Convection Heat Transfer in a Differentially Heated Enclosure

M. Ferdows
Research Group of Fluid Flow Modelling and Simulation, Department of Applied Mathematics, University of Dhaka, Dhaka-1000, Bangladesh.
**Corresponding author:* ferdows@du.ac.bd

ABSTRACT
Motivated by materials processing and hybrid fuel cell applications, in the current paper a numerical energy Dissipative Particle Dynamics (eDPD) method is deployed to simulate natural convection heat transfer in a differentially heated enclosure filled with different hybrid nanofluids separately: Ag(50%)-ZnO(50%) + H_2O, TiO_2(50%) -SiO_2(50%) + H_2O(50%) -EG(50%), and SiC(50%) -CuO(50%) /C nanocomposite(50%) + EG. Validation with previous experimental and numerical (finite volume method) studies from the literature is included. Deep feedforward neural networks (DFNNs) are additionally deployed to optimize Nusselt number (dimensionless wall heat transfer rate) values for hybrid nanoparticle concentrations. This study shows that using both eDPD simulations and machine learning can help improve and predict more effectively transport characteristics of hybrid nanofluids in enclosure flows of relevance to materials processing and fuel cell systems.

Invited -13

A Multi-Stage Capacity Expansion Stochastic Model for Power Generation

Mohammad Babul Hasan
Professor, Department of Mathematics, University of Dhaka Dhaka-1000, Bangladesh
**Corresponding author:* babulhasan.math@du.ac.bd

ABSTRACT
Bangladesh's rapid electricity demand growth calls for resilient and cost-effective power expansion planning. This thesis develops a multi-stage stochastic programming model that jointly optimizes generation, transmission, and sub-transmission investments under uncertainties in demand, fuel prices, and renewable output. Renewable capacity factors are generated using Monte Carlo simulation, with scenarios structured into a multi-stage decision tree. Compared with a conventional two-stage model, the proposed approach reduces expected costs by approximately 30%, increases the renewable energy share to nearly 40%, and significantly mitigates load shedding. Sensitivity analyses highlight sub-transmission upgrades and renewable incentives as critical levers. The framework provides planners with a practical and adaptive tool for designing sustainable and flexible power system expansion strategies.

Invited -14

Optimization Model in Supply Chain Coordination, Traffic Flow and Epidemic Control

Dr. Mohammed Forhad Uddin
Professor and Head, Dept. of Mathematics, BUET
**Corresponding author:* forhad@math.burt.ac.bd

ABSTRACT
Bangladesh's rapid electricity demand growth calls for resilient and cost-effective power expansion planning. This thesis develops a multi-stage stochastic programming model that jointly optimizes generation, transmission, and sub-transmission investments under uncertainties in demand, fuel prices, and renewable output. Renewable capacity factors are generated using Monte Carlo simulation, with scenarios structured into a multi-stage decision tree. Compared with a conventional two-stage model, the proposed approach reduces expected costs by approximately 30%, increases the renewable energy share to nearly 40%, and significantly mitigates load shedding. Sensitivity analyses highlight sub-transmission upgrades and renewable incentives as critical levers. The framework provides planners with a practical and adaptive tool for designing sustainable and flexible power system expansion strategies.

Invited -15

Model-Aided Understanding of Oncolytic Virotherapy in Cancer Treatment

M. Humayun Kabir
Mathematical and Computational Biology (MCB) Group, Department of Mathematics,
Jahangirnagar University, Savar, Dhaka 1342, Bangladesh
**Corresponding author:* hkabirju@juniv.edu

ABSTRACT
Cancer is a significant public health concern and one of the most common causes of death in the world, irrespective of gender. Cancer cells have the ability to divide uncontrollably, resulting in the formation of tumors that invade surrounding tissues and can metastasize, spreading to other parts of the body. Cancer can be cured if it is detected early and has undergone a sustainable, effective treatment protocol. There are several protocols of cancer treatment varying with cancer types and their stages as well, for instance, surgery with chemotherapy, radiation therapy, immunotherapy, targeted cell therapy, hormone therapy, etc. Virotherapy is a popular therapeutic approach for cancer treatment that targets cancer cells and kills them using a specific virus, without damaging healthy cells. A promising treatment approach for cancer is oncolytic virotherapy, which utilizes a virus to infect and kill cancer cells. The interaction among the tumor, the replicating virus population, and the antiviral immune response is not straightforward. Model-aided understanding can be a valuable technique for describing such an interaction. To understand the reciprocity among the immune system, the tumor, and the virus, we propose a reaction-diffusion system that considers three state variables: uninfected cells, infected cells by a virus, and a virus-specific cytotoxic T lymphocyte (CTL) response. In this talk, we focus on the spatiotemporal dynamics of the proposed reaction-diffusion system from analytical and numerical viewpoints. The efficacy of oncolytic virotherapy is assessed in relation to stimulation by infected cells and the effects of immunosuppressive medications. Furthermore, numerical results provide valuable insights into the role of oncolytic virotherapy in cancer treatment. The outcome of this research is expected to provide a deeper understanding of the effectiveness of oncolytic virotherapy in various oncological contexts.

Invited -16

Predicting Stunting Among Under-Five Children in Bangladesh Using Machine Learning Techniques

Papia Sultana
Professor, Department of Statistics
University of Rajshahi, Rajshahi-6205, Bangladesh
**Corresponding author:* papia.stat@gmail.com

ABSTRACT

Childhood malnutrition, particularly stunting, remains a major public health concern in Bangladesh. This study aims to predict stunting and identify the most influential socio-demographic risk factors among under-five children in Bangladesh using machine learning models. This study is conducted by using the dataset of 4,053 under-five children from the 2022 Bangladesh Demographic and Health Survey (BDHS). Descriptive analysis and chi-square tests are performed and applies eight ML algorithms such as Logistic Regression, Random Forest, Support Vector Machine, Gradient Boosting, Extreme Gradient Boosting, AdaBoost, LogitBoost, and Neural Network. Four feature selection techniques e.g., Regularized Random Forest (RRF), LASSO, Information Gain, and Relief are used to identify key predictors to predict stunting.

Descriptive statistics and chi-square tests reveal significant associations between stunting and variables such as child's age, region, parental education, wealth index, and maternal BMI. Among the models, LogitBoost demonstrate the best performance with the highest accuracy (0.780) and F1-score (0.875), and the lowest false discovery rate (0.214). Feature importance analyses consistently highlight wealth index, father's and mother's education, mother's BMI, and child's age as the most influential predictors of stunting. These results confirm that socioeconomic and demographic factors play a crucial role in childhood malnutrition. The findings emphasize the potential of ML-based approaches, particularly LogitBoost, in early identification of at-risk children and in supporting targeted public health interventions. This data-driven approach can enhance evidence-based decision-making for reducing stunting and improving child health outcomes in Bangladesh.

Invited -17

From Fish Swimming to Underwater Robots: Emerging Frontiers

Md. Mahbub Alam
School of Robotics and Advanced Manufacturing
Harbin Institute of Technology (Shenzhen), Shenzhen 518055, China
**Corresponding author:* alam@hit.edu.cn

ABSTRACT

For hundreds of millions of years, adaptation and evolution have enabled fish to achieve excellent propulsion performance with their fast speed and high efficiency. During this long history of evolution, swimming animals have mastered an exquisite capacity to control their bodies and the flow around themselves to efficiently cruise in water. Researchers admire the swimming skills of aquatic animals and hope to have a similar capacity, conscientiously considering swimming performance to be scientific and explained in light of fluid dynamics. Generally, natural swimmers share two major propulsive strategies, including caudal-fin pitching propulsion (e.g. salmon, tuna, dolphins, and sharks) and travelling wave propulsion (e.g. eels and lampreys). A question arises, is the motion of the caudal fin symmetric about the propulsion axis when a fish swims? We therefore first conducted experiments on fish to understand the motion of the caudal fin. The motion is then numerically examined for a hydrofoil. We home in on the insight into the fluid-structure interaction involved and the relationship between the kinematics and thrust or efficiency. This lecture encompasses (i) experiments on fish, (ii) enhancement of both thrust and efficiency using the experimentally obtained motion, (iii) understanding of fluid-structure interaction, and (iv) the hydrodynamic performance of a traveling wavy foil with varying foil kinematics (Strouhal number), fluid properties (Reynolds number), and foil deforming characteristics (wavelength). The results show that the caudal fin motion is asymmetric with the retract stroke being faster than the forward stroke. The pitching motion with the faster retract strokes enhances both thrust and efficiency, and the propulsive force increases with increasing Strouhal number, Reynolds number, and wavelength. A decreasing wavelength leads to a smaller thrust. A slender tail or a slender swimming body cannot have a large traveling wavelength as a large added mass makes the tail or body heavier. A shorter wavelength makes thrust steadier while a longer wavelength enhances maximum instantaneous thrust. The latter is beneficial for prey to escape from a predator.

Invited -18

Application of Machine Vision Technology for Applied Engineering and Science

Wahyu Caesarendra
Department of Mechanical and Mechatronics Engineering
Faculty of Engineering and Science, Curtin University, Malaysia
**Corresponding author:* w.caesarendra@curtin.edu.my

ABSTRACT
Recently, machine vision and computer vision technology is developing tremendously. This technology has been applied in various sectors to facilitate rapid decision-making. In this presentation, we will discuss some applications of machine vision technology in engineering and science. The applications include mechanical and manufacturing engineering, for example, to detect the edge condition of the aluminum block and post-process welding. The presentation will also discuss the components to build the machine vision technology that comprises of software development and hardware implementation.

Invited -19

Gas Transport Mechanisms in the Respiratory Bronchioles: The Interplay of Axial Heterogeneity and Irreversible Flow

Mahtab U. Ahmmed
Department of Mathematics, Jahangirnagar University, Dhaka-1342, Bangladesh,
**Corresponding author:* mahtab_ahmmed@juniv.edu

ABSTRACT
Efficient gas transport in the respiratory bronchioles arises from a complex interplay between convective and diffusive mechanisms, influenced by the structural and flow-related heterogeneities of the distal airways. This study investigates the combined effects of axial heterogeneity such as variations in airway geometry and local flow resistance and irreversible flow phenomena, such as recirculation and convective mixing, on gas exchange dynamics within the terminal bronchiolar region. A compliance-resistance coupled boundary condition was employed in CFD simulation to validate the results with PIV results in real scale measurements.
Results reveal that the longitudinal distribution due to velocity and pressure gradients augment convective dispersion. Moreover, irreversible flow patterns are found during the transition between inspiration and expiration due to bifurcated airways resistance. The air trajectory for homogeneous and inhomogeneous compliances is taken for high frequency oscillatory ventilation (HFOV) condition to demonstrate the findings of this work.
These findings suggest that physiological heterogeneity in the respiratory bronchioles is not merely a structural irregularity but an essential feature promoting efficient ventilation at the acinar level. The study provides new insights into the fundamental mechanisms governing distal gas exchange and offers a mechanistic basis for interpreting alterations in gas transport observed in pathological conditions such as chronic obstructive pulmonary disease (COPD) and bronchiolar remodeling.

Contributed Papers

Computational Fluid Dynamics

Paper ID: ICSHSD-18

Traffic Dynamics: A Fluid Mechanical Perspective Using Mass and Momentum Equations

Bitu Joydhar[1*], MD Rasel Ahmed[2], and Dr. Md. Laek Sazzad Andallah[3]
[1]Lecturer, Department of Mathematical and Physical Sciences, East West University, Dhaka-1212, Bangladesh
[2]Lecturer, Department of Mathematics, Uttara University, Dhaka-1230, Bangladesh
[3]Professor, Department of Mathematics, Jahangirnagar University, Dhaka-1342, Bangladesh
[*]*Corresponding email: bitujoydhar@gmail.com.*

ABSTRACT

This study explores the application of mass and momentum conservation equations- Payne- Whitham traffic flow model-to simulate vehicular traffic behavior. By treating traffic as a continuum, we derive this model that captures key phenomena such as congestion waves, flow- density relationships. For the pressure term of the Payne-Whitham traffic flow model we consider a linear relationship between pressure and density. We perform numerical solutions using the finite difference method (Lax-Friedrich & Lax-Wendroff Scheme) for the simulation of the Payne- Whitham traffic flow model. We also show the Von Neumann Stability Analysis for these numerical schemes and the convergency of these numerical schemes. The results highlight the utility of fluid mechanical analogies in traffic engineering, offering insights for improved traffic management and infrastructure planning.

Paper ID: ICSHSD-44

Optimization of Heat Transfer of Cu-H_2O Nanofluid inside a Hexagonal Cavity using Response Surface Methodology and Artificial Neural Network

Tasnim Rahman Mim[1]* and Md. Shariful Alam[1]
[1]Department of Mathematics, Jagannath University, Dhaka-1100, Bangladesh
**Corresponding author: tasnimrahman2933@gmail.com*

ABSTRACT

This study presents a comparative analysis of response surface methodology (RSM) and artificial neural networks (ANN) for optimizing natural convection heat transfer of Cu-H_2O nanofluid within a hexagonal cavity. A set of variable transformations is used to render the governing nonlinear partial differential equations dimensionless, which makes it possible to identify the model parameters that control it. The Galerkin weighted residual based finite element approach has been used to solve the governing dimensionless equation with the initial and boundary conditions. Comparisons with previously published works are made to ensure that the results are accurate, and it is found that there is an excellent level of agreement between the results. The investigation considers the effects of key parameters—thermal Rayleigh number (10^3–10^5), Hartmann number (10–80), and nanoparticle volume fraction (1–5%)—using numerical simulations. A central composite design was employed in the RSM framework for statistical modeling, while ANN was trained on the same dataset to capture nonlinear relationships. Sensitivity analysis revealed that high Rayleigh number, low Hartmann number, and higher nanoparticle volume fraction significantly enhance thermal performance. The optimal condition was observed at Ra = 100,00, Ha = 10, and ϕ = 5%, yielding the highest Nusselt number 15.775. Model performance was evaluated using R^2, MSE, RMSE, and MOD metrics. Both RSM and ANN demonstrated strong predictive capabilities (R^2: RSM = 0.9780, ANN = 0.9868), with ANN outperforming RSM in accuracy and handling complex nonlinearities. The findings highlight ANN as a robust tool for optimizing nanofluid-based thermal systems, offering significant implications for advanced cooling technologies, heat exchangers, and energy-efficient designs.

Paper ID: ICSHSD-46

Convective Heat Transfer of Hybrid Nanofluid in a Rectotrapezoidal Enclosure under the Influence of Periodic Magnetic Field using Thermally Equilibrium Model

Sumaya Binta Mosharraf[1]* and Md. Shariful Alam[1]
[1]Department of Mathematics, Jagannath University, Dhaka-1100, Bangladesh
**Corresponding author sumayabintamosharraf@gmail.com*

ABSTRACT

In the present study, the problem of unsteady natural convective flow of Ag-MgO/water hybrid nanofluid within a two-dimensional rectotrapezoidal enclosure under the influence of periodic magnetic field with thermal boundary conditions has been studied numerically. The presented analysis is based on a one-component thermally equilibrium homogeneous model. A set of variable transformations is used to render the governing nonlinear partial differential equations dimensionless, which makes it possible to identify the model parameters that control it. The Galerkin weighted residual based finite element approach has been used to solve the governing dimensionless equation with the initial and boundary conditions. Comparisons with previously published works are made to ensure that the results are accurate, and it is found that there is an excellent level of agreement between the results. In order to understand the flow and thermal fields of Ag-MgO/water hybrid nanofluid for the current study, the impact of different model parameters including thermal Rayleigh number (*Ra*), Hartmann number (*Ha*), nanoparticle volume fraction (ϕ), inclination angle (γ) and period (λ) of the magnetic field on the streamlines, isotherms as well as on the average Nusselt number have been shown both graphically and in tabular form and discussed them from the physical point of view as well. The obtained numerical results show that the heat transfer rate can be increased with the increasing values of the Rayleigh number, volume fractions of the nanoparticles whereas, an increment in Hartmann number reduce the overall heat transfer rate from the bottom heated wall.

Paper ID: ICSHSD-48

Nanoparticle-Based Drug Delivery for Blood Flow Disruption in Idealized Aneurysmal Arteries

M. A. K. Khan[1], K. E. Hoque[2,] *, M. Osman Gani[1], M. Sahidul Islam[3], M. Masum Billah[2]
[1]Department of Mathematics, Jahangirnagar University (JU), Savar, Dhaka-1342, Bangladesh
[2]Department of Arts and Sciences, Faculty of Engineering, Ahsanullah University of Science and Technology (AUST), Dhaka-1208, Bangladesh
[3]Department of Mathematical and Physical Sciences, East West University, Dhaka-1212, Bangladesh
**Corresponding author: ekram_math.as@aust.edu*

ABSTRACT

A major challenge in the global health arena is cardiovascular disorders. This study investigates nano- therapeutic transport and its influence on hemodynamic patterns in idealized aneurysmal arteries using computational fluid dynamics (CFD). The simulation utilizes the use of the non-Newtonian Carreau-Yasuda model.The interaction between wall shear stress (WSS) and disturbed flow fields within the aneurysmal sac is analyzed. The results reveal that aneurysmal dilation significantly alters local flow patterns and WSS. These findings may use in advanced medical research in future.

Paper ID: ICSHSD-49

Finite Element Study of Mixed Convective Flow and Entropy Generation in a T-Shaped Cavity with an Octagonal Block

Sadia Islam[1], Md. Nur Alam[2,*] and Md. Aslam Hossain[3]
[1,2,3]Department of Mathematics, Pabna University of Science and Technology, Pabna-6600, Bangladesh.
Corresponding author: nuralam23@pust.ac.bd

ABSTRACT
Mixed convective heat transfer and entropy generation in closed T-shaped cavities with interior polygonal obstructions has not been well explored. A few important gaps in research include that there has not yet been a systematic mapping of entropy generation, there have not been many FEM-based benchmark studies, and geometry - performance trade-offs have yet to be quantified in these systems. In this research, we sought to address these gaps by applying a Galerkin finite element method to examine steady laminar flow, heat transfer, and entropy generation in a T-shaped cavity with an octagonal block present in the middle of the cavity. We found that an increase in the Rayleigh number ($10^3 \leq Ra \leq 10^6$), increases the effects of convection significantly: maximum Nusselt number approximately increased by 366%, maximum flow velocities approximately increased by 24,581%, wall heat transfer approximately increased by 19,436%, and the Bejan number approximate dropped from 1 to less than 0.2. The results of this study can be applied in compact heat exchanger technologies, electronics applications, or passive thermal systems, and indicated that at the highest Ra transports dominated the irreversibility associated with fluid friction. Overall, this study contributes to FEM-based research of thermofluid dynamics and irreversibility trends in complicated cavity geometries.

Paper ID: ICSHSD-54

Numerical Analysis of MHD Mixed Convection in a Cavity with Internal Circular Heater and Heat Flux Boundary Conditions

Mst. Kakoly Akter Mitta[1] and Md. Nur Alam[2,*]

[1,2]Department of Mathematics, Pabna University of Science & Technology, Pabna-6600, Bangladesh
Corresponding author: nuralam23@pust.ac.bd

ABSTRACT
Efficient thermal management in complex enclosures is crucial for electronic cooling, heat exchangers, and reactor systems. Previous studies have primarily focused on simple cavities with uniform heating, leaving a limited understanding of irregular geometries with internal obstructions and mixed boundary conditions. This study numerically investigates MHD mixed convection in a cavity containing a central circular heater with ducts. The lower wall and circular heater are maintained at a hot temperature, the vertical side walls are cold, and the top wall is subjected to a constant heat flux with leakage. All solid walls are treated with no-slip conditions. The governing continuity, momentum, and energy equations are solved using the Galerkin weighted residual method within the COMSOL Multiphysics finite element framework. Variations in key parameters significantly impact the Nusselt number. Streamlines and isotherms visually illustrate flow patterns and temperature distributions, providing insight into heat transfer mechanisms driven by mixed convection. Results reveal that the heated bottom and circular heater enhance buoyancy-driven circulation, while the top-wall heat flux strengthens thermal gradients. The study provides insights for optimizing compact thermal systems under complex boundary interactions.

Paper ID: ICSHSD-70

Thermal Analysis of Cu–H_2O Nanofluid in a Corrugated Trapezoidal Enclosure with Multiple Internal Heat Sources at Different Positions

Sree Pradip Kumer Sarker[1*], Md. Mahmud Alam[2]
[1,2]Department of Mathematics, Dhaka University of Engineering and Technology (DUET) Gazipur-1707, Bangladesh.
**Corresponding author: pradip.duet@gmail.com*

ABSTRACT
This study numerically investigates the thermal performance of Cu–H_2O nanofluid in a top-corrugated trapezoidal enclosure featuring two circular heat-generating obstacles placed at different horizontal positions (left, middle, and right). The analysis considers the effects of varying Hartmann numbers (Ha = 0, 30, 50), Rayleigh numbers (Ra = 10^3– 10^6), with fixed cavity base angle ($\gamma = 15°$), inclination angle ($\lambda = 0°$), and Prandtl number (Pr = 4.9833). Results reveal that obstacle position significantly affects the Nusselt number and Effective Coefficient of Performance (ECOP). Increased Ha suppresses convection, while central obstacle placement offers optimal heat transfer and ECOP efficiency.

Paper ID: ICSHSD-71

Entropy Generation and Heat Transfer Analysis in Mhd Free Convection of Cu–H_2O Nanofluid within Trapezoidal Cavities with Varying Top Corrugation

Sree Pradip Kumer Sarker[1*], Md. Mahmud Alam[2]
[1,2]Department of Mathematics, Dhaka University of Engineering and Technology (DUET)
Gazipur-1707, Bangladesh.
**Corresponding author: pradip.duet@gmail.com*

ABSTRACT
This study presents a numerical investigation of entropy generation and heat transfer in MHD free convection of Cu– H_2O nanofluid within trapezoidal cavities featuring two different top corrugation shapes: sinusoidal and square wave. Simulations were performed using COMSOL Multiphysics for various Hartmann numbers (Ha = 0, 30, 50) and Rayleigh numbers (Ra = 10^3–10^6). At Ra = 10^6, the average Nusselt number (Nu) reaches 7.9 for the sinusoidal case and 7.2 for the square case at Ha = 0, indicating stronger convective heat transfer with sinusoidal corrugation. The ECOP peaks at ~4500 (sinusoidal) and ~4100 (square), while entropy generation (St) drops from ~15 to ~0.002 as Ra increases. Sinusoidal corrugation consistently shows better thermal performance and lower entropy production, suggesting its superiority in enhancing heat transfer and system efficiency under MHD effects.

Paper ID: ICSHSD-73

A Computational Study of the Velocity of Air and Nanoparticles in Human Lung Airways

Sumaiya Akter[1,*], Mahtab Uddin Ahmmed[2]
[1]Department of Mathematical and Physical Sciences, East West University, Dhaka-1212, Bangladesh
[2]Department of Mathematics, Jahangirnagar University, Dhaka-1342, Bangladesh
**Corresponding author: sumaiya.akter@ewubd.edu*

ABSTRACT
When we inhale, some harmful particles enter our lung along with normal air. Nanoparticles is one type of particles. The velocity of air and nanoparticles in airway tube of lung is influenced by various fluid parameter such as Reynold number, Periodic Permeability, breathing frequency and porosity etc. In this study, the impact of these parameter is showed graphically. When these parameters increase or decrease, the velocity of air or nanoparticles also increase or decrease in airway tube. The velocity of air and nanoparticles influence the deposition of nanoparticles in different region of lung and causes various lung diseases.

Paper ID: ICSHSD-084

Periodic Mhd Non-Linear Radiative Jeffrey Fluid Flow Past a Stretching Porous Sheet with Arrhenius Activation

S. Shefath[1*], K. Suraiya[2, 1], J. Luna[3], M. Y. Hossain[4] and S. F. Ahmmed[5]
[1]Mathematics Discipline, Khulna University, Khulna-9208, Bangladesh.
[*]*Corresponding author: tishashefath@gmail.com*

ABSTRACT

Electro-Magneto-hydrodynamics (EMHD), non-linear thermal radiation as well as activation energy all work together to accurately describe the flow of electrically conducting fluids that are used in heat transfer, engineering applications, nuclear cooling systems and chemical engineering. This study intends to elaborate the nonlinear radiation patterns for EMHD, non-Newtonian fluid model (Jeffrey) flow past a porous stretching sheet. The governing equations are developed using the appropriate boundary conditions. By using appropriate non-dimensional variables and parameters, these equations are then converted into their dimensionless counterparts. The resulting set of dimensionless equations are solved by using the explicit finite difference method (EFDM) for numerical simulation. Tecplot360 and Microsoft Excel are then used to show the result graphically. The velocity, temperature, as well as concentration flow field are influenced by various physical parameters, including the Deborah number (β), ratio of relaxation and retardation time (λ_2), radiation parameter (Rd), chemical reaction parameter (Kr), Prandtl number (Pr), Casson parameter (λ), heat source parameter (Q), electric parameter (Ee), Eckert number (Ec), magnetic parameter (M), thermophoresis parameter (Nt), activation energy (AE) and Brownian motion parameter (Nb). The velocity distribution increases with an increase in the electric parameter (Ee) and the Deborah number (β), whereas it decreases with a rise in the ratio of relaxation and retardation time (λ_2), porous term (Kp) and the magnetic parameter (M). A lower temperature profile is produced by a greater Prandtl number (Pr), whereas an increased radiation parameter (Rd), thermophoresis (Nt), Brownian motion (Nb), Eckert number (Ec) along with Deborah number (β) causes the opposite effect. Moreover, an increase in the Arrhenius activation energy (AE) leads to an enhancement in the concentration profile and a decrease in the increment of chemical reaction (Kr). In the case of increasing values of ratio of relaxation and retardation time (λ_2), the skin friction (Cf) drops, whereas it increases with higher Deborah number (β) and Brownian motion (Nb) effects. For the radiation parameter (Rd), the Nusselt number (Nu) increases and then decreases with the magnetic parameter (M). With an increase in activation energy (AE), the Sherwood number (Sh) reduces, while it increases with increments in the Soret number (Sr) and heat source parameter (Q). Additionally, streamlines along with isothermal lines show the visualization of fluid flow.

Paper ID: ICSHSD-087

Maxwell Fluid Flow in a Porous Channel with Chemical Reaction: A Haar Wavelet Approach

Israt Jahan Luna[1*], Md. Yousuf Hossain[1], Tazrian Tamim[1], Jeba Tasnia[1], Salmoon Shefath[1], Sarder Firoz Ahmmed[1]
[1]Mathematics Discipline, Khulna University, Khulna-9208, Bangladesh
Corresponding author: isratjahanluna78@gmail.com

ABSTRACT

This study investigates the flow of a non-Newtonian fluid, particularly Maxwell fluid in a porous channel with the influence of chemical reaction. The governing partial differential equations are formulated by incorporating the effects of viscoelasticity, porosity and chemical reactions. The governing equations are transformed into a set of ordinary differential equations through similarity transform. Haar wavelet collocation method is applied to obtain solutions also MATLAB is used to perform the numerical computations. The result of this study provide the insights into how chemical reaction parameter and porosity influence the transport phenomena in Maxwell fluid. The effects of different parameters like Reynold's number (Re), Deborah number (De), Schmidt number (Sc), Chemical reaction parameter (γ) and Darcy number (Da) on velocity profile and concentration profile, skin friction and rate of mass transfer. The velocity profile decreases for increasing values of Re and De for suction the reverse effect is seen for injection. The concentration profile increases for increasing values of Re, Sc and γ. This analysis has practical applications in polymer processing, enhanced oil recovery and chemical engineering systems.

Paper ID: ICSHSD-085

Analysis of Casson Fluid Flow Past a Stretching Sheet Under Periodic Magnetic Field with Thermal Radiation and Chemical Reactions.

Md. Yousuf Hossain[1*], Israt Jahan Luna[1], Tazrian Tamim[1], Jeba Tasnia[1], Salmoon Shefath[1], Sarder Firoz Ahmmed[1]
[1]Mathematics Discipline, Khulna University, Khulna-9208, Bangladesh.
Corresponding author: 211236yousuf@gmail.com

ABSTRACT

This investigation explores the behavior of the unsteady non-Newtonian fluid (particularly Casson fluid) past a stretching sheet under the periodic magnetic field. It is also considered the thermal radiation and higher order chemical reaction. The governing equations such as continuity equation, momentum equation, energy equation and concentration equation are formed by considering the aforementioned properties. In this study the time dependent governing equations are transformed properly into its non-dimensional form with the help of some dimensionless variables and quantities. A number of dimensionless parameters are obtained when the governing equation is non-dimensionalized such as Grashof number (Gr), Modified Grashof number (Gm), Magnetic Parameter (M), Prandtl number (Pr), Radiation Parameter (R), Dufor number (Du), Schmidt number (Sc), Soret number (Sr) and Chemical reaction parameter (Kr). In order to get the numerical solutions, the explicit finite difference method (EFDM) is used. The (EFDM) is implemented in the language of FORTRAN 6.6 a. For graphical representation of the insight of the problem, Tecplot 9.0 software is used. This investigation provides the interaction between some fluid properties like skin friction, Nusselt number and Sherwood number. Different values of well-known parameters are used for different step time which clearly shows how the graphs rise or falls for the values of those parameters. All the graphs and table are carried the information which are able enough to describe the result and discussion. The application of non-Newtonian (Casson) fluid can be observed in many kinds of field like manufacturing industries, ink industries, polymer industries, food processing, medicine sectors and engineering sectors. In this study the convergence analysis, along with the stabilization of numerical method has been established and it becomes conclude that the current study has conversed for $Pr \geq 0.2422$ and $Sc \geq 0.069$. The outcome of this research reveals that the movement of fluid can be dynamically influenced by fluctuations in non-dimensional parameters. Notably, the velocity profile is reduced with the increase of the Prandtl number and magnetic parameter.

Paper ID: ICSHSD-090

Analysis of Radius of Curvature Effect on Mhd Multiphase Flow in an Eccentric Square Curved Duct with Differential Wall Heating in a Porous Medium

Md. Khalilur Rahman[1,2*], Rid–Wanul Alam Likhon[2], and Md. Abdul Hakim Khan[2]
[1]Department of Mathematics, Bangladesh Civil Service, Ministry of Education, Dhaka-1000, Bangladesh.
[2]Department of Mathematics, Bangladesh University of Engineering & Technology, Dhaka-1000, Bangladesh.
[*]*Corresponding author: khalil33bcs@gmail.com*

ABSTRACT

This work explores the combined effects of curvature radius (L) and Hartmann number (Ha) on magnetohydrodynamic (MHD) multiphase flow through an eccentric square-shaped curved duct with differentially heated walls, using the finite element method (FEM). The governing conservation equations of mass, momentum, and energy are coupled with the magnetic induction equation to incorporate Lorentz force and buoyancy contributions. The curved duct is accurately modelled using a non-uniform body-fitted mesh, while velocity, pressure, and temperature distributions are resolved with higher-order Lagrange interpolation functions. A Galerkin weighted residual approach, enhanced by stabilisation schemes, is applied to effectively handle convection-dominated conditions. Boundary conditions include no-slip velocity at the walls, prescribed constant wall temperatures, insulated external surfaces, and specified magnetic field orientations. Parametric analyses over a wide range of Hartmann numbers and curvature radii are performed to investigate secondary vortex formation, flow characteristics, and thermal transport behaviour. Results reveal a pronounced interplay between magnetic dissipation and curvature effects, where stronger magnetic fields suppress but stabilise secondary flows, while moderate curvature promotes smoother and more predictable flow structures.

Paper ID: ICSHSD-091

Aerodynamic Performance Assessment of Horizontal Axis Wind Turbine for Coastal Regions of Bangladesh Using CFD

Md Abid Hassan Mitul[1] and Most Nasrin Akhter[1*]
[1]Department of Mathematics, Dhaka University of Engineering & Technology, Gazipur, Bangladesh.
[*]*Corresponding author: nasrin@duet.ac.bd*

ABSTRACT

Renewable energy is increasingly vital for ensuring sustainable, low-carbon power generation, especially in regions with limited access to traditional energy grids. In Bangladesh, the coastal areas of Kuakata, Sandwip, and Cox's Bazar offer significant potential for wind energy due to their consistent wind speeds of 3–6 m/s, particularly during the monsoon season. Although earlier studies have evaluated wind resources through feasibility assessments and mapping, they have not thoroughly explored the aerodynamic performance of turbines under these specific wind conditions. This study uses Computational Fluid Dynamics (CFD) to evaluate a three-bladed Horizontal Axis Wind Turbine (HAWT) under local coastal conditions. Wind speeds between 3–6 m/s were considered to replicate the regional environment. The findings indicate that at 5 m/s, the turbine develops favorable pressure differentials across blade surfaces, producing stable torque and achieving a peak power coefficient (C_p) of approximately 0.36 at a tip speed ratio (TSR) of 3.5. These results align with international benchmarks for small-to-medium HAWTs, confirming that coastal Bangladesh can sustain efficient wind turbine operation within its natural wind regime. The importance of this research lies in providing the aerodynamic performance assessment tailored to Bangladesh's coastal context. By demonstrating the technical feasibility of HAWTs under real local wind speeds, the study supports evidence-based renewable energy planning and offers a pathway for hybrid energy systems in rural and coastal communities. Moreover, the outcomes highlight the role of CFD as a decision-support tool for optimizing blade geometry, predicting site-specific performance, and guiding sustainable wind energy expansion.

Paper ID: ICSHSD-116

Heat and Mass Transfer in Unsteady Flow over an Oscillating Cylinder under the Effects of Radiation and Chemical Reaction

Tazrian Tamim[1*], Md. Yousuf Hossain[1], Israt Jahan Luna[1], Jeba Tasnia[1], Salmoon Shefath[1], Sarder Firoz Ahmmed[1]
[1]Mathematics Discipline, Khulna University, Khulna-9208, Bangladesh
[*] *Corresponding author: tazriantamim211233@gmail.com*

ABSTRACT

The present analysis reports the effect of radiation and chemical reaction on an unsteady magnetohydrodynamics fluid flow past an oscillating cylinder. The governing equations are formulated in cylindrical coordinates as the object is cylindrical in shape and used in the flow. Then, the dimensionless governing equations of the flow have been solved by applying the explicit finite difference method with the corresponding boundary conditions. To get the numerical values, the Fortran programming language (Compaq Visual Fortran 6.6a) is used. This study's findings have been analyzed based on different known parameter values for the flow. The effect of different parameters like Prandtl number, Schmidt number, Grashof number and Modified Grashof number has been analyzed. With the increases and decreases of magnetic field the velocity curves are in downward-upward direction for the effect of Lorentz force. The effects of Schmidt number and Prandtl number on the temperature and concentration profiles are also presented.

Paper ID: ICSHSD-119

Heat Transfer Enhancement with a Mixed Convective Cavity Containing a Heated Rotating Cylinder Using Ternary Hybrid Nanofluid

M.S. Alam[1,2], M. Masum. Billah[3*], Aminur Rahman Khan[1], U.K. Suma[4,] M.N. Islam[1]
[1]Department of Mathematics, Jahangirnagar University (JU), Savar, Dhaka-1342, Bangladesh.
[2]Department of Basic Science, Sonargaon University (SU), Dhaka-1215, Bangladesh.
[3]Department of Arts and Science, Ahsanullah University of Science and Technology (AUST), Dhaka-1208, Bangladesh.
[4]Department of Mathematics, Bangladesh University (BU), Dhaka-1207, Bangladesh.
[*] *Corresponding author: mdshahinam@gmail.com*

ABSTRACT
The present research analyzes the flow dynamics and heat transmission properties within a rectangular cavity enclosing a heated rotating cylinder using water-based ternary hybrid nanofluid. The working fluid comprises a novel suspension of three distinct nanoparticles: aluminum oxide (Al_2O_3), carbon nanotubes (CNTs), and graphene, which are dispersed in water to form the ternary hybrid nanofluid. After transforming the governing equations and boundary conditions into a non-dimensional form, the non-linear PDEs were solved using the finite element technique based on the Galerkin weighted residual method. Computational results are achieved for several controlling factors, including the solid volume fraction ($\delta = 0.04$), Richardson number ($0.1 \leq Ri \leq 10$), Prandtl number (Pr = 6.83) and non-dimensional time ($0.1 \leq \tau \leq 1$). The variation of ternary hybrid nanoparticles profoundly impacts the movement and temperature fields, including the thermophysical properties of the base fluid throughout the cavity. Based on the computational results, the solid volume fraction has a significant impact on the flow fields. It has been found that the heat transmission rate rises 38.13% while the Richardson number (Ri) increases from 0.01 to 10.

Paper ID: ICSHSD-120

Computational Study of a Dual Phase Change Material Cap for Sustained Heat Protection

Mohammad Junaid[1], Pabel Shahrear [2*]
1 Department of Mechanical Engineering, Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh
2 Department of Mathematics, Shahjalal University of Science and Technology, Sylhet, 3114, Bangladesh
[*]*Corresponding email: shahrear-mat@sust.edu*

ABSTRACT
The rising frequency of extreme heat events due to climate change and urbanization necessitates innovative thermal protection solutions. Wearable technologies utilizing phase change materials (PCMs) offer a promising approach to mitigate heat-related risks by dynamically regulating temperature through latent heat storage and release. This study aims to develop and evaluate the thermal performance of a lightweight wearable cap integrated with a single-phase change material (PCM), either Rubitherm RT-27 (melting point: 27°C) or Capric Acid (melting point: 32°C), to provide both immediate and sustained protection against extreme heat conditions. The research employed a three-dimensional numerical model using the enthalpy-porosity method. The cap design incorporated upper and lower layers of wool-cotton fabric and a middle PCM layer. Simulations were conducted at ambient temperatures of 40°C and 50°C to assess melting behavior, thermal distribution, and energy absorption. PCMs included melting points (RT-27: 27°C; Capric Acid: 32°C) and latent heat capacities (RT-27: 179 kJ/kg; Capric Acid: 264 kJ/kg). We observe that at 40°C, RT-27 fully liquefied within 155 minutes, while capric acid completed melting in 230 minutes. At 50°C, RT-27 melted in 108 minutes and capric acid in 133 minutes. RT-27 demonstrated rapid cooling during initial exposure, maintaining the cap temperature below 32.2°C for 155 minutes at 40°C and 33.7°C for 108 minutes at 50°C. Capric Acid provided extended cooling, keeping temperatures below 35.2°C for 230 minutes at 40°C and below 36°C for 133 minutes at 50°C. Energy absorption was 130 kJ/kg for RT-27 and 140 kJ/kg for capric acid. RT-27 is suitable for short-term cooling needs, while capric acid offers prolonged thermal protection. The cap design effectively mitigates heat stress by maintaining favorable head temperatures under extreme heat conditions. R results are based on numerical simulations and have not been validated through real-world testing, limiting practical applicability until further experimental validation.

Paper ID: ICSHSD-122

Mhd Radiative Heat and Mass Transfer of a Sisko Nanofluid with Variable Thermal Conductivity over a Porous Stretching Sheet

Khadija Suraiya[1], Md. Rafiqul Islam[2], Sarder Firoz Ahmmed[3] and Salmoon Shefath[4]
Mathematics Discipline, Khulna University, Khulna-9208, Bangladesh.
Corresponding author: sfahmmed@math.ku.ac.bd

ABSTRACT

This study focuses on analyzing the magnetohydrodynamic (MHD) flow behavior of Sisko nanofluid over a stretching sheet, incorporating the effects of radiation and chemical reactions. Temperature dependent thermal conductivity and molecular diffusivity have also been studied on porous surface. The governing system consists of the continuity, momentum, energy, and concentration equations, which are transformed into non-dimensional form using appropriate similarity variables. The resulting dimensionless equations are solved numerically by the explicit finite difference method (EFDM) implemented in Compaq Visual Fortran 6.6.a. Stability and convergence analyses are performed to ensure the reliability of the numerical results. Through extensive numerical computations, the behavior of velocity, temperature, and concentration fields is meticulously analyzed across a range of physical parameters, with results graphically explained. Furthermore, the pertinent quantities of skin friction, heat transfer rate, and mass transfer rate are quantitatively assessed for varying parameters and presented in tabular format. An in-depth analysis, accompanied by graphs and tables, illustrates the influence of parameters such as thermal viscosity (β_1), molecular diffusivity(β_2), magnetic parameter (M), porosity parameter (Da), radiation parameter (R), thermal Grashof number (Gr), mass Grashof number (Gc), Prandtl number (Pr), Lewis number (Le), Schmidt number (Sc), thermophoresis parameter (Nt), Brownian motion parameter (Nb), Soret number (Sr), and heat source parameter (Q). The demonstrable effects of Sisko fluid parameters ($A1$,$A2$) on various flow fields are graphically depicted, alongside visualizations of the fluid flow through streamlines and isotherms. Key observations include an increase in velocity profiles with elevated variable conductivity, molecular diffusivity, mass Grashof number, and thermal Grashof number, contrasted with a decrease observed for increasing values of the magnetic parameter, Prandtl number, Schmidt number, radiation parameter, and first Sisko parameter. Additionally, an inverse relationship is noted between Prandtl number and temperature profiles, while the radiation parameter exhibits a direct relationship with temperature profiles. Heat source parameter has been observed a direct relationship with concentration profiles.

Paper ID: ICSHSD-124

Flower-Shape Rooftop Wind Turbines and Prospect in Bangladesh

Umme Salma[1*], Sadia Rahman Mithila [2], Md Masud Rana [3] , and Md. Sabbir Alam [4]
[1234]Department of Mathematics, Jahangirnagar University, Savar, Dhaka-1342.
Corresponding author: salmashila52@gmail.com

ABSTRACT

Bangladesh is experiencing rapid development and a growing demand for energy. As the country faces increasing electricity demand and environmental challenges, renewable energy solutions are becoming essential. One promising approach is the use of rooftop flower-shaped wind turbines. Compact, efficient wind energy systems are designed to harness wind power even in urban environments with low to moderate wind speeds. This paper explores the possible application of wind turbines on rooftops in Bangladesh.Using theoretical models such as Momentum Theory, Blade Element Theory, Blade Element Momentum Theory, and Betz Law to analyze turbine performance and energy conversion efficiency. A complete study of wind characteristics in three different locations along Bangladesh's coast (Kutubdia, Satkhira and Mongla) regions, the investigation of wind properties includes gaining knowledge of the wind velocity and the flow direction. We study the flow direction of the wind through WIND ROSE and also investigate the frequency distribution of wind velocity to understand the velocity profiles. Flower-Shape Rooftop Wind Turbine specifications for suitable locations in Bangladesh will be studied. We analyze the power output from wind turbines at different hub heights, considering the technological, environmental, economic, and social implications. The feasibility offers rooftop wind power as a sustainable energy solution and recommendations for successful implementation.

Paper ID: ICSHSD-126

A Magnetic Field Effect on Coronary Artery Disease: A Computational Fluid Dynamic Approach

Tanzin Ahammed, Md Mojammel Haque, Most. Nasrin Akhter*
Department of Mathematics, Dhaka University of Engineering & Technology, Gazipur
*Corresponding email: nasrin@duet.ac.bd

ABSTRACT

Coronary artery disease (CAD), a leading cause of death worldwide, is driven by the formation of atherosclerotic plaques in regions of complex blood flow, especially at arterial curvatures and bifurcations. Hemodynamic factors like wall shear stress (WSS) and oscillatory shear index (OSI) play key roles in plaque development. Magnetohydrodynamics (MHD), the study of the behavior of electrically conductive fluids in the presence of magnetic fields, offers a promising framework for influencing blood flow characteristics non-invasively. Since blood contains charged particles such as ions and iron-rich hemoglobin, it behaves as a weakly conducting fluid. When exposed to an external magnetic field, electromagnetic forces (Lorentz forces) act on the blood flow, potentially altering its velocity profile and shear stress distribution. This study explores the potential of magnetohydrodynamics (MHD) which examines the behavior of conductive fluids like blood under magnetic fields as a non-invasive method to influence coronary blood flow. Using ANSYS, a computational model of a coronary artery was developed, incorporating realistic geometry and modeling blood as a non-Newtonian, MHD fluid. Simulations were conducted under varying magnetic field strengths and orientations. Results show that magnetic fields can significantly modify velocity profiles, reduce turbulence, and alter shear stresses linked to plaque progression. The study suggests that MHD-based techniques could provide a promising approach for non-invasive modulation of blood flow and risk reduction in CAD.

Paper ID: ICSHSD-148

A Study of Differential Equation Wall Model in LES of Turbulent Channel Flow Using Artificial Neural Network Technique

Mohammad Azizul Hoque[1, 2], Muhammad Saiful Islam Mallik[1], Muhammad Sajjad Hossain[1*] and Md. Ashraf Uddin [2]
[1]Department of Arts and Sciences, Ahsanullah University of Science and Technology, Dhaka-1208, Bangladesh
[2]Department of Mathematics, Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh
*Corresponding email: msh.as@aust.edu

ABSTRACT

This study uses Artificial Neural Network (ANN) technique to predict the performance of the differential equation wall model (DEWM) in large eddy simulation (LES) of turbulent channel flow. The ANN model is trained using LES-DEWM and direct numerical simulation (DNS) data. The ANN model outperforms the LES-DEWM model by a significant margin, and regression and error histogram plots are used to assess the simulation's turbulence characteristics. LES has emerged as a useful design and research tool for comprehending turbulent flows in recent years due to advancements in computational methods and resources. The fact that this simulation method models the lower, more universal turbulence scales while using grid resolution to address the larger, flow-dependent scales as one of its benefits. Through machine learning techniques called ANNs, computers can be trained to process information similarly to the human brain, increasing their accuracy and efficiency in tasks like document summarization and facial recognition. The ANN techniques are also used to develop a new sub grid-scale model in LES which are more effective than a traditional dynamic model. In the current study, the ANN is used to assess the performance of LES on a plane turbulent channel flow while approximating the near wall layer using a DEWM whichis the main focus. The ANN approach is trained using LES-DEWM and DNS data through a testing, validation, and training procedure. The simulation is carried out using a low-storage explicit Runge-Kutta approach with third order accuracy in time and a finite difference method with second order accuracy in space. DNS data are used to compare the computational results. A second order back propagation strategy known as the Levenberg Marquardt algorithm is used to minimize the trained ANN approach's loss function. The results show that the prediction of ANN model is significantly better than the LES-DEWM model in terms of DNS results. The ANN-predicted turbulence properties are compared with the LES and DNS data using regression and error histogram charts. In comparison to the LES-DEWM data, the ANN-LES data predicts better in capturing the effects of near wall structures. Furthermore, throughout the calculation domain the ANN results exhibit better agreement with the DNS results than that of the LES with DEWM. The behavior of the flow structures in the calculated flow field have also been addressed in the contour plots.The study uses a Reynolds number of 590 for turbulent plane channel flow in LES, focusing on the ANN method and DEWM models. Key turbulence statistics are compared with DNS reference data using RANS, DEWM, and ANN-trained data. The ANN data generally provides better agreement with DNS results.

Paper ID: ICSHSD-159

Analysis of The Impact of Irregular Building Arrays and Roof Geometries on Pollution Dispersion: A Case Study of Urban Street Canyons in Dhaka City

Nashidul Islam[1], Motiur Rahman[1] and Most. Nasrin Akhter[1]*
[1]Department of Mathematics, Dhaka University of Engineering and Technology, Gazipur, Bangladesh
**Corresponding author email: nasrin@duet.ac.bd*

ABSTRACT
The dispersion of urban pollution in Dhaka is critically shaped by building configurations, particularly roof geometries within street canyons. Dhaka's dense landscape—with narrow streets, irregular building arrays, and heavy traffic emissions—often traps heat and pollutants, worsening air quality at pedestrian level. Among urban morphological factors, roof shape strongly influences canyon airflow and pollutant dilution. This study examines the effects of common roof geometries—flat, sloped, pitched, and round—on pollutant dispersion in representative canyons of Dhaka. Two-dimensional CFD simulations were carried out in ANSYS Fluent using the Finite Volume Method (FVM) with Large Eddy Simulation (LES), incorporating both airflow and thermal transport. The analysis assessed how roof-induced flow changes affect vortex stability, vertical mixing, and pollutant accumulation. Results show that roof geometry substantially modifies pollutant distribution. Our findings highlight how even small variations in roof geometry can alter canyon ventilation efficiency. The study emphasizes that strategic roof design can help mitigate urban air pollution. For Dhaka, where rapid urbanization and high density intensify exposure, such approaches offer cost-effective, practical solutions to improve air quality, with broader relevance to other compact cities worldwide.

Paper ID: ICSHSD-161

Stability analysis of two-dimensional Viscous Burger's equations by Explicit Finite Difference Method

Nazrul Islam[1*], Md. Ashraf Uddin[2], Mohammad Sayful Islam[2]
[1]Department of Mathematics, Shahjalal University of Science and Technology, Sylhet-3114
[2] Professor, Department of Mathematics, Shahjalal University of Science and Technology, Sylhet-3114
[*]*Corresponding email: nazrulislam.sust38@gmail.com*

ABSTRACT
The Navier-Stokes Equation (NSE) governs fluid dynamics but lacks exact analytical solutions, requiring numerical methods for analysis. The viscous Burgers' equation, a simplified version of the NSE, retains key nonlinear features and admits exact solutions, making it ideal for testing numerical techniques. This study solves the two-dimensional Burgers' equation using the Cole-Hopf transformation to linearize it, applying and comparing three finite difference schemes: ECCDS, EBCDS, and EFCDS. Error analysis and visualizations are used to assess each scheme's accuracy, with ECCDS yielding the best results. The study emphasizes the potential for further exploration of Burgers' equation in fluid mechanics and related fields.

Paper ID: ICSHSD-176

Magnetohydrodynamic Influence on Pulsatile Blood Flow in Porous Stenosed Arteries

Morium Akter Mim[1,*], Rahima Akter[1], Mahtab U. Ahmmed[1]
[1]Department of Mathematics, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh
**Corresponding author: mimarisha16@gmail.com*

ABSTRACT
This study presents a mathematical model to investigate pulsatile blood flow in a stenosed artery treated as a porous medium under the influence of a transverse magnetic field. The model incorporates the principles of magnetohydrodynamics (MHD) to account for the effects of the magnetic field on the hemodynamic behavior of blood. Analytical solutions of the governing equations of motion are derived to evaluate key flow characteristics, including axial velocity, wall shear stress, pressure gradient, volumetric flow rate, and flow resistance. The results demonstrate that the axial velocity exhibits periodic oscillations, with its peak amplitude decreasing as the magnetic number increases, indicating that the magnetic field resists the motion of blood and suppresses flow velocity. Furthermore, it is observed that wall shear stress rises significantly with increasing permeability of the porous medium and with greater stenosis length, highlighting the role of arterial narrowing in altering shear forces at the vessel wall. The analytical expressions reveal that both the magnetic field and stenosis severity have a strong impact on blood flow distribution, resistance, and associated shear stresses. This comprehensive modeling approach provides valuable insights into the complex interactions between magnetic fields, porous effects, and stenosis on arterial blood flow dynamics. The study further emphasizes potential applications in clinical research, including the development of magnetic therapies and optimization of medical devices that rely on the control of blood flow under varying physiological and pathological conditions.

Paper ID: ICSHSD-189

Inspiratory Flow Simulation for Cylindrical Model Channel of Human Lung

Morium Akter Mim[1,*], Rahima Akter[1], Mahtab U. Ahmmed[1]
[1]Department of Mathematics, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh
**Corresponding author: rahima.stu2018@juniv.edu*

ABSTRACT

Understanding airflow dynamics within the human lung is crucial for respiratory healthcare, aerosol drug delivery, and the diagnosis of pulmonary diseases. The present study focuses on the numerical simulation of inspiratory airflow through a simplified cylindrical model channel, representing a section of the human lung. While real airways possess a complex branching morphology, cylindrical geometries provide a practical and physiologically relevant approximation to examine the fundamental behavior of inhaled air. A two-dimensional unsteady incompressible flow model in a two-dimensional bifurcated airway (G18) model was constructed using the Advection-Diffusion(AD) equations, which were solved numerically in MATLAB via the Finite Difference Method. The cylindrical channel was defined with a physiologically consistent length-to-diameter ratio, and boundary conditions included a time- dependent parabolic inlet velocity, a zero-pressure outlet, and no-slip conditions at the walls. Simulations were performed for the initial phase of inspiration, up to 0.05 seconds, to capture transient flow development. Flow rates and velocity distributions were analyzed along both the axial length and the transverse width of the channel. The results reveal that flow along the channel length increases progressively from the entrance region before stabilizing in the fully developed zone, consistent with laminar Poiseuille flow theory. Across the width, the velocity distribution follows a parabolic profile, peaking at the channel centerline and decreasing symmetrically toward the walls due to viscous effects. Compared with an equivalent rectangular model, the cylindrical channel achieved higher volumetric flow rates and more uniform velocity profiles, indicating reduced resistance and improved efficiency. These findings align with physiological expectations, where rounded airway geometries minimize energy loss and facilitate effective air transport during breathing. In conclusion, the study demonstrates that cylindrical channel models provide more realistic and efficient representations of inspiratory airflow compared to rectangular geometries. The developed numerical framework is computationally efficient and adaptable, offering potential applications in extended studies of branching airway structures, pathological airflow conditions, and optimization of inhalation-based drug delivery. The insights gained contribute to bridging the gap between simplified theoretical flow analysis and realistic physiological modeling.

Paper ID: ICSHSD-190

Evaluating the Impact of Roadside Vegetation on Pollutant Dispersion in Urban Street Canyons: A CFD Study of Dhaka City

Nahida Akter[1] and Most. Nasrin Akhter[1], *
[1]Department of Mathematics, Dhaka University of Engineering and Technology, Gazipur, Bangladesh
**Corresponding author email: nasrin@duet.ac.bd*

ABSTRACT

Urban Street canyons in densely populated cities like Dhaka often experience elevated levels of air pollution due to heavy traffic emissions and restricted natural ventilation. This study investigates the influence of roadside vegetation on the dispersion of key traffic-related pollutants—carbon monoxide (CO), carbon dioxide (CO_2), and particulate matter (PM_{10})—within such environments. Computational Fluid Dynamics (CFD) simulations were conducted using the finite volume method (FVM) and the standard k–ε turbulence model. To accurately represent physical phenomena such as wind flow, velocity profiles, turbulent kinetic energy, and pollutant dissipation rates, custom User Defined Functions (UDFs) written in C/C++ were incorporated into the model. Three vegetation configurations were examined: a street canyon without vegetation, one with two trees each 10 meters tall, and another with two trees of differing heights—10 meters and 15 meters. The results show that vegetation-free canyons allow for more efficient pollutant dispersion due to unobstructed airflow. In contrast, the presence of vegetation alters the street geometry and can disrupt ventilation, occasionally creating stagnant zones that trap pollutants. However, under certain arrangements, vegetation was also found to reduce ground-level pollutant concentrations. These findings emphasize the need for thoughtful urban greening strategies that consider not only aesthetic and ecological benefits but also the critical impact of roadside vegetation on air quality in dense urban environments.

Paper ID: ICSHSD-192

Computational Simulation for the Prediction of Rocket Turbine's Blade Flutter

Khairuzzaman Mamun[1], Funazaki Ken-ichi[1], Tnazin Ahammed[2] and Nasrin Akter[2]
[1] Mechanical engineering department, Iwate University, Morioka, Iwate, Japan
[2]Department of Mathematics, Dhaka University of Engineering and Technology, Gazipur
[*]*Corresponding email: nasrin@duet.ac.bd*

ABSTRACT
This study is to predict the flutter of the first rotor blade of the two-stage axial turbine of a rocket engine turbopump, where the turbine was designed by the Japan Aerospace Exploration Agency (JAXA) in the project of Dynamic Design Team (DDT). The number of blade counts of the first rotor of the turbine is 36. A pre-stressed modal analysis has been carried out using ANSYS Mechanical 18.1 on a single rotor blade using fixed support at the hub and rotational velocity boundary conditions, for getting natural frequencies and mode shapes (eigenvectors). The first four modes of Inconel 718 and Titanium 64 blade have been taken for the CFD calculation. However, ANSYS CFX 18.1 has been taken as the solver for the CFD calculation of the simulations. Reynolds Average Navier Stoke's equations have been used as the governing equation. H2 ideal gas has been considered as a working fluid. Shear Stress Transport (SST) model has been used as the turbulence model. At the inlet, total pressure and total temperatures are 7.55 MPa and 500 K respectively. At the outlet, static pressure is 1.71 MPa. The blade wall has been considered as a no-slip, whereas the slip wall has been considered for the hub and casing. The rotational speed of the rotor blade has taken as 60600 rpm where the rotational axis is Z-axis. A transient blade row model has been used for the unsteady calculations. Results of this study have been presented by graphical and contour representations. Aerodynamic damping coefficient and blade's wall work per cycle have been taken as the parameters for the analysis. However, the stability of Inconel and Titanium blades is predicted for $-90 \leq IBPA \leq +90$ degrees, whereas instability or flutter of the blades may occur when $-180 \leq IBPA < -90$ degrees or $+90 < IBPA \leq +180$ degrees.

Paper ID: ICSHSD-201

Droplet, Slug, And Plug Flow in T-Junction Microchannels: A Numerical Study

Rid–Wanul Alam Likhon[1*] and Md. Abdul Hakim Khan[1]
[1]Department of Mathematics, Bangladesh University of Engineering & Technology, Dhaka-1000, Bangladesh.
[*]*Corresponding email: ridwanlikhon98@gmail.com*

ABSTRACT
Droplet microfluidics in T-junction microchannels offers a versatile approach for generating controlled two-phase flows, where droplet, slug, and plug regimes arise due to the interplay of viscous, inertial, and interfacial forces. In this study, numerical simulations are conducted to investigate the influence of the dimensionless parameter—Capillary number (Ca)—on droplet generation and flow regime transitions. Results indicate that at low Ca, the squeezing mechanism dominates, producing elongated slug or plug flows, whereas higher Ca promotes dripping behavior with smaller and more uniform droplets. These findings highlight the sensitivity of flow regimes to governing parameters and provide design insights for precise control of droplet size, breakup, and mixing efficiency. The outcomes contribute to optimizing microfluidic systems, enabling reliable and tunable droplet, slug, and plug flows for applications in biomedical diagnostics, chemical synthesis, and lab-on-a-chip technologies.

Paper ID: ICSHSD-204

Numerical Simulation of Hemodynamic Behavior in Stenosed Arteries

Umme Habiba Akter[1*] and Md. Abdul Hakim khan[1]
[1]Department of mathematics, Bangladesh University of Engineering & Technology, Dhaka-1000, Bangladesh.
[*]*Corresponding email: ummehabibatamanna65@gmail.com*

ABSTRACT
Cardiovascular disorders such as aneurysms, coronary artery narrowing, heart attacks, and strokes remain the leading cause of death worldwide. The arteries most commonly affected include the aorta, coronary, carotid, and femoral arteries. Research into blood circulation behavior and viscosity under shear stress is therefore of great importance. In this work, mathematical modeling and analysis of blood flow through stenosed arteries at varying velocities have been carried out. A hyperbolic trajectory is applied at the inlet, while fixed pressure conditions are set at the outlets. Uniform Neumann boundary conditions govern flow motion, and no-slip conditions are imposed on the arterial walls. The governing equations of mass and momentum, expressed using normalized primitive variables, are solved through the Galerkin weighted residual finite element method. The outcomes of the model are illustrated through streamline patterns, axial flow directions, pressure profiles, and velocity contour plots. The graphical results reveal the effects of blood velocity, arterial pressure distribution, streamline and governing parameters such as the Reynolds number (*Re*). These insights will aid clinicians in diagnosing stenosis-related cardiovascular diseases and in planning effective treatments.

Paper ID: ICSHSD-205

Natural Convective Heat Transfer of Nanofluids in A Square Cavity with A Curved Hot Wall Partially Heated from Below

Janntul Ferdious Mele[1, *] and Md. Abdul Hakim Khan[1]
[1]Department of Mathematics, Bangladesh University of Engineering & Technology, Dhaka-1000 Bangladesh
[*]*Corresponding email: jannatmili8186@gmail.com*

ABSTRACT
Natural convective heat transfer using nanofluids has attracted increasing interest for applications in cooling, energy storage, and solar systems. This work investigates natural convection of nanofluids in a square cavity where a curved hot wall is partially heated from below and the remaining walls are kept cold or adiabatic. The governing equations for mass, momentum, and energy are solved numerically under steady, laminar, incompressible flow conditions, with effective nanofluid properties incorporated from standard correlations. Parametric studies are carried out for different Rayleigh numbers, nanoparticle concentrations, and wall curvature ratios. Results show that nanofluid addition enhances heat transfer compared to the base fluid, with greater improvement at higher Rayleigh numbers and suitable particle loadings. The curved heated wall significantly modifies the flow structure, promoting stronger circulation and higher average Nusselt numbers. Overall, the study highlights how combining optimized wall geometry with nanofluid characteristics can substantially improve natural convection performance in enclosures for advanced thermal applications.

Paper ID: ICSHSD-206

Numerical Analysis of Heat Transfer Enhancement in A Pentagon-Shaped Cavity Using Nanofluids Under Constant Heat Flux

Afsana Mimi[1, *] and Md. Abdul Hakim Khan[1]
[1]Department of Mathematics, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
[*]*Corresponding email: mafsana481@gmail.com*

ABSTRACT
This numerical study investigates laminar natural convection heat transfer and fluid flow in a two-dimensional pentagon-shaped cavity filled with a nanofluid. The bottom wall is subjected to a constant heat flux, while the inclined sidewalls are maintained at a cold temperature, creating buoyancy-driven flow influenced by the cavity's complex geometry. The objective is to clarify how the unique pentagonal configuration, together with the enhanced thermophysical properties of nanofluids, affects thermal performance and flow dynamics. The governing mass, momentum, and energy equations are solved using the finite element method, with nanofluid properties incorporated through established correlations. Key parameters such as the Rayleigh number (*Ra*), nanoparticle volume fraction (φ), and cavity aspect ratio are systematically examined. The findings provide new insights into the interplay between geometry and nanofluid properties, offering practical guidance for designing advanced thermal management systems in electronics, energy storage, and aerospace applications.

Paper ID: ICSHSD-218

Nanoparticles-Based Drug Simulations in Coronary Arterial Diseases

M. A. Jabed[1], K. E. Hoque[1,*], M. Masum Billah[1], Anas Al Rafin[1] and M. N. Uddin[2]
[1]Department of Arts and Sciences, Faculty of Engineering, Ahsanullah University of Science and Technology, Dhaka -1208, Bangladesh
[2]Department of ICT, Faculty of Science and Technology, Bangladesh University of Professionals, Dhaka-1216, Bangladesh
[*]*Corresponding email: ekram_math.as@aust.edu*

ABSTRACT
Coronary artery disease (CAD), the leading cause of death worldwide, requires novel therapeutic approaches. Nanoparticle-based drug simulation represents a breakthrough in cardiovascular precision medicine, enabling non-invasive prediction of patient-specific treatment responses. Computational drug modeling investigates nanoparticle dynamics in coronary artery flow. Understanding drug–artery interactions help optimize nanoparticle size, shape, and surface characteristics for improved therapeutic effects. Nanoparticle-based drug delivery methods show promise for targeted release and enhanced bioavailability of therapeutic agents in stenotic arteries. The present work, motivated by nano-drug delivery technologies for the treatment of CAD, aims to provide a deeper understanding of nano-hemodynamics in stenotic arteries through simulations of nanoparticle transport in arteries with varying degrees of stenosis. Patient-based CAD model was developed for the nanoparticle-based drug delivery system, representing one of the contemporary strategies for CAD treatment. A bifurcated artery model, with and without stenosis, was designed using SolidWorks software. This study investigates how nanoparticles may improve cardiovascular health and treatment outcomes. The finite volume method (FVM) was employed for numerical simulation with appropriate boundary conditions. The non-Newtonian Carreau model with no-slip boundary conditions was used. The highly nonlinear Navier–Stokes partial differential equations governed the simulations. Hemodynamic characteristics—including velocity magnitude, wall shear stress (WSS), and flow rate—were evaluated for different stenosis severities. Targeted drug delivery for coronary stenosis was studied using the left coronary artery model and numerical simulations. Nanoparticles, commonly used as carriers for targeted drug delivery in both preclinical and clinical studies, were modeled with a 20 nm radius and a mass of 1×10^{-8} kg. They were introduced into the system after 0.5 s. To simulate arterial nanoparticle accumulation, diffuse scattering was applied at the vessel wall. Targeted CAD treatment using nanoparticle-based drug simulation appears highly promising. Combining computer modeling with nanoparticle drug delivery optimizes therapeutic efficacy, reduces systemic side effects, and enables patient-specific cardiovascular disease management. This research demonstrates how nanoparticles can enhance cardiovascular treatment by improving efficacy, reducing adverse effects, and supporting personalized therapy.

Paper ID: ICSHSD-227

Natural Convection of Mdh Double Diffusive Nano-Encapsulated Phase Change Material (Nepcm) in The Annulus Between Concentric Horizontal Circular and Square Cylinders

Md. Mahadul Islam[1, 2] and Md. Mamun Molla [1, 2]
[1]Department of Mathematics and Physics, North South University, Dhaka-1229, Bangladesh.
[2]Center for Applied and Computational Science (CACS), North South University, Dhaka-1229, Bangladesh.
[*]Corresponding email: amamun.molla@northsouth.edu

ABSTRACT
The natural convection of MHD double diffusive Nano-Encapsulated Phase Change Material (NEPCM) in an annulus formed by concentric horizontal circular and square cylinders is studied. The inner circular cylinder has a higher temperature than the outer, cooled square cylinder. The NEPCM particles move within the cavity due to natural convection. In the heated zone, the PCM cores absorb some of the surrounding heat as latent heat, and in the cold zone, they solidify and release the heat they absorbed. Furthermore, the PCM cores undergo a phase transition from solid to liquid. The governing equations for mass, velocity, and heat conservation in NEPCM suspension are partial differential equations. After converting the governing equations to non-dimensional forms, the finite element method solves them. The Rayleigh number, $10^4, 10^5, 10^6$, the Hartmann number, $0\leq Ha \leq 50$, the Stefan number, $0.15\leq Ha \leq 0.7$, the fusion temperature, $0.1\leq \theta_f \leq 0.9$, volume fraction, $0.0\leq \varphi \leq 0.05$, Lewis number, $1\leq Le \leq 5$, Aspect ratio, $0.1\leq AR \leq 0.25$, Buoyancy ratio, $-2\leq Br \leq 2$, are among the important parameters that have been numerically simulated. To ensure the accuracy of the simulations, the results are validated and checked on a grid. The findings indicate that as Br rises, so do the $\overline{Nu}$ and $\overline{Sh}$. As φ rises, $\overline{Nu}$ increases while $\overline{Sh}$ decreases. As Ra increases, so do the local Nu and Sh. The $\overline{Nu}$ and $\overline{Sh}$ decrease by 34.28% and 33.40%, respectively, when AR increases from 0.10 to 0.25 at $Ra = 10^6$ and $Le = 5$.

Paper ID: ICSHSD-234

Rans-Based Numerical Investigation of Airflow and Pollutant Dispersion in an Urban Industrial Area of Dhaka

Md. Mejbah Ullah Chowdhury[1,2], Md. Mamun Molla[1,2*]
[1]Department of Mathematics & Physics, North South University, Dhaka-1229, Bangladesh.
[2]Center for Applied and Scientific Computing (CASC), North South University, Dhaka-1229, Bangladesh.
[*]*Corresponding author: mamun.molla@northsouth.edu*

ABSTRACT
Air pollution in densely populated industrial regions poses serious environmental and health challenges, particularly in rapidly growing cities such as Dhaka, Bangladesh. This study presents a numerical investigation of airflow behavior and pollutant dispersion within a representative section of the Tejgaon Industrial Area using the Reynolds-Averaged Navier–Stokes (RANS) turbulence model. A domain was selected from a map of the industrial zone and reconstructed in COMSOL Multiphysics as a two-dimensional rectangular geometry measuring 22 cm in width and 12.5 cm in height. The left boundary of the domain was defined as the inlet, the right boundary as the outlet, and the remaining boundaries are symmetric. Three cylindrical pollutant sources, each with a radius of 0.2 cm, were positioned adjacent to industrial structures, with inflows specified in positive and negative y-directions to represent realistic emission patterns. To capture the turbulent nature of industrial airflow, the standard k–ε closure scheme under the RANS framework was applied with a high Reynolds number. The simulation examined the influence of flow conditions on pollutant dispersion and identified critical airflow characteristics. Results demonstrate variations in vorticity distribution, pollutant concentration fields, and turbulence intensity concerning Reynolds number and dissipation rate (ε). Detailed analysis of centerline profiles, including pollutant concentration, axial velocity, and turbulent kinetic energy, provided further insight into pollutant transport mechanisms. The study highlights the strong dependence of dispersion patterns on turbulence characteristics, showing that higher Reynolds numbers enhance mixing but may also contribute to pollutant accumulation in recirculating flow zones.

Paper ID: ICSHSD-243

Thermal Analysis of Mixed Convection in an Irregular Hexagonal Cavity with Mixed Boundaries

Mahfuza Sultana[1*], M. A. Alim[1], and Suvash C. Saha[1]
[1]Department of Mathematics, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh
[2]University of Technology Sydney, Australia
[*]*Corresponding author: sultanamahfuza5757@gmail.com*

ABSTRACT
In present study, thermal analysis of the conjugate heat transfer within an irregular hexagonal cavity has been numerically investigated. Using high-fidelity simulations with COMSOL Multiphysics, we investigated the thermal behavior and convection patterns within the cavity. The irregular hexagonal cavity was discretized to ensure the resolution of thermal gradients, and the governing equations are solved using the finite element method (FEM). The study explored the temporal evolution of temperature fields, heat flux distributions, and the development of thermal boundary layers within the cavity. The study examined how different boundary conditions impact temperature distribution, fluid flow dynamics, and heat transfer efficiency. Special attention was given to the interactions between the irregular geometry and mixed thermal boundaries, which significantly influence the convection patterns and thermal performance of the system. The results revealed that the irregular geometry introduces complex flow structures and varying thermal gradients within the cavity. The study provided insights into how geometric irregularities and boundary condition variations affect the overall thermal behavior, offering guidelines for optimizing cavity design in applications requiring efficient thermal management. This research provided valuable insights into optimizing cavity design for enhanced thermal management, particularly in applications involving irregular geometries and mixed thermal boundaries. The findings offered practical implications for designing more efficient thermal systems and contribute to the broader understanding of natural convection in complex geometrical configurations.

Paper ID: ICSHSD-246

Unsteady and Mhd Thermal Transportation in A Nanofluid Filled Wavy Octagonal Enclosure Including Parabolically Heated Wall

Tinni Saha [1, 2], Nazma Parveen [2*]
[1]Bangladesh Civil Service, Department of Mathematics, Ministry of Education, Dhaka, Bangladesh.
[2]Department of Mathematics, Bangladesh University of Engineering and Technology, Dhaka 1000, Bangladesh.
[*] *Corresponding author: nazma@math.buet.ac.bd*

ABSTRACT

In various thermal engineering applications, the hydromagnetic field natural or free convective fluid flow and heat transfer in enclosures is a widespread phenomenon. Numerous researchers have given it superabundant importance. Because of few studies we here investigated about the unsteady natural convective fluid flow and heat transfer within an octagonal cavity filled with nanofluids under the influence of the hydromagnetic field with wavy top wall. This research explores the mathematical modeling of magnetohydrodynamics (MHD) in a time dependent, 2D, free convective and thermal transport within a blade-shaped Kerosene-Ag nanofluids filled wavy octagonal domain. The undulating wall remains at a cooler temperature T_c, while the lower wall maintains parabolic thermal boundary condition T_h. For the numerical simulations, finite element technique of Galerkin weighted residual which is very powerful partial differential equations solver type has been employed. The results illustrate wonderful agreement with previous published work. Various parameters are investigated, including $0 \leq Ha \leq 80$, $10^3 \leq Ra \leq 10^6$, and $0 \leq \phi \leq 0.01$. The results are showed by using streamlines, isotherms for both steady and unsteady conditions and heat transfer rate in terms of average Nusselt number. The findings reveal that the buoyancy force leads to enhanced 53.21% thermal transport when Ra increase from 10^3 to 10^6, while 1.16% decrease in the rate of thermal transport observed with increasing Lorentz force Ha from 20 to 80. Moreover, an increase in ϕ from 0.001 to 0.1 augments 5.61% thermal transport rate. The heat transfer mechanisms of the solution for Kerosene-Ag nanofluid reaches to steady state within a very sorter time. It has been calculated approximately before $\tau = 0.3$ when the solution reached to its steady state.

Paper ID: ICSHSD-248

Thermo-Hydraulic Performance of Microchannel Heat Exchangers: An Artificial Neural Network Analysis

Md. Shamim Hasan[1*], Md. Asif Ishtiaq[1], Md. Nur Alam[2], Md. Manirul Alam Sarker[1]
[1]Department of Mathematics, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
[2]Department of Mathematics, Pabna University of Science and Technology, Pabna-6600, Bangladesh
[*]*Corresponding author: shamim.math.buet@gmail.com*

ABSTRACT

The thermo-hydraulic performance of microchannel heat exchangers is very important for making compact, energy-efficient cooling systems. These systems are becoming more and more significant in high-performance applications, such as electronics and industrial cooling, where space is limited and effective heat transmission is a crucial factor. Although previous studies have examined microchannel heat transfer, significant gaps persist in understanding the effects of various channel geometries, fluid flow configurations, and the role of nanofluids in enhancing performance. Previous methods have not provided highly accurate forecasts about the correlation between design features and results when using advanced computational models like Artificial Neural Networks (ANN). The main objective of this study is to analyse the heat exchanger performance metrics of diverse cross-sectional channels, which utilise three-dimensional CFD simulations and ANN models to evaluate the impact of flow arrangements and nanofluid concentrations with different Reynolds numbers. The research applied the Galerkin weighted residual finite element method to solve the conjugate heat transport equations. It uses an ANN to model how design characteristics and performance parameters are related. The statistical measurements, determination coefficient (R^2) and mean squared error (MSE), are used to see how well the model performs. The outcomes indicate that circular microchannels have a high thermal effectiveness and a low pressure drop, but it is the best way to save energy. At the same time, square and triangular channels incur higher pressure penalties but enhance heat transfer. Nanofluid enhances heat transfer, especially at higher Reynolds numbers, but requires more pumping power. The ANN model demonstrates accurate predictions, with 90% accuracy, connecting the predicted and actual Nusselt number values. This signifies that the model's accuracy is highly effective. This study proposes practical design proposals to optimise microchannel geometry and nanofluid application in compact cooling systems through CFD modelling and ANN applications in thermal-fluid analysis, yielding significant insights for engineers to enhance energy efficiency in industrial cooling systems. This study is going to focus on developing efficient ANN-based mathematical models for hybrid nanofluid structures to determine computational simulations that align with sustainable engineering objectives, directly contributing to various sustainable development goals, including SDG 7, SDG 9, and SDG 13.

Paper ID: ICSHSD-256

Aging-Induced Variations of Pulmonary Permeability and Darcy Drag Force in Bronchial Channel

Tasnuba Farin Toma[1*], Faisal Alam[2] and Mahtab U. Ahmmed[3]
[1,2,3]Department of Mathematics, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh
[*]*Corresponding author: tasnubarahman70451@gmail.com*

ABSTRACT

The human lung serves not only as a site for gas exchange but also as a dynamic filter, protecting the body from pathogens, airborne particles, and fluid imbalance. This filtration function is closely linked to pulmonary permeability, which governs the ease with which gases and fluids traverse the alveolar-capillary barrier. Age-related physiological changes such as alveolar wall thinning, capillary rarefaction, extracellular matrix remodelling, and chronic low-grade inflammation lead to increased permeability, compromising this natural filtration mechanism. This study investigates the impact of age-induced changes in lung permeability on the Darcy drag force. Focusing on the 18th generation bronchial tube (respiratory bronchiole) with a length of 1.2 mm and diameter of 0.5 mm, we model airflow using the 1D extracted form of the 2D incompressible Navier–Stokes equations augmented with a Darcy drag term. To capture the flow dynamics under varying permeability conditions, we implement finite difference methods using three numerical schemes: Forward Time Central Space (FTCS) scheme, DuFort–Frankel scheme and Crank–Nicolson scheme. Numerical simulations are implemented using Python programming language in Colab to examine how declining permeability due to aging reduces the magnitude of the Darcy drag force, alters airflow velocity and pressure profiles and weakens the lung's filtration efficiency. Comparative analyses between cases with and without Darcy drag demonstrate its significant role in modulating velocity, pressure drop and diffusion effect. Our findings confirm that increased pulmonary permeability associated with aging and pulmonary diseases reduces Darcy drag, thereby impairing lung filtration. This highlights the importance of tissue-level resistance in respiratory performance and provides insights into the biomechanical effects of aging on lung health.

Paper ID: ICSHSD-312

Temperature-Induced Buoyancy Effects in The Human Respiratory System

Faisal Alam[1*], Tasnuba Farin Toma[2] and Mahtab U. Ahmmed[3]
[1,2,3]Depertment of Mathematics, Jahangirnagar University, Dhaka-1342, Bangladesh
**Corresponding author: faisalju.math@gmail.com*

ABSTRACT

This study explores the influence of temperature-induced buoyancy effects on respiratory airflow in the distal regions of the human lung, focusing particularly on Generation 18 (G18) bronchioles. Under quiet breathing conditions, airflow in these small airways is slow, laminar, and strongly dominated by viscous forces due to low Reynolds numbers. However, when body temperature rises during fever or infection, a small but important temperature difference develops between inhaled air (typically around 308 K) and the surrounding airway walls (310–313 K). These thermal gradients produce local density variations that generate buoyancy forces, which, although weak, can alter airflow distribution and pressure characteristics in the micro-airways. To investigate these effects, a two-dimensional bifurcated airway (G18 and G19) model was constructed, and the governing equations of mass, momentum, and energy were solved with temperature-dependent properties using the Boussinesq approximation. This formulation captures the coupling between thermal and fluid fields while remaining computationally efficient. Key parameters such as the Grashof number (Gr), representing the ratio of buoyancy to viscous forces, and the Prandtl number (Pr), describing the balance of momentum and thermal diffusion, were evaluated to characterize the thermal–fluid interaction. The results demonstrate that while the Grashof number remains low under mild thermal gradients, indicating negligible buoyancy relative to viscous forces, even these small buoyancy contributions are sufficient to disrupt flow symmetry. Pressure contours at bifurcation junctions exhibit measurable asymmetry, and streamlines show slight vertical deflections. Furthermore, viscosity increases in the warmer near-wall regions, intensifying velocity gradients and amplifying local flow asymmetry. The Prandtl number confirms that viscous effects dominate thermal diffusion, but the subtle interplay between viscosity and buoyancy still produces observable modifications in velocity and pressure fields. These findings emphasize that temperature-induced buoyancy effects, though minimal in magnitude, cannot be entirely neglected in respiratory airflow modeling. Their influence becomes particularly relevant under febrile or pathological conditions such as COVID-19, influenza, or pneumonia, where elevated body temperature and airway inflammation exacerbate thermal variations. Understanding these coupled effects provides valuable insights for improving computational lung models, enhancing the accuracy of predictions for particle transport and deposition, and supporting the development of optimized therapeutic interventions, including targeted drug delivery and advanced ventilation techniques for patients in critical care.

Paper ID: ICSHSD-314

Simulation of Mhd Micropolar Fluid Flow with Hall and Ion-Slip Effects Along a Vertical Wall

Toufiqur Rahman Tamim[1], Nahid Sultana Mitu[1], Sourab Roy[1] and Mohammad Wahiduzzaman[1*]
[1]Mathematics Discipline, Khulna University, Khulna-9208, Bangladesh.
[*]Corresponding author: wahidmathku@gmail.com

ABSTRACT
This study examines how magnetic fields influence the behavior of electrically conducting micropolar fluids, with a particular attention to the Hall and ion-slip effects that are often overlook in traditional magnetohydrodynamic (MHD) models. These effects, however, becomes especially important in low-density plasmas and in environment with strong magnetic fields, making their inclusion necessary for more accurate representation. The research considers the unsteady flow of an incompressible micropolar fluid past a vertical surface, where equations for momentum, microrotation, energy, and concentration are developed while also accounting for viscous dissipation, stratification, and the presence of a porous medium. To simplify and solve this system, suitable similarity transformation are applied and the resulting dimensionless equations are handled numerically using finite difference method, ensuring both stability and reliability of results. The analysis reveals that while magnetic fields tend to slow down the main velocity, they enhance microrotation, leading to noticeable changes in the thermal and solutal boundary layers. Moreover, the study also makes it clear that changes in the Hall and ion-slip parameters play a major role in controlling heat and mass transfer. This influence becomes visible through the variations observed in skin friction as well as in the Nusselt and Sherwood numbers. The results agree well with earlier research, which adds further weight to the model's reliability.Overall, the work offer deeper insights into micropolar MHD flows with complex electromagnetic effects and point to future directions, such as incorporating radiation, nanofluids, or more advance porous structures, to broaden its relevance to engineering and industrial process.

Paper ID: ICSHSD-389

Hemodynamic Changes in a Bypass Graft Due to Coronary Artery Stenosis

Rehnuma Islam[1], K. E. Hoque[1*], S. Subah[1], M. Ashraf Hossain[2], and S. M. A. Hoq[3]
[1]Department of Arts and Sciences, Faculty of Engineering, Ahsanullah University of Science and Technology. Dhaka -1208
[2]Department of Mathematics, Bangladesh University of Engineering and Technology, Dhaka, 1000, Bangladesh.
[3]Department of Science in Engineering, Faculty of Engineering, IIUM, Malaysia
**Corresponding author: ekram_math.as@aust.edu*

ABSTRACT
The present study investigates the relationship between coronary artery bypass grafting (CABG) and the severity of stenosis. A three-dimensional CAD model was utilized for the computational hemodynamic (CHD) simulation of coronary heart disease. The findings highlight the significance of accurate grafting measurements for improving diagnostic precision and facilitating disease prevention.

Paper ID: ICSHSD-347

Efficacy Thermo-Viscoelastic Stress Analysis in Particle-Laden Polymer Melts Flowing Through Contraction Geometries

Shamima Akter[1], Riaz Hossain[1], Adaito Basak[1], and Muhammad Minarul Islam[1*]
[1]Department of Mathematics, Gopalganj Science and Technology University, Gopalganj 8105, Dhaka, Bangladesh.
Corresponding author: minarul_math@gstu.edu.bd

ABSTRACT

The flow behavior of particle-laden viscoelastic polymer melts through contraction geometries plays a critical role in determining the mechanical properties and consistency of extruded polymer products. This study presents a coupled Eulerian–Lagrangian numerical simulation to investigate the complex interactions between dispersed solid particles and the viscoelastic carrier fluid flowing through the contraction pipe. The polymer melt is modelled using logarithm form viscoelastic constitutive equation, while particles are tracked individually to capture their influence on the flow and stress fields. Critical transport and microstructural phenomena including particle migration, elastic stress localization, and mixing dynamics are systematically examined to evaluate their impact on flow uniformity and composite strength. The normalized average fluid-particle force f_p as a function of the volume fraction (ϕ) of the dispersed solid phase and the Weissenberg number (W_i) representing the relative magnitude of elastic to viscous stresses. The results demonstrate that particle–fluid interactions significantly alter the viscoelastic stress fields, particularly within high-strain regions near the contraction interface. These interactions induce non-uniform particle dispersion, localized stress amplification, and potential defect formation. Case studies involving hydraulic fracture operations and particle settling in both Newtonian and viscoelastic fluids show excellent agreement with experimental data, providing new insights into optimizing die geometries and processing parameters to improve product homogeneity, mechanical robustness, and overall reliability in polymer composite extrusion processes. Polyimide is employed as the base fluid owing to its exceptional thermal stability, chemical resistance, and intrinsic viscoelastic behavior, rendering it highly suitable for high-performance applications. To enhance the multifunctional characteristics of the polymer, two nanocomposite reinforcements are investigated: carbon nanotube–graphene oxide (CNT + GO) and aerogel–nonclay (AG + NC). These nanoparticles were first dispersed in a solvent medium using ultrasonication to ensure uniform distribution. The prepared suspensions were subsequently mixed into molten polyimide using high-shear mechanical stirring at elevated temperatures under a nitrogen atmosphere to avoid oxidation and moisture interference. The loading concentrations were optimized to ensure stable suspension, avoiding particle agglomeration while maintaining rheological consistency. These resulting composite materials are then subjected to flow through a contraction pipe where the fluid behavior is calculated using the Navier–Stokes equations in combination with appropriate constitutive equations that represent viscoelastic behavior. Thermal analysis is performed using the energy equation to understand heat transfer behavior during flow. The general analysis of the final composite material's flow, stress state, and thermal behavior is aimed to evaluate its potential application in extreme and harsh environments, in which toughness and multifunctionality are required. These resulting composite materials are then subjected to flow through a contraction pipe where the fluid behavior is calculated using the Navier–Stokes equations in combination with appropriate constitutive equations that represent viscoelastic behavior. Thermal analysis is performed using the energy equation to understand heat transfer behavior during flow. The general analysis of the final composite material's flow, stress state, and thermal behavior is aimed to evaluate its potential application in extreme and harsh environments, in which toughness and multifunctionality are required. The simulation outcomes indicate that the particle–fluid interactions are responsible to a great extent for the alteration of the viscoelastic stress distribution, particularly within the regions of high strain along the contraction interface. Elastic stresses caused high particle migration, leading to non-uniform dispersion and localized stresses amplification that may introduce microstructural defects. Thermal analysis indicated intensified heat dissipation upon incorporating nanofillers but reduced thermal uniformity due to particle clustering in certain regions. Among the dual-filler systems, composites of CNT + GO exhibited higher stress localization, and AG + NC systems showed enhanced dispersion and thermal insulation. These outcomes highlight the importance of creating optimal filler selection and processing conditions to enhance flow uniformity and functional properties in viscoelastic nanocomposite extrusion.

Paper ID: ICSHSD-396

Mathematical Model to Describe the Flapping Motion in Nature

S. M. Kamal Hossain[1*], Sadia Rahman Mithila[1], and Md. Sabbir Alam[1]
[1]Department of Mathematics, Jahangirnagar University, Savar, Dhaka-1342
**Corresponding author: kamalbd1974@gmail.com*

ABSTRACT
Nature shows different kinds of flapping flight, each shaped by evolution and the environment. This research studies the flapping motion of birds, insects, and butterflies, focusing on how their wings move and the aerodynamic forces involved. Birds usually fly with steady aerodynamics using smooth wings and joint actions, while insects and butterflies rely on unsteady forces like delayed stall, rotational lift, and wake capture. By combining biological study, mathematical modelling, and MATLAB simulations, the research examines factors such as wingbeat frequency, stroke amplitude, elevation angle, and pitch angle. The findings show how different species create lift and thrust through unique strategies and highlight the importance of wing flexibility and timing for control. These results improve our understanding of natural flight and support the design of bio-inspired aerial systems like micro and nano aerial vehicles (MAVs and NAVs). This study connects biology, physics, and engineering to explain the main principles of flapping flight in nature.

Paper ID: ICSHSD-415

Investigation of Thermomagnetic Convective Flow in a Vertical Layer of Ethylene Glycol Based Magnetic Fluid Under the Effect of Inclined Magnetic Field

Md. Habibur Rahman[1*], and Sushmita Mondal[1]
[1] Department of Mathematics, Khulna University of Engineering & Technology, Khulna-9203, Bangladesh
**Corresponding author: hrahman180@math.kuet.ac.bd*

ABSTRACT
The linear stability of thermomagnetic convection in the ethylene glycol based magnetic fluid layer enclosed by two differentially heated walls. Ethylene glycol ($C_2H_6O_2$) is a colorless and sweet-tasting viscous liquid. The goal of this article is to examine the impacts of thermo-gravitational buoyancy and magnetic forces due to the effects of orientation angle and intensity of magnetic field. The pseudo-spectral Chebyshev expansion technique is employed using Matlab software to produce the suitable numerical results. The intensity and inclination angle of the applied magnetic field play a crucial role in stabilization in the flow domain. The destabilizing magnetic field variation effect is most pronounced in close to walls, particularly near the cold wall. However, viscous dissipation near the cold wall is likewise greater than that near the hot wall. As a result, the general instability pattern moves to the hot wall. It concludes that the thermomagnetic disturbances that occur in the magnetic fluid layer cause the magnetic and magnetization fields to become more uniform near the walls. Gravitational buoyancy due to thermal effects drives the instability more than magnetic effects. The magnetic fluids that are less sensitive to thermomagnetic changes than their more sensitive counterparts exhibit greater stability in the flow domain. With disregard for the linear magnetization rule, the differences in the critical values of the wave number, wave speed, and magnetic Grashof number are more pronounced for field orientation angles between $0^o$and 90^o. However, the results reveal that variations in Prandtl number, Pr significantly influence the growth rate and stability characteristics of the flow. The higher Prandtl numbers tend to enhance the stabilizing effects of the magnetic field, delaying the onset of instability, whereas lower Pr values promote thermal diffusion and shift the instability thresholds accordingly. This comparative analysis elucidates the critical role of thermal transport properties in conjunction with magnetic and buoyant forces, offering valuable insight into the underlying physical mechanisms governing MHD boundary layer stability.

Paper ID: ICSHSD-425

Natural Convective Heat Transfer in a Confined Domain Filled with Water Based Nanofluid Considering Heat Sources and Sinks

Md. Najmul Islam[1*], and M. U. Ahammad[1]
[1]Department of Mathematics, Dhaka University of Engineering and Technology, Gazipur, Bangladesh
**Corresponding author: najmulislamdueto48@gmail.com*

ABSTRACT

The Finite element method (FEM), a proper numerical approach for capturing both regular and irregular domains, is employed in the present research. Two key parameters, namely the free convection parameter Rayleigh number ($10^4 \leq Ra \leq 10^7$) and nanoparticle volume fraction ($0.01 \leq \varphi \leq 0.1$), are analyzed here to expose flow pattern and heat transfer phenomena. Outcomes are presented through streamlines, isotherms, and the average Nusselt number, which are displayed in both graphical and tabular forms. Velocity profiles, temperature profiles, and temperature gradient magnitude profiles are also revealed to enhance comprehension of flow visualization and temperature behavior. According to the results, heat removal effectiveness is enhanced by increasing the value of Ra and φ, where Ra plays a crucial role in the heat transfer rate. Additionally, the flow patterns, temperature distribution, and overall thermal performance within the enclosure are significantly impacted by the arrangement and power of the heat sources and sinks. This work offers insightful observations on the design and optimization of thermal systems utilizing nanofluids.

Paper ID: ICSHSD-466

Analysis of Flow and Thermal Behavior Over a U-Shaped Enclosure with an Internal Body Using Al_2O_3-Water Nanofluid

Shohag Hossain Reyad [1*], and M. U. Ahammad[1]
[1]Department of Mathematics, Dhaka University of Engineering and Technology, Gazipur, Bangladesh
**Corresponding author: shohagreyad1998@gmail.com*

ABSTRACT

This research investigates computationally the study of convective heat transfer that occurs naturally in a U-shaped device having an internal thermally isolated solid strip using the Al_2O_3-water nanofluid. Such a configuration, along with the specified boundary conditions, is very promising for obtaining the most favorable cooling efficiency. The nanoparticle alumina (Al_2O_3) is considered here to form a single-phase nanofluid mixing with pure water, corresponds to Pr = 7.0. The Galerkin weighted residual finite element approach, coupled with advanced software, has been employed to solve the non-dimensional partial differential equations governing continuity, momentum, and energy in the current situation. The effects of natural convection parameter Rayleigh number varied as $10^4 \leq Ra \leq 10^7$ and geometric parameter volume fraction of nanoparticle in the range $0.01 \leq \varphi \leq 0.1$ on the flow and thermal field, as well as heat transfer rate, have been analyzed and expressed by streamlines, isotherms, and average Nusselt number. Additionally, profiles of velocity, temperatures and temperature, gradient magnitude are also revealed for a better understanding of fluid flow behavior and temperature distribution. The main results of the current investigation are shown in both graphical and tabular form. The findings demonstrate the importance of relevant parameters in their respective fields by showing that the average Nusselt number, a measure of heat transfer performance, increases when both the Rayleigh number and the nanoparticle volume percentage rise.

Paper ID: ICSHSD-487

Fluid Structure Interaction (FSI) Analysis of the Blood Flow and Geometrical Characteristics in the Brain Aneurysm

Mohammad Matiur Rahman[1], and Most. Nasrin Akhter[1*]
[1]Department of Mathematics, Dhaka University of Engineering and Technology, Gazipur-1700, Bangladesh
**Corresponding author: nasrin@duet.ac.bd*

ABSTRACT

Brain aneurysms pose significant risks to human health due to their potential to rupture, often resulting in severe neurological damage or fatality. Understanding the complex interaction between blood flow dynamics and arterial wall deformation is essential for improving diagnosis, treatment, and prevention strategies. This study presents a comprehensive Fluid-Structure Interaction (FSI) analysis of cerebral aneurysms, focusing on how blood flow characteristics interact with the geometry and mechanical properties of the arterial wall. Using idealized aneurysm geometries, a coupled FSI model was developed employing computational fluid dynamics (CFD) and finite element analysis (FEA) to simulate pulsatile blood flow and vessel wall deformation. The model incorporates realistic boundary conditions and material properties to accurately replicate physiological conditions. Key hemodynamic parameters such as wall shear stress (WSS), pressure distribution, and flow velocity were analyzed in conjunction with the structural response of the arterial wall. Results indicate that geometrical variations in aneurysm morphology significantly influence flow patterns and stress distributions. Regions with high WSS gradients and oscillatory shear index (OSI) were found to correlate with areas prone to rupture. Moreover, the deformability of the aneurysmal wall plays a critical role in modulating flow-induced stresses, emphasizing the necessity of coupled FSI modeling for accurate risk assessment. This study highlights the importance of integrating fluid and structural mechanics in cerebral aneurysm research and demonstrates the potential of FSI simulations as a non-invasive tool for diagnosis and treatment planning.

Paper ID: ICSHSD-504

Analysis of Lorentz Force Effect on Mixed Convection Nanofluid Flow in a Vented Channel with Diamond Shaped Obstacle

Pushpa Akhtar[1], M. M. Touhid Hossain[1,*], Md. Abdul Alim[2] and Mohammad Mokaddes Ali[3]
[1]Department of Mathematics, Khulna University of Engineering & Technology, Khulna-9203, Bangladesh.
[2]Department of Mathematics, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh.
[3]Department of Mathematics, Mawlana Bhashani Science and Technology University, Santosh, Tangail-1902, Bangladesh.
**Corresponding author: mthosain@math.kuet.ac.bd*

ABSTRACT

The mixed convective flow in a vertical vented rectangular enclosure filled with CuO-nano-fluid containing adiabatic diamond-shaped barrier inside is investigated numerically in this article. The impact of a horizontally imposed magnetic field on the cavity's right vertical wall is studied. All walls of the chamber are set adiabatic except the center portion of the bottom wall, which is heated to a temperature T_h, and the temperature of the top cooled wall is put T_C. Galerkin's weighted residual formulation based on finite element numerical technique is used to solve the model governing equations with related boundary conditions. The consequences of various relevant parameters, including the volume fraction (ϕ) of nano-particles, the Reynolds number (Re) and the Hartmann number (Ha) on the on the velocity and temperature fields are examined. The data obtained indicate that an increase in the volume fraction of nano-particles enhanced heat conduction to raises the mean temperature inside the cavity.

Numerical Heat and Mass Transfer

Paper ID: ICSHSD-09

APPLICATION OF LBM TO SIMULATE MICRO-ORIFICE FLOW

Md. Nurunnabi Sohel[1], Runu Biswas[1,2], and Mohammad Abu Taher[1,*]
[1]Department of Mathematics, Dhaka University of Engineering and Technology, Gazipur-1707, Bangladesh
[2]Open School, Bangladesh Open University, Gazipur-1705, Bangladesh
**Corresponding author email: tahermath@duet.ac.bd*

ABSTRACT
The goal of this study is to investigate various important characteristic of micro-orifice flow. We have taken mainly two types of microchannel, converging and diverging, where these were created by decreasing and increasing the height of wall mounted orifices respectively. The flow patterns and other parameters of these channels were compared with that of smooth channel. Knudsen number is one of the key parameters to study fluid flows. Lattice Boltzmann method (LBM) has been employed here to investigate incompressible laminar flow through the orifice channel. LBM is generally simple, parallelizable and effective to handle complex boundary conditions. We compared the variation of different parameters like performance enhancement(η), friction factor (fRe), Nusselt number (Nu) with respect to Knudsen number ranges from 0.01 to 0.1 indicates a slip flow regime. The performance enhancement and normalized friction factor remained unity for smooth channel but they fell quickly for low Knudsen number. On the other hand, friction factor in the smooth channel is much lower than in the convergent divergent orifice channel and decreased gradually in a similar manner in all three channels.

Paper ID: ICSHSD-21

Soret and Dufour Effects on Mixed Convective Thermo-Solutal Boundary Layer Flow from a Horizontal Porous Surface with Thermal Radiation

Md. Sondhi Sheikh[1,*], Anika Tahsin Biva[1], and Abid Hossain[1]
[1]Department of Applied Mathematics, University of Dhaka, Dhaka 1000, Bangladesh
**Corresponding author: sondhisheikh16@gmail.com*

ABSTRACT
The present work investigates the steady two-dimensional Newtonian laminar mixed convective thermo-solutal boundary layer flow with cross-diffusion effects from a horizontal surface embedded in a saturated porous medium, taking into account thermal radiation. The governing equations are transformed into a system of nonlinear dimensionless coupled differential equations by applying the local non-similarity method, and then the Runge-Kutta- Fehlberg method is employed to numerically solve the non-similar equations. A parametric study of the influence of key emerging parameters, such as the Soret number, Dufour number, mixed convection parameter, radiation parameter, and Lewis number, on the flow field is conducted. Also, the effects of these parameters on the Nusselt and Sherwood numbers are analyzed with the aid of graphical plots.

Paper ID: ICSHSD-42

Effect of Circular and Square Obstructions on Heat Transfer and Flow Patterns in a Microchannel: A Numerical Study Using the Lattice Boltzmann Approach

R. Biswas[1,2], M. N. Sohel[2], Md. Y. Arafat[2], M. A. Taher [2,*]
[1]Open School, Bangladesh Open University, Gazipur-1705, Bangladesh & PhD Student
[2]Department of Mathematics, Dhaka University of Engineering & Technology, Gazipur-1707, Bangladesh
**Corresponding author: tahermath@duet.ac.bd*

ABSTRACT
The study emphasis on the heat transfer and fluid flow characteristics of two-dimensional incompressible laminar air flow, with cold air entering at the inlet. The effects of circular and square obstructions immersed in a rectangular microchannel (MC) are examined with different Reynolds number (Re). Three different configurations are studied: without obstructions (Case-1), circular-shaped obstructions (Case-2), and square-shaped obstructions (Case-3), all arranged in a zigzag pattern in the MC. The analysis is conducted using the Thermal Lattice Boltzmann Method (TLBM) with the Bhatnagar-Gross-Krook (BGK) approach. The simulation is implemented through a computer code written in FORTRAN. The walls and the embedded obstructions are assumed to be uniformly heated while the outlet of the MC is open. The study aims to analyze the rarefaction effect a low Reynolds number range from Re = 3 to 50, corresponding to Knudsen numbers (Kn) varying from 0.1 to 0.01, to capture the slip flow regime. A temperature jump is incorporated into the boundary conditions for the top and bottom walls of the microchannel. The study also examines the impact of isotherm in terms of temperature profiles, stream limes regarding velocity vector, Nusselt number, average friction coefficients according to different Reynolds number. The friction coefficient is defined as the ratio of the Poiseuille number (Pn) to the Reynolds number (Re), while the dimensionless heat transfer, represented by the Nusselt number (Nu), has been studied for various values of Re. The presence of four obstructions slows fluid movement within the MC, leading to faster cooling at the outlet. It is observed that the Nusselt number (Nu) increases by 10% and 9% when circular obstructions are present in the MC, compared to square obstructions, for Reynolds numbers Re = 3 and Re = 30, which correspond to Kn = 0.1 and Kn = 0.01, respectively. The results suggest that the studied configurations are particularly relevant for applications in microelectronic cooling, micro heat exchangers, and lab-on-a-chip devices, where thermal efficiency and compactness are of paramount importance.

Paper ID: ICSHSD-200

Integrated Multi-Scale Modeling of Bioheat Transfer in Skin Cancer Hyperthermia

Marzina Akter Reba[1, *] and Md.Abdul Hakim Khane [1]
[1] Department of Mathematics, Bangladesh University of Engineering and Technology, Dhaka-1000
[*]*Corresponding email:* reba.du2001@gmail.com

ABSTRACT
Skin cancer has the potential to spread to distant sites such as the lymph nodes, lungs, liver, brain, and bones. If left untreated, or detected at an advanced stage particularly in the case of melanoma it can be life-threatening. Hyperthermia therapy for skin cancer is emerging as a promising technique, where controlled heating is applied to destroy cancerous cells while limiting harm to surrounding healthy tissues. In recent years, laser ablation has gained recognition as an effective treatment method because it allows precise energy delivery to tumor regions. This Study introduces a multi-scale modeling framework designed to simulate bioheat transfer during hyperthermia, capturing processes at the cellular (microscale), tissue (mesoscale), and organ (macroscale) levels. A comprehensive bioheat model is formulated based on governing equations such as Pennes' bioheat equation. The work further investigates how variations in laser irradiance affect thermal distribution, aiming for selective tumor heating with minimal injury to adjacent normal tissue. Numerical simulations are validated using experimental results. The study employs the Finite Element Method (FEM) to model heat transfer coupled with thermoelastic effects. It incorporates tissue-specific thermal properties, blood perfusion, and nanoparticle heating. The simulations yield temperature distributions, time-dependent thermal profiles, and tissue damage predictions to guide optimization of hyperthermia protocols.

Paper ID: ICSHSD-214

Numerical Investigation of Fluid Flow in Thermal Boundary Layers with Intense Suction

Md.Babul Akter Durjoy[1], Md.Kashem Ali[1] and Mohammad Wahiduzzaman[*1]
[1]Mathematics Discipline, Khulna University, Khulna-9208, Bangladesh
[*]Corresponding email*:* wahidmathku@gmail.com

ABSTRACT
Velocity profile and temperature distribution of a viscous incompressible fluid along a semi- infinite vertical plate with large suction is investigated in this work. Dynamical equation of motion and energy equation are derived in vector form. The governing equation of the problem are transformed into a non-dimensional system by a usual transform. To solve the momentum and energy equation perturbation technique is used here. The obtained numerical values of fluid velocity and temperature are drawn in figures are discussed in details by using Matlab. To obtain the solution, the expression for velocity field and temperature distribution are transferred into first order ordinary differential equations

Paper ID: ICSHSD-271

Exploring H_2 Enrichment as an Innovative Strategy for Reducing Greenhouse Gas Emissions in Hydrocarbon–Air Counterflow Diffusion Flames

Akter Hossain[1*], Mohammad Abdur Rahman [2], and Shardar Firoz Ahmmed [3]
[1]Department of Mathematics, Pirojpur Science and Technology University, Pirojpur-8500, Bangladesh.
[2]Department of Mathematics, National University, Gazipur-1704, Dhaka, Bangladesh.
[3]Mathematics Discipline, Khulna University, Khulna- 9208, Bangladesh.
[*]*Corresponding author: dahossain.tu@gmail.com*

ABSTRACT

The combustion of hydrocarbons in devices like internal combustion engines produces a significant amount of greenhouse gas emissions, primarily carbon dioxide (CO_2). This process contributes to global warming and negatively affects ecosystems. Therefore, minimizing CO_2 and other pollutants are crucial for mitigating climate change and promoting a sustainable environment. This study investigates potential strategies for reducing CO_2 emissions in hydrocarbon-air diffusion flames by blending hydrogen (H_2), argon (Ar), and nitrogen (N_2) into the fuel stream. This study employs numerical simulations to explore effective strategies for reducing CO_2 emissions. We used the OPPDIF program, which solves the one-dimensional (1D) steady-state governing equations for mass, momentum, energy, chemical species transport, and the equation of state. The simulations were based on a detailed chemical reaction scheme involving 350 elementary reaction steps and 53 chemical species. To ensure a controlled study, we kept boundary conditions constant: a temperature of 300 K and a loading velocity of 25 m/s at both the fuel and oxidizer ports. The only variable was the mole fraction of H_2, Ar, and N_2 blended with the hydrocarbon fuel. This approach allowed us to isolate and identify the most effective blending component for reducing CO_2 and its precursors. Our numerical results show that increasing the hydrogen mole fraction significantly alters the thermal and chemical structures of the diffusion flames. This leads to a notable increase in radical pools (O, H, and OH) due to the promotion of crucial chain-branching reactions: $O + H_2 \rightarrow OH + H$ and $H + O_2 \rightarrow OH + O$. In contrast, these specific reactions and radical pools were not promoted when Ar and N_2 were blended with the hydrocarbon fuel. This observation suggests that H_2 enrichment is a promising strategy, as it effectively increases the accumulation of radicals in the flame zone. This, in turn, promotes a vital chemical pathway: $CO + OH \rightarrow CO_2 + H$, ultimately reducing carbon monoxide (CO), a precursor to CO_2, and subsequently reducing CO_2 in the combustion system. However, further investigation is necessary using a three-dimensional (3D) geometry and more practical operating conditions, as typically found in engine systems, to fully validate the hypothesis that hydrogen (H_2) enrichment is a viable solution for reducing CO_2 emissions from hydrocarbon combustion systems.

Paper ID: ICSHSD-353

LBM Simulation of Wedge Ribbed Microchannel on Thermal-Fluid Behaviour Under Slip Flow Condition

Md Y. Arafat[1], R. Biswas[1,2], M. N. Sohel[1], and M. A. Taher[1,*]
[1]Department of Mathematics, Dhaka University of Engineering & Technology, Gazipur-1707, Bangladesh
[2]Open School, Bangladesh Open University, Gazipur-1705, Bangladesh
**Corresponding author: tahermath@duet.ac.bd*

ABSTRACT

Numerical analysis of flow and thermal performances in upstream wedge ribs microchannel at the slip flow regime has been considered in the present article using a Lattice Boltzmann Method (LBM). A two-dimensional 9-bit (D2Q9) single relaxation time Thermal LBM (TLBM) model is used to simulate this problem. The governing factors are Knudsen number (Kn), which range is $0.01<Kn<0.1$ and roughnes height (rh=20%) of the channel height.The boundary conditions are inlet temperatures of the fluid which is cold, top and bottom walls are heated. Velocity andt temperature distribution, streamlines and pressure differences are discussed regarding ribs height with different Kn. The Nusselt number (Nu) is used to measure the rate of heat transfer, while the friction coefficients are calculated in terms of the Poiseuille number (Pn). Results depict that the friction factor decreases with increases the Kn at the slip flow regime. The vortices are observed between the two ribs across the entire gap at low Knudsen numbers (Kn), the size and shape are gradually reducing as Kn increases. The Nusselt numbers slowly decreasing for both smooth and ribs microchannels. Tthe performance of the ribs microchannel gradually decreasing as Knudsen number increases, while the smooth microchannel maintains a constant value of unity. The results have been compared with previously published works and show excellent agreement.

Paper ID: ICSHSD-348

Microstructural Analysis of Magnetohydrodynamic Micropolar Fluid Flow Between Parallel Plates

Adaito Basak[1], Riaz Hossain[1], Shamima Akter[1], and Muhammad Minarul Islam[1*]
[1]Department of Mathematics, Gopalganj Science and Technology University, Gopalganj 8105, Dhaka, Bangladesh.
**Corresponding author: riaz.17mat069@gstu.edu.bd*

ABSTRACT
Eringen's micropolar fluid theory is a generalized approach to modeling fluids with intrinsic microstructure and microrotation effects, which cannot be achieved using classical Navier–Stokes equations. Such fluids, characterized by microelements that are capable of rotating independently, are used in lubrication, polymeric suspensions, blood flow, and microfluidic transport. In the present study, unsteady flow of a micropolar fluid between two parallel plates is investigated using the finite volume method (FVM). The governing equations are the continuity equation, linear momentum balance, and angular momentum balance for microrotation. The equations are expressed in tensorial notation and discretized through the FVM on a collocated grid arrangement. Spatial discretization of the convective and diffusive terms is done using second-order schemes to resolve boundary layer gradients accurately. An implicit time-integration method is employed to handle the problem's unsteadiness, and velocity–pressure coupling is achieved through the SIMPLE algorithm. Special attention is given to the implementation of the boundary conditions: a constant velocity is prescribed at the inlet, no-slip and spin-gradient conditions at the walls, and a zero-gradient condition at the outlet. Numerical experiments demonstrate that micropolar effects are significant on both the velocity and microrotation fields. Asymmetric velocity profiles, in contrast to those of Newtonian fluids, are generated by the presence of microrotation, and the shear stress distribution in the channel is changed. The degree of microrotation coupling, controlled by the vortex viscosity parameter and spin-gradient boundary condition, significantly influences flow resistance and wall shear stress. Results show that the rotary motion near the walls is enhanced by increasing the micropolar coupling number, and the velocity magnitude is reduced in the core of the channel. Time-developing simulations also illustrate the gradual establishment of a steady-state microrotation field, highlighting the role of microstructure in energy dissipation and momentum transfer control.

Paper ID: ICSHSD-369

MHD Darcy-Forchheimer Convective Flow above a Vertical Permeable Plate with Radiative Heat Transfer and Chemical Reaction

Md. Jarif Mollah[1], and M. M. Touhid Hossain[1*]
[1]Department of Mathematics, Khulna University of Engineering & Technology, Khulna-9203, Bangladesh.
**Corresponding author: mthosain@math.kuet.ac.bd*

ABSTRACT
The contemporary research aims to impart attention in studying the two dimensional steady-state MHD Darcy-Forchheimer flow via a moving vertical permeable surface embedded in a porous medium for a laminar convective heat generating fluid with thermal radiation and chemical reaction. Firstly, the coupled nonlinear partial differential equations are converted into a set of ODEs and are then solved numerically using the efficient solver 'ODE45 MATLAB'. Through addressing the inertia effects, numerical computations are obtained to investigate how the dimensionless velocity, thermal and concentration boundary layers are influenced by different pertinent parameters involving thermal radiation and chemical reaction in the presence of MHD.

Paper ID: ICSHSD-529

Computational Study of a Dual Phase Change Material Cap for Sustained Heat Protection

Mohammad Junaid[1], Pabel Shahrear[2*]
[1]Department of Mechanical Engineering, Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh
[2]Department of Mathematics, Shahjalal University of Science and Technology, Sylhet, 3114, Bangladesh
**Corresponding email: shahrear-mat@sust.edu*

ABSTRACT

Background: The rising frequency of extreme heat events due to climate change and urbanization necessitates innovative thermal protection solutions. Wearable technologies utilizing phase change materials (PCMs) offer a promising approach to mitigate heat-related risks by dynamically regulating temperature through latent heat storage and release.

Aims: This study aims to develop and evaluate the thermal performance of a lightweight wearable cap integrated with a single-phase change material (PCM), either Rubitherm RT-27 (melting point: 27°C) or Capric Acid (melting point: 32°C), to provide both immediate and sustained protection against extreme heat conditions.

Methodology: The research employed a three-dimensional numerical model using the enthalpy-porosity method. The cap design incorporated upper and lower layers of wool-cotton fabric and a middle PCM layer. Simulations were conducted at ambient temperatures of 40°C and 50°C to assess melting behavior, thermal distribution, and energy absorption.

Parameters: Key properties of the PCMs included melting points (RT-27: 27°C; Capric Acid: 32°C) and latent heat capacities (RT-27: 179 kJ/kg; Capric Acid: 264 kJ/kg).

Results: At 40°C, RT-27 fully liquefied within 155 minutes, while capric acid completed melting in 230 minutes. At 50°C, RT-27 melted in 108 minutes and capric acid in 133 minutes. RT-27 demonstrated rapid cooling during initial exposure, maintaining the cap temperature below 32.2°C for 155 minutes at 40°C and 33.7°C for 108 minutes at 50°C. Capric Acid provided extended cooling, keeping temperatures below 35.2°C for 230 minutes at 40°C and below 36°C for 133 minutes at 50°C. Energy absorption was 130 kJ/kg for RT-27 and 140 kJ/kg for capric acid.

Conclusion: RT-27 is suitable for short-term cooling needs, while capric acid offers prolonged thermal protection. The cap design effectively mitigates heat stress by maintaining favorable head temperatures under extreme heat conditions. Limitations: The study's results are based on numerical simulations and have not been validated through real-world testing, limiting practical applicability until further experimental validation.

Paper ID: ICSHSD-530

Advanced Machine Learning Approaches for Dengue Outbreak Prediction in Monsoon-Driven Epidemics

Alvi Ahmed Sarker[1,*], Dr. Md. Kamrujjaman [2]
[1,2]University of Dhaka
**Corresponding email: a.a.sarker09@gmail.com*

ABSTRACT

Dengue fever poses considerable public health challenges in Bangladesh and other tropical areas, characterised by highly variable outbreak patterns and intricate seasonal dependencies. This ongoing research examines sophisticated machine learning techniques for forecasting dengue outbreaks that utilise extensive meteorological and epidemiological data from Bangladesh (2008-2024). The dataset shows an unprecedented amount of variation, with reported cases ranging from 1 to 107,498 per month. This makes it very hard for traditional forecasting methods to work. Our research framework will systematically assess various advanced methodologies, including Long Short-Term Memory networks, Transformer-based foundation models, ensemble methods, and Neural Ordinary Differential Equations (NODEs). Initial analysis indicates that conventional methods encounter difficulties with extreme value distributions typical of epidemic time series. We are creating specialised extreme-value modelling methods that use quantile transformations, peak-weighted loss functions, and latent Neural ODEs to learn about how epidemics work directly from data instead of using mechanistic constraints. Preliminary experiments utilising compartmental SIR-based models suggest possible constraints when epidemiological assumptions are contravened in actual surveillance data. Our intended comprehensive assessment will encompass: (1) a rigorous comparison of discrete-time and continuous-time modelling methodologies, (2) an exploration of attention mechanisms for elucidating long-range seasonal dependencies, (3) the formulation of hybrid architectures that integrate the advantages of various approaches, and (4) the creation of specialised loss functions that prioritise significant outbreak intervals. We anticipate illustrating that log-space modelling with robust scaling is crucial for outbreak prediction, and that domain-specific model design markedly surpasses generic time series methodologies. The study seeks to establish operational frameworks for early warning systems in monsoon-affected areas, with wider ramifications for epidemiological forecasting in climate-sensitive disease contexts.

Paper ID: ICSHSD-531

A Machine Learning Approach to Fault Dynamics and Seismic Hazard by Using Rate-and-State Friction and Finite Element Methods

Pinky Rani Dey[1*], Supti Rani Dash[2], and Dr. Mohammed Forhad Uddin[3]
[1]Department of Mathematics, BUET, Dhaka
[2]Department of Mathematics, BUET, Dhaka
[3]Department of Mathematics, BUET, Dhaka
[*] *Corresponding Email: pinkydey.math@gmail.com*

ABSTRACT

Despite momentous evolution in seismology, the innate unpredictability of earthquakes proceeds to present an alarming scientific challenge, highlighting the critical importance of advance mathematical research to deepen insights into fault behavior and reduce its harmful consequences. This need has been tragically highlighted by recent events, including the devastating Mw 7.8 earthquake that struck near the Turkey-Syria border in 2023, the Mw 7.5 earthquake that hit the Noto Peninsula of Japan on January 1, 2024, and the very recent Mw 7.7 earthquake in Myanmar in early 2025. These events disclose how complex the after reactions of earthquakes can be and why it is crucial to prepare for multiple hazards at once. This study presents a comprehensive mathematical analysis for simulating the complex dynamics of earthquake nucleation, rapture, and seismic wave propagation, aiming to predict the after-effect reduction of seismic hazards. We have used two methodologies here: firstly, we use the Dieterich- Ruina Rate and State Friction law to dominate the expansion of friction on fault surface for both stable and unstable events which actually results earthquake; secondly, to describe the surrounding rocks distortion the Finite Element Method (FEM) has been applied to solve the dynamic equations. The application of FEM gives a high resolution and territorial numerical description for both stress and strain field, which is crucial for perfectly describing the seismic hazard. Finally, we have tried to verify both the results by applying Machine Learning algorithms, which helps to predict accurately that the analysis can simulate the whole mathematical cycle from initial stress to rapid, dynamic slip and the states of seismic waves. We have aimed to reveal that how the fault geometry and surface material can affect the seismic event for ground motion. The nonlinear dynamics of friction laws have observed the seismological occurrences like foreshocks and aftershocks. Furthermore, the machine learning algorithms highlight the realistic importance of the interaction of seismic hazard assessment to fault-rock, which offers a more subtle simulation that how earthquakes commence and propagate. This research approach represents a remarkable headway to understand the fundamental tactics of earthquake. By integrating the rate-and-state method and FEM with machine learning, our research gives a powerful tool for analyzing fault dynamics. The flair achievement from these simulations has great implications for developing the seismic hazard maps, improving more accurate warning systems for earthquake, and eventually, reducing the risks by future seismic events.

Biomathematics and Mathematical Modeling

Paper ID: ICSHSD-06

A Nonlinear SEITR Model for Tuberculosis Transmission Dynamics: Stability, Bifurcation, and Sensitivity Analysis with Real-World Validation

M. A. Salek[1,*], J. Nayeem[2], M. Humayun Kabir[1]
[1]Department of Mathematics, Jahangirnagar University, Dhaka, Bangladesh
[2]Department of Arts & Sciences, AUST, Tejgaon, Dhaka, Bangladesh
Corresponding author: salekphd@gmail.com

ABSTRACT

This study presents a deterministic nonlinear SEITR (Susceptible–Exposed–Infected–Treated–Recovered) compartmental model to explore the transmission dynamics and control strategies for Tuberculosis (TB). The model incorporates key epidemiological features, including latent and active infections, treatment interventions, and disease-induced mortality. Analytical expressions for the basic reproduction number $R0$ are derived using the next-generation matrix method, serving as a threshold parameter to assess the potential for disease outbreak or eradication. The local and global stability of the disease-free and endemic equilibria are rigorously established using Routh–Hurwitz criteria, Lyapunov functions, and center manifold theory. A forward (trans critical) bifurcation is demonstrated at $R0=1$, confirming the model's realistic transition behavior from disease-free to endemic states. Sensitivity analysis—including normalized forward sensitivity indices, partial rank correlation coefficients (PRCC), and Latin Hypercube Sampling (LHS) identifies the transmission rate, progression rate, and treatment rate as key parameters influencing TB dynamics. Extensive numerical simulations validate the theoretical findings and highlight the critical impact of treatment effectiveness and contact reduction on disease suppression. Furthermore, the model is calibrated using real TB incidence data from Bangladesh (2010–2024), showing excellent agreement between observed and predicted trends. This comprehensive framework offers valuable insights into TB control and provides a robust foundation for public health policy formulation based on nonlinear dynamical systems theory.

Paper ID: ICSHSD-07

Modeling Dengue Dynamics with Fuzzy Parameters: Impact of Media-induced Vaccination and Bed Nets

Shobha Islam[1,*], Md. Shahidul Islam[2] and Md. Kamrujjaman[2]
[1]Department of Mathematical and Physical Sciences, East West University, Dhaka 1212, Bangladesh. [2]Department of Mathematics, University of Dhaka, Dhaka 1000, Bangladesh
Corresponding author: shobha.islam@ewubd.edu

ABSTRACT

This paper presents a novel SVEIR-SEI compartmental model for dengue disease where five key parameters such as transmission rate, mortality rate, recovery rate, biting rate, and vaccination rate are treated as fuzzy numbers. Fuzzy reproduction number is derived as a triangular fuzzy number. Numerical results show that biting rate and vaccination rate are the two most sensitive parameters to crisp reproduction number. Finally, It is found that using bed nets is a more effective strategy for dengue control than media coverage regarding vaccination.

Paper ID: ICSHSD-20

Transmission Dynamics of Nipah Virus in Bangladesh: A Comprehensive Mathematical Modeling Approach

Souyba Jannat[1,*], Md. Tanvir Hasan[1], and Md Hamidul Islam[1]
[1]Department of Applied Mathematics, University of Rajshahi, Rajshahi-6205, Bangladesh
Corresponding author: souybajannat123@gmail.com

ABSTRACT

Nipah virus (NiV), a high-mortality zoonotic pathogen, poses a persistent threat in Bangladesh, transmitted mainly through bat-contaminated raw date palm sap and human-to-human spread. We develop a deterministic QSEI model with a non-susceptible class Q to represent behavioral and geographic isolation, alongside time-dependent interventions. Analytical results reveal a forward bifurcation at $R_0=1$, with transmission rate β and progression fraction δ as key outbreak drivers. Optimal control simulations find combined awareness, treatment, and contact reduction most effective. This framework guides targeted NiV control in resource-limited settings and supports modeling of similar zoonoses.

Paper ID: ICSHSD-23

Dynamics of Rabies Transmission with and Without Vaccination: A Modelling Investigation

Md. Majharul Islam[1, *] and Md. Hamidul Islam[1]
[1]Department of Applied Mathematics, University of Rajshahi, Rajshahi, Bangladesh
**Corresponding author: majharul2585@gmail.com*

ABSTRACT
Mathematical models in epidemiology play a significant role in gaining insight into the dynamical behavior of infectious diseases and can be used to analyze important perspectives of the disease. In our study, we have proposed a mathematical model of rabies transmission among dogs in which we include PrEP and PEP and examined their impact on dog populations. We calculated a vaccination threshold both analytically and numerically from the model, indicating the fraction of the dog population that has to be vaccinated to eradicate the spread of rabies transmission in Dhaka City, Bangladesh. Moreover, we extend our proposed integer-order model into a fractional order model to examine the memory effect on the dynamics of the model.

Paper ID: ICSHSD-27

Investigation of The Spread of COVID-19 of Bangladesh by Using SIR and SVIR Models

Jannatul Ferdous[1], Md Rasel Ahmed[2], Md. Laek Sazzad Andallah[3, *]
[1,2,3]Department of Mathematics, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh.
**Corresponding author: andallah@juniv.edu*

ABSTRACT
In this study, we have examined the dynamics of COVID-19 in Bangladesh, using the SIR and the SVIR model. We use an SIR epidemic model including diseases-induced death rate for understanding the dynamics of the susceptible, infected and recovered population. We also use the SVIR model with birth rate, death rate, and diseases induced-death rate, for understanding the dynamics of the susceptible, vaccinated, infected and recovered population. First of all, the formulation of the SIR model and the SVIR model are discussed. We also discuss about equilibrium points, local stability of the equilibrium, the basic reproduction number, herd immunity threshold the sensitivity analysis and the numerical results of these two models. We use the modified SIR model to estimate the infected and removed population of COVID-19 in Bangladesh. Finally, we compare the results of these two models and show that vaccination is one of the vital tools in diseases control.

Paper ID: ICSHSD-31

Herd Immunity and Prevention in HPV Transmission with Exogenous Reinfection

Md. Mehedi Hasan[1, *], and Md Hamidul Islam[1]
[1]Department of Applied Mathematics, University of Rajshahi, Rajshahi, Bangladesh
**Corresponding author:* mehediamru@gmail.com

ABSTRACT
Cervical cancer, largely resulting from human papillomavirus (HPV), persists due to exogenous reinfection even when natural immunity exists. We developed a deterministic mathematical model—incorporating reinfection—parameterized using VIA test result data from Bangladesh (2019–2023). Analysis and MATLAB simulations reveal a reinfection-induced backward bifurcation, indicating that targeting only primary infections is insufficient for eradication. Optimal control strategies combining targeted prevention and community education—particularly in settings with limited vaccine access—are essential for effective HPV control.

Paper ID: ICSHSD-55

Investigation of Soliton Formation and Modulation Instability in Optical Fibers with Ultrashort Femtosecond Pulses

Md Alamgir Hossain[1] and Md. Nur Alam[2, *]
[1]Department of Mathematics, Govt. Edward College, Pabna-6600, Bangladesh.
[2]Department of Mathematics, Pabna University of Science & Technology, Pabna-6600, Bangladesh.
Corresponding author: nuralam23@pust.ac.bd

ABSTRACT

Nonlinear partial differential equations (NLPDEs) are used to describe a wide range of contemporary scientific disciplines, such as mathematical modelling and physics, plasma physics, atmospheric sciences, marine sciences, hydrodynamics, nonlinear mechanics, and other intricate nonlinear physical processes. Understanding the dynamical characteristics of noteworthy results for higher-dimensional NLPDEs and the behaviour of solitary wave solutions depends heavily on the exact solutions. The nonlocal Kundu–Eckhaus model understands higher-order nonlinearities and nonlocal effects as an integrable extension of the nonlinear Schrödinger equation. Using the adapted (G'/G) expansion (AG'/GE) method, the stability behaviours of dark, bright, periodic multiple, and singular soliton solutions to the nonlocal Kundu–Eckhaus (KE) equation with the parity-time (PT) symmetry model have been investigated. Previous research has ignored the effects of parity-time (PT) symmetry and nonlocal interactions. AG/GE is a well-known technique, especially for representing wave dynamics in quantum and nonlinear optical systems. Using this approach, we obtain accurate travelling wave solutions that evolve into trigonometric and hyperbolic forms, representing various classes of solitons. The results demonstrate the elasticity of the generated soliton solutions and the persistence of localised waveforms under nonlocal conditions, demonstrating that they are stable under tiny disturbances. We created contour, 2D, and 3D graphs to simulate our findings. This study clarifies the enigmatic interpretation of nonlocal nonlinear wave behaviour and provides analytical techniques for further investigation in domains like complex nonlinear systems and optical physics.

Paper ID: ICSHSD-61

Vegetation Pattern Formation in Arid Ecosystems with Nonlocal Dispersal

Riya Akter[1, *]
[1]Department of Mathematics, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh.
Corresponding author: akteriya15@gmail.com

ABSTRACT

This study examines the emergence of vegetation patterns in arid environments using a mathematical model incorporating nonlocal plant dispersal. The system consists of two coupled reaction–diffusion equations for water and plant biomass, which account for rainfall input, plant mortality, and long-range seed dispersal mechanisms. Analytical stability analysis of homogeneous steady states is performed, and numerical simulations reveal the formation of diverse spatial patterns under specific parameter regimes. The results highlight the critical role of non-local dispersal in enhancing ecosystem resilience and provide valuable insights for desertification prevention and ecological restoration strategies.

Paper ID: ICSHSD-66

Bifurcations in Two-Species Dynamical Systems

Saiful Islam[1*] and M. Osman Gani[2]
[1,2]Department of Mathematics, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh.
**Corresponding author: saif.khan.19914@gmail.com*

ABSTRACT
This work investigates bifurcations in dynamical systems, with a particular focus on two-dimensional systems and their ecological applications. The study begins with an introduction to one-dimensional bifurcations, including saddle-node, transcritical, supercritical, and subcritical pitchfork bifurcations, as well as phenomena such as hysteresis and cusp catastrophe. These foundational concepts are then applied to ecological models involving the logistic equation under various harvesting strategies—constant, proportional, and variable—highlighting how changes in parameters can lead to critical transitions in population dynamics. The core of the work explores two-dimensional bifurcations, extending the analysis to encompass not only the bifurcations present in one dimension but also the Hopf bifurcation, which introduces oscillatory behavior and complex dynamics not found in simpler systems. This theoretical framework is then applied to a range of ecological models, such as the classical Lotka-Volterra system modified with logistic growth of prey, systems incorporating nonlinear growth and intraspecific competition, and models with Holling type II functional responses. Special emphasis is placed on the Rosenzweig-MacArthur model, which demonstrates rich dynamics including limit cycles and the paradox of enrichment. Through this progression from theoretical bifurcation structures to ecologically grounded models, the work illustrates how bifurcation theory can be used to understand, predict, and potentially manage dynamic changes in ecological systems.

Paper ID: ICSHSD-67

Investigation of Soliton Formation in The Benney–Luke Equation for Surface Waves in A Shallow Channel with Surface Tension Effects

Muhammad Ziaul Haque[1] and Md. Nur Alam[2, *]
[1,2]Department of Mathematics, Pabna University of Science & Technology, Pabna-6600, Bangladesh.
**Corresponding author: nuralam23@pust.ac.bd*

ABSTRACT
The Benney-Luke equation is crucial for simulating wave propagation in shallow water, particularly when elucidating the influence of surface tension. Numerous analytical and numerical methods have been used to solve this equation; however, many of the previous studies have either produced a limited number of solution classes or have not consistently verified the stability of the solutions. This paper fills these gaps by examining a broader range of analytical soliton solutions to the Benney–Luke equation using four variations of the ansatz approach. The research yields numerous novel solutions, including lump solutions, kink–soliton combinations, and bright, dark, unique, hyperbolic, exponential, periodic, and rational solitons. We examine the dynamical behaviour of these solutions using 2D, contour, density, rotational 3D, and surface 3D graphical representations. These representations exhibit stability properties and potentially chaotic patterns under specific parameter regimes. We immediately replace each answer in the original problem to verify its validity. The findings offer new insights into the dynamics and formation of nonlinear wave structures and contribute to our understanding of complex wave phenomena in shallow water systems. Furthermore, the proposed methodological framework demonstrates accuracy, efficacy, and broad applicability, making substantial contributions to nonlinear dynamics, applied mathematics, and physical oceanography.

Paper ID: ICSHSD-69

Optimal Climate Economic Control: Modeling Temperature, Forest Area, Carbon Emissions and GDP Trade-Offs

Maliha Tasnim[1, *], and Md. Kamrujjaman[1]
[1]Department of Mathematics, University of Dhaka, Dhaka 1000, Bangladesh.
**Corresponding author: malihaluba123@gmail.com*

ABSTRACT
This study develops a time varying nonlinear dynamical system coupling climate–biosphere interactions with GDP to investigate mitigation strategies in South Asia, focusing on Bangladesh. Decoupled subsystems for temperature, forest cover, CO_2 emissions, and GDP are calibrated with empirical data via least squares and correlation analysis. The coupled model incorporates realistic ecological economic feedback and is analyzed for well posedness, equilibria, and stability. Numerical simulations and optimal control indicate early and mid-period reforestation to restore forests and enhance carbon absorption, followed by later clean technology investments, providing a quantitative tool for efficient resource allocation and long-term climate resilience.

Paper ID: ICSHSD-086

Modeling of Herbivore-Plant Interactions with Holling Type II Functional Response in a Random Environment

Abu Jaher[1*]
[1]Department of Mathematics, Jahangirnagar University, Savar, Dhaka-1342.
[*] *Corresponding author: abujaher033@gmail.com*

ABSTRACT
The present analysis reports the effect of radiation and chemical reaction on an unsteady magnetohydrodynamics fluid flow past an oscillating cylinder. The governing equations are formulated in cylindrical coordinates as the object is cylindrical in shape and used in the flow. Then, the dimensionless governing equations of the flow have been solved by applying the explicit finite difference method with the corresponding boundary conditions. To get the numerical values, the Fortran programming language (Compaq Visual Fortran 6.6a) is used. This study's findings have been analyzed based on different known parameter values for the flow. The effect of different parameters like Prandtl number, Schmidt number, Grashof number and Modified Grashof number has been analyzed. With the increases and decreases of magnetic field the velocity curves are in downward-upward direction for the effect of Lorentz force. The effects of Schmidt number and Prandtl number on the temperature and concentration profiles are also presented.

Paper ID: ICSHSD-097

Vector–Host Model for Dengue Transmission with Vaccination, Treatment, Reinfection, Awareness and Control

Hosneara Khatun[1], Motiur Rahman[1], Nashidul Islam[1] and Most. Nasrin Akhter[1,*]
[1]Department of Mathematics, Dhaka University of Engineering and Technology, Gazipur, Bangladesh.
**Corresponding author: nasrin@duet.ac.bd*

ABSTRACT
Dengue fever is one of the most prevalent mosquito-borne viral diseases, causing severe morbidity, mortality, and economic loss in tropical and subtropical regions. Despite extensive prevention efforts, dengue control remains difficult due to waning vaccine immunity, reinfection, and limitations of conventional interventions. To address these challenges, we develop a comprehensive vector–host compartmental model that integrates vaccination with partial efficacy, reinfection, treatment, public awareness, mosquito life-cycle dynamics, and insecticide-based vector control. The human population is divided into six compartments: susceptible, vaccinated, exposed, infectious, treated, and recovered, while the mosquito population consists of aquatic, susceptible, exposed, and infectious groups. The system is formulated using nonlinear differential equations, with positivity and boundedness ensuring biological feasibility. The disease-free equilibrium and basic reproduction number (R_0) are derived via the next-generation matrix, and local stability is examined through the Jacobian method. Sensitivity analysis using Partial Rank Correlation Coefficients identifies the most influential parameters.Results show that the disease-free equilibrium is stable when $R_0<1$, while an endemic equilibrium exists for $R_0>1$. Sensitivity findings reveal that infection progression, mosquito biting rate, and transmission probabilities are key drivers of dengue spread, whereas treatment, vaccination, insecticide efficacy, and awareness significantly reduce transmission. Numerical simulations further confirm that combining vaccination and treatment with vector control and awareness campaigns markedly reduces both human and mosquito infections. This study provides a unified modeling framework for dengue dynamics and highlights the importance of integrated strategies for sustainable control and effective outbreak management.

Paper ID: ICSHSD-103

Understanding The Tri-trophic Food Chain Dynamics of Interacting Populations

Moin Uddin[1,*]
[1]Department of Mathematics, Jahangirnagar University, Savar, Dhaka-1342.
**Corresponding author: moin.stu2018@juniv.edu*

ABSTRACT
The tri-trophic food chain model is analyzed to study steady states, stability, and dynamic behavior. The uniqueness and non-negativity of solutions are established, followed by a sensitivity analysis that shows how small parameter changes impact system dynamics. Numerical simulations, including reaction–diffusion extensions, reveal spatial effects such as uniform states and Turing patterns. A modified model with Holling type II response further highlights the role of functional responses and spatial scales in ecological stability and pattern formation.

Paper ID: ICSHSD-110

Dynamics of Two-species Mutualism: An Optimal Control Approach

M. Rakib Akun[1, *]
[1]Department of Mathematics, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh.
[*]*Corresponding author: rakibhasanakash725@gmail.com*

ABSTRACT
This study develops a mathematical model for two-species mutualism using Holling-type II functional response to reflect nonlinear ecological benefits [1-4]. The model is biologically well-posed, with non-negative and bounded solutions. Equilibrium points are analyzed for existence and stability through qualitative methods. Numerical simulations support the analytical findings across varying ecological conditions. Sensitivity analysis reveals key parameters influencing population dynamics. An optimal control framework is introduced to sustain species coexistence [3]. Time-dependent control strategies are applied and solved using the Runge–Kutta method to promote long-term, sustainable mutualism between species.

Paper ID: ICSHSD-125

Mathematical Analysis of Periodic Travelling Waves in A Reaction-Diffusion Framework

Md Showkat Akber[1, *], Md Munna Hassan[1], and M. Osman Gani[1]
[1]Department of Mathematics, Jahangirnagar University, Dhaka, 1342, Bangladesh.
* *Corresponding author: showkatakbers@gmail.com*

ABSTRACT
Spiral waves are central to phenomena ranging from chemical reactions to cardiac arrhythmias and morphogenesis, yet their instability remains a critical challenge. Periodic traveling waves (PTWs), emitted from spiral cores, hold the key to understanding these dynamics. In this work, we examine PTWs in the diffusive chlorine dioxide-iodine-malonic acid (CDIMA) model through analytical proofs and numerical bifurcation analysis. We establish existence and uniqueness, identify a Hopf bifurcation that generates oscillatory PTWs, and locate the Eckhaus bifurcation boundary where stability is lost. Our results link spiral wave breakdown in the far field directly to Eckhaus-instability-driven destabilization of PTWs.

Paper ID: ICSHSD-131

Flapping Motion of Birds, Insects, and Butterflies

Sadia Rahman Mithila[1, *], and Md. Sabbir Alam[1]
[1]Department of Mathematics, Jahangirnagar University, Savar, Dhaka-1342.
*Corresponding email: sadiarahmanmithila152@gmail.com

ABSTRACT
Nature shows different kinds of flapping flight, each shaped by evolution and the environment. This research studies the flapping motion of birds, insects, and butterflies, focusing on how their wings move and the aerodynamic forces involved. Birds usually fly with steady aerodynamics using smooth wings and joint actions, while insects and butterflies rely on unsteady forces like delayed stall, rotational lift, and wake capture. By combining biological study, mathematical modelling, and MATLAB simulations, the research examines factors such as wingbeat frequency, stroke amplitude, elevation angle, and pitch angle. The findings show how different species create lift and thrust through unique strategies and highlight the importance of wing flexibility and timing for control. These results improve our understanding of natural flight and support the design of bio-inspired aerial systems like micro and nano aerial vehicles (MAVs and NAVs). This study connects biology, physics, and engineering to explain the main principles of flapping flight in nature.

Paper ID: ICSHSD-149

Evaluating Tropical Cyclone Energetics Over The Bay of Bengal: Insights from WRF Model Simulations

Kh. Hafizur Rahman[1, 2, *], M. A. Taher[2]
[1] Bangladesh Meteorology Department, Agargaon, Dhaka.
[2] Department of Mathematics, Dhaka University of Engineering & Technology, Gazipur-1700
Corresponding author email: rs77_hafizbmd@yahoo.com

ABSTRACT
Tropical cyclones (TCs) over the Bay of Bengal (BoB) are among the most destructive worldwide, with their impact determined not only by intensity but also by storm size and energy. Two commonly used indices, Accumulated Cyclone Energy (ACE) and Integrated Kinetic Energy (IKE), quantify TC energetics. ACE reflects intensity-based climatology, and IKE offers a more comprehensive measure of storm destructive potential. In this study, we analyze ACE and IKE for selected BoB TCs such as Amphan (2020), Bulbul (2019), and Titli (2018) using the Weather Research and Forecasting (WRF) model and compare them with best track data from the International Best Track Archive for Climate Stewardship (IBTrACS). Results show that WRF generally captures the temporal evolution of ACE and IKE but exhibits systematic biases in magnitude, mainly due to an underestimation of intensity as indicated by IBTrACS-based estimates. This study emphasizes the importance of incorporating both ACE and IKE metrics when evaluating TC energetics in the BoB region.

Paper ID: ICSHSD-154

Exact Traveling Wave Solutions of The Fitzhugh–Nagumo Equation for Excitable System

Khondaker Fahad Mia[1,3, *], A. K. M. Nazimuddin[2], and M. Osman Gani [3]
[1]Department of Computer Science and Engineering, National Institute of Textile Engineering and Research, Savar, Dhaka, 1350, Bangladesh.
[2]Department of Mathematical and Physical Sciences, East West University, Dhaka, 1212, Bangladesh.
[3]Department of Mathematics, Jahangirnagar University, Savar, Dhaka, 1342, Bangladesh.
Corresponding email: kfmia@niter.edu.bd

ABSTRACT
A basic mathematical model for explaining excitability and pulse propagation in physical and biological systems is the FitzHugh-Nagumo (FHN) equation. This model can create different types of wave patterns, like fronts and single waves, while keeping the cubic nonlinearity that is common in systems that can be excited. In this research, we used an analytical method called the new auxiliary equation method, which is a structured way to find correct traveling wave solutions for nonlinear equations. We generated various soliton solutions and examined their physical significance by assigning specific values to the parameters involved. This study also demonstrates how these precise solitons facilitate a deeper understanding of excitations in the simplified FHN equation. It is unveiled that the proposed approach provides a more powerful mathematical tool for generating exact traveling wave solutions for a wide variety of nonlinear evolution equations.

Paper ID: ICSHSD-162

Numerical Simulation of A Macroscopic Multilane Traffic Flow Model Based on Linear Velocity-Density Function

Md Rasel Ahmed[1, *], Bitu Joydhar[2], Md. Laek Sazzad Andallah[3], Jannatul Ferdous[3]
[1]Department of Mathematics, Uttara University, Dhaka, Bangladesh.
[2]Department of Mathematical & Physical Sciences, East West University, Dhaka, Bangladesh.
[3]Department of Mathematics, Jahangirnagar University, Dhaka, Bangladesh
Corresponding author: raselju47@gmail.com

ABSTRACT
In this paper, we assume a macroscopic multilane traffic flow model based on linear velocitydensity relationship, which yields a non-linear first-order system of hyperbolic partial differential (PDE) equations as an initial boundary value problem (IBVP). Due to the analytical solution's complexity, we explore the numerical solution by using the finite difference method, namely first-order Explicit Upwind Scheme, the Lax-Friedrich Scheme, and the second-order Lax-Wendroff Scheme. We determine the well-posed ness and the stability analysis, and we explore the convergence of the numerical solution, and finally compare the three numerical schemes.

Paper ID: ICSHSD-165

Nonlinear Waves Across Fields: Soliton Solutions and Dynamical Insights from The Modified KdV–Burgers Equation

Md. Abdus Saad[1*] and Dr. Md. Tarikul Islam[1]
[1]Department of Mathematics, Faculty of Science, Hajee Mohammad Danesh Science & Technology University, Dinajpur-5200
[*]*Corresponding email: abdussaad.math@gmail.com*

ABSTRACT
This research focuses on the behavior of nonlinear waves described by the mKdV-Burgers equation in applied physical scenarios. Using the improved auxiliary equation method and improved tanh technique, we obtain explicit solutions that include localized, kink, anti-kink, and periodic waves. Solutions are visualized through 3D surfaces, 2D profiles, and contour plots to illustrate diffusion effects. A dynamical system analysis with phase portraits, Hamiltonian energy, and time series reveals how varying diffusion like real, imaginary, or time-dependent affects wave stability and energy distribution. M-soliton interactions are also studied, showing phase shifts and shape changes. Findings are relevant to fluids, plasmas, optical communication, and traffic flow.

Paper ID: ICSHSD-184

Nonlinear Diffusion Dynamics of Emphysema Progression

Md. Khalil Islam[1, *] and M. Osman Gani[1]
[1]Department of Mathematics, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh
**Corresponding author: khalil.stu2018@juniv.edu*

ABSTRACT
This study presents a nonlinear reaction-diffusion model to describe emphysema progression, where protease-mediated tissue damage spreads through the lung parenchyma with concentration-dependent diffusivity $D(C) = D^0 e^{-kC}$. The model extends Fick's 2nd law by incorporating a logistic reaction term, capturing the balance between protease production and antiprotease inhibition. Using a traveling wave ansatz, the PDE is reduced to a system of ODEs, enabling qualitative analysis of fixed points, stability, and phase trajectories. Phase plane analysis reveals two key states: a stable fixed point at $(0,0)$, representing recovery from mild damage, and a saddle point at $(1,0)$ acting as a threshold between resolution and chronic progression. Nullcline intersections and trajectory simulations illustrate the basin of attraction around the healthy state. The structure of the phase portrait suggests that initial conditions determine long-term outcomes, small perturbations heal, but larger one lead to sustained damage. This work provides a mechanistic understanding of how spatial and biological factors interact in emphysema, offering insights into early intervention strategies before irreversible damage occurs. The basin of attraction around the healthy state highlights the role of initial conditions in disease outcome. This work provides a predictive framework for understanding emphysema progression and identifying critical thresholds for intervention.

Paper ID: ICSHSD-185

An Approximation Technique for Solving Cubic-Quintic Duffing Oscillator

M. Kamrul Hasan[1, *], Md. Ashraful Huq[1] and M S Alam[1]
[1]Department of Mathematics, Rajshahi University of Engineering & Technology (RUET), Rajshahi-6204, Bangladesh.
[*]*Corresponding email: mkh2502@yahoo.com*

ABSTRACT
An approximation technique was presented for solving strong nonlinear oscillators. The method is independent of harmonic functions. The determination procedure of related unknown coefficients of this method is similar to that of harmonic balance method. The main advantage of this method is that the algebraic equations of unknown coefficients are linear. In contrast, the corresponding equations for harmonic balance method are nonlinear. The technique was illustrated by some strong nonlinear oscillators. In this article, the technique is applied to solve cubic-quintic Duffing oscillator.

Paper ID: ICSHSD-198

Application of The Sine-Gordon Expansion Method to Obtain Soliton Solution of The KdV and mKdV Equations

Dr. Shahansha Khan[1], Md. Mehedi Hasan Modern[1, *], Abdus Salam[1], Muktarebatul Jannah[1]
[1]Department of Mathematics, Uttara University, Dhaka, Bangladesh
**Corresponding email: mehedi.modern@uttarauniversity.edu.bd*

ABSTRACT

The study of nonlinear partial differential equations (PDEs) has attracted considerable attention due to their fundamental role in modeling physical phenomena such as shallow water waves, plasma physics, fluid mechanics, and nonlinear optics. Among these, the Korteweg-de–de Vries (KdV) and modified Korteweg-de–de Vries (mKdV) equations are classical integrable models that describe the evolution of nonlinear dispersive waves and exhibit rich soliton dynamics. The KdV equation governs the balance between nonlinearity and dispersion in shallow water waves, while the mKdV equation extends this framework to account for stronger nonlinear effects, leading to kink-type and pulse-type solitons. Deriving exact solutions for these equations not only deepens mathematical understanding but also provides powerful tools for predicting nonlinear wave behavior in applied sciences. In this work, the sine Gordon expansion method (SGEM) is systematically applied to obtain exact soliton solutions of the KdV and mKdV equations. The SGEM utilizes the auxiliary equation of the sine–Gordon type to construct solution expansions, which, under appropriate traveling wave transformations, reduce the nonlinear PDEs to solvable ordinary differential equations (ODEs). This approach generates a broad class of explicit solutions expressed in terms of hyperbolic, trigonometric, and exponential functions. These include single- and multi-soliton solutions, kink- type waves, and periodic wave structures. For the KdV equation, the derived solutions capture localized solitary waves that balance nonlinearity with dispersion, while for the mKdV equation, the results include both bright solitons (sech-type) and dark solitons (tanh-type). Additionally, periodic trigonometric solutions highlight oscillatory dynamics that may arise in nonlinear dispersive systems. The exact forms of the solutions confirm that the SGEM not only recovers known results but also provides new representations that enrich the solution space of these classical equations. Graphical illustrations in both two and three dimensions are presented to highlight the physical features of the solutions. The figures demonstrate how different parameter choices influence amplitude, width, and propagation speed of solitons, thereby clarifying the dynamics of nonlinear wave evolution. The analysis emphasizes the versatility and efficiency of the SGEM compared with other existing methods, particularly in handling equations of KdV type. Overall, this study demonstrates that the sine–Gordon expansion method is a powerful and unified analytical tool for obtaining exact solutions of nonlinear evolution equations. The results for the KdV and mKdV equations reaffirm the importance of soliton theory and provide a framework for applying SGEM to other nonlinear dispersive models in mathematical physics.

Paper ID: ICSHSD-202

A More Efficient Differential Transform Method for Solving Duffing- Harmonic Oscillator

Mostafa Amir Faishal[1] and M. Kamrul Hasan[1, *]
[1]Department of Mathematics, Rajshahi University of Engineering & Technology, Rajshahi-6204, Bangladesh
[*]Corresponding email: mkh2502@yahoo.com

ABSTRACT

In this paper, a more efficient differential transform method (DTM) is developed for solving the Duffing harmonic oscillator. The proposed approach significantly reduces computational effort while maintaining high accuracy in approximating the nonlinear dynamic behavior of the system. Comparative analysis with conventional methods demonstrates the effectiveness and efficiency of the method in obtaining analytical-numerical solutions for various forms of Duffing oscillators. The results show that the improved DTM is a powerful tool for analyzing nonlinear dynamic systems.

Paper ID: ICSHSD-199

Solution Structures of Burgers and Burgers– Fisher Equations Via Sine-Gordon Expansion Method

Dr. Shahansha Khan[1], Md. Mehedi Hasan Modern[1, *], Tania Sultana[1], S.M. Kamal Hossain[1]
[1]Department of Mathematics, Uttara University, Dhaka, Bangladesh
**Corresponding author: mehedi.modern@uttarauniversity.edu.bd*

ABSTRACT

Nonlinear partial differential equations (PDEs) play a fundamental role in describing a wide range of physical, chemical, and biological processes. Among them, the Burgers equation and its extension, the Burgers–Fisher equation, have been widely studied due to their significant applications in fluid mechanics, gas dynamics, traffic flow, combustion theory, and reaction– diffusion systems. The Burgers equation captures essential features of nonlinear convection and diffusion, while the Burgers–Fisher equation incorporates additional reaction terms that model population growth and chemical kinetics. Despite their relative simplicity, these equations admit a rich variety of solution structures, including shock waves, traveling fronts, and solitary wave solutions, which provide deeper insights into the underlying physical mechanisms. In this work, we apply the Sine–Gordon expansion method (SGEM), a systematic and powerful analytical technique, to investigate exact traveling wave solutions of the Burgers and Burgers– Fisher equations. The SGEM relies on the auxiliary equation of the sine–Gordon type to construct a series expansion that leads to closed-form soliton, periodic, and singular solutions. By implementing appropriate traveling wave transformations, both equations are reduced from PDEs into ordinary differential equations (ODEs). Subsequently, the SGEM is employed to extract multiple classes of exact solutions expressed in terms of hyperbolic, trigonometric, and exponential functions. The obtained results reveal diverse solution structures, including kink-type solitons, bell-shaped solitary waves, and periodic wave trains. In particular, for the Burgers equation, we establish solutions that describe dissipative shock-like structures and diffusion-dominated solitary waves. For the Burgers–Fisher equation, the derived solutions exhibit wavefronts and propagating solitons that reflect the competition between nonlinear convection, diffusion, and reaction dynamics. Furthermore, the sech- and csch-type solutions demonstrate the presence of localized pulses, while periodic solutions highlight oscillatory behavior relevant to biological and chemical pattern formation. To illustrate the physical relevance and clarity of the obtained solutions, graphical representations are provided in both two-dimensional and three-dimensional plots. These visualizations illustrate how various parametric choices affect the amplitude, width, and propagation speed of the traveling waves. Such solution structures are not only mathematically significant but also applicable in predicting and modeling wave propagation in realistic physical systems. The study confirms that the sine–Gordon expansion method is an efficient and versatile analytical tool for constructing exact solutions to nonlinear PDEs. The methodology can be further extended to other nonlinear evolution equations in higher dimensions, contributing to the broader field of mathematical physics and applied nonlinear dynamics.

Paper ID: ICSHSD-219

Mathematical Modeling of Bivalve-Phytoplankton Interactions and Nutrient Dynamics in Aquatic Ecosystem

Md. Anishur Rahman Palash[1] and Md. Haider Ali Biswas[1, *]
[1]Mathematics Discipline, Khulna University, Khulna-9208, Bangladesh
[*]Corresponding email: mhabiswas@yahoo.com

ABSTRACT

Intricate networks of living and non-living components, aquatic ecosystem have an impact on water quality, nitrogen cycling and productivity. A mathematical model that represents the interactions of bivalve mollusk's, phytoplankton, nutrients, light, bio deposits, sediment, and turbidity in a regulated aquatic environment is presented in this work. Bivalves' growth, phytoplankton's resource-based, limited growth, nutrient uptake and recycling, and the processes of sediment deposition and resuspension are all included in the model. This provides a holistic perspective of ecosystem functioning. The study determines equilibrium states, stability conditions, and potential outcomes for the coexistence or extinction of important components by evaluating the system. This provides important information components by evaluating the system. This provides important information on how resilient ecosystems are. The study demonstrates the critical role bivalves play in preserving water quality and productivity by highlighting their effects on nutrient and light availability. The sustainable management of aquatic resources is supported by this work, which combines ecological modeling with empirical data. It tackles the Sustainable Development Goals (SDG 6 and 14) of biodiversity preservation, ecosystem conservation, and clean water. The model facilitates simulations and management techniques for aquatic ecosystem and establishes the foundation for future research.

Paper ID: ICSHSD-221

Sustainable Sericulture Through Mathematical Modeling of Silkworm Growth, Virus Propagation and Piezoelectric Temperature Control

Nusrat Yesmin Kona[1] and Md. Haider Ali Biswas[1, *]
[1]Mathematics Discipline, Khulna University, Khulna-9208, Bangladesh
**Corresponding email: mhabiswas@yahoo.com*

ABSTRACT

Sericulture, centered on the domesticated silkworm (*Bombyx mori*), is a vital agricultural practice that supports millions of rural livelihoods and contributes significantly to the global textile industry. However, the sericulture industry faces persistent challenges from viral infections, particularly the Nuclear Polyhedrosis Virus (NPV), and environmental stressors such as temperature fluctuations. NPV outbreaks often lead to severe silkworm mortality and considerable economic losses, while unstable rearing conditions further reduce silk yield and quality. Taking all these incidents into account, we develop a non-linear compartmental mathematical model to analyze the population dynamics of silkworm under the dual influence of NPV and environmental temperature. The model incorporates logistic growth of healthy silkworm, virus transmission and increment of infected silkworm, population dynamics of virus in the environment, while introducing piezoelectric energy harvesting as a novel temperature regulation mechanism. By converting mechanical vibrations into electrical energy, piezoelectric system provides a sustainable method for maintaining optimal rearing conditions, suppressing viral replication and enhancing cocoon production. Also, silk-protein based nano-fibers has piezoelectric property. The results demonstrate how combining epidemiological modeling with renewable energy technology can support sustainable sericulture, which is in line with several SDGs, such as Climate Action, Affordable and Clean Energy, and Zero Hunger. This research not only bridges a critical gap between biological and environmental factors in sericulture but also offers predictive insights for improving silk yield, farmer profitability and eco-friendly agricultural practices.

Paper ID: ICSHSD-231

Mathematical Modelling Approach to Analyze Water Scarcity Dynamics and Effects in The Chittagong Hill Tracts for Sustainable Development

Wino Prue Chowdhury[1] and Md. Haider Ali Biswas[1, *]
[1]Mathematics Discipline, Khulna University, Khulna-9208, Bangladesh
**Corresponding email: mhabiswas@yahoo.com*

ABSTRACT

Water scarcity is a pressing global challenge that directly threatens human well-being, ecosystems, and sustainable development. In Bangladesh, the Chittagong Hill Tracts face a unique combination of physical and economic water scarcity: freshwater sources such as springs and streams often dry up during the summer months, while heavy rainfall in the monsoon season remains underutilized due to inadequate storage systems and infrastructure. This study aims to analyze the dynamics and effects of water scarcity in the Chittagong Hill Tracts of Bangladesh through a mathematical modelling approach. The research will focus on developing a system of nonlinear differential equations to represent interactions among key variables such as water availability, population pressure, deforestation, land-use practices, pollution, and seasonal climatic variability. Community adaptation practices such as rainwater harvesting and bamboo pipe distribution systems will also be incorporated to reflect indigenous resilience strategies. The proposed model will be examined for equilibrium points, stability conditions, and sensitivity to different parameters, with the objective of identifying thresholds and scenarios that influence long-term water security. By adopting this mathematical modeling framework, the study expects to provide new insights into the drivers of water scarcity in the CHT and offer a scientific foundation for policy interventions. The anticipated contribution is twofold: first, to bridge the gap between quantitative modeling and indigenous knowledge systems, and second, to support strategies that align with the Sustainable Development Goals (SDGs), particularly SDG 6 (Clean Water and Sanitation), SDG 13 (Climate Action), and SDG 15 (Life on Land).This research will therefore serve as both an academic and practical tool, guiding policymakers, NGOs, and local communities toward sustainable water resource management in a region highly vulnerable to climate change and socio-economic pressures.

Paper ID: ICSHSD-242

Mathematical Analysis of The Adverse Effects of Air Pollution on Tree Health and Ecosystems

Sadia Shihab Sinje[1], and Md. Kamrujjaman[1,*]
[1]Department of Mathematics, University of Dhaka, Dhaka-1000, Bangladesh.
[*]*Corresponding author: kamrujjaman@du.ac.bd*

ABSTRACT
Haze or fog that has been intensified by smoking or other air pollution is referred to as smog. It is one of the main elements influencing both the immediate and long-term health of humans and animals. Many illnesses are influenced by the rising pollution levels. Considering Dhaka is one of the most heavily the world's most populous metropolis, smog is a major factor in an alarming array of health issues affecting both humans and animals. Trees are very important for climate. Tree gives us oxygen to breath. Trees are negatively impacted by air pollution. It stops forests from growing. In this paper, firstly we describe the air pollution in Bangladesh and causes of air pollution. Then, we write the negative effects of air pollution on forest. After that, we develop mathematical model for negative effects of air pollution on trees, humans, animals that eat trees for sustenance. We describe the positivity and boundedness of the model. Then, we solve the model and find the conditions for stability. After that, we give numerical examples and write about the steps should be taken to mitigate air pollution to control the negative effects of air pollution on forest.

Paper ID: ICSHSD-245

When Guests Become Predators: An Analytical Predator–Prey Framework Linking Tourists and The Environment to Destination Sustainability

Soumitro Kumar Das[1,*], Shreya Dash Titli, Effat Rowja[1], Tithy Saha[2] & Tahsin Fahim Ratul[3]
[1]Department of Applied Mathematics, University of Rajshahi, Rajshahi-6205, Bangladesh.
[2]Department of Food and Nutritional Science, Aff. with University of Rajshahi, Rajshahi-6205, Bangladesh.
[3]Department of Mathematics, University of Rajshahi, Rajshahi-6205, Bangladesh.
**Corresponding author: sdasshuvro@gmail.com*

ABSTRACT
Environmental degradation and tourism growth represent coupled processes that determine destination sustainability across economic, ecological, and social dimensions, yet our policy framework treats these dynamics independently rather than as interdependent systems. This paper developed a mathematical framework to analyze tourism-environment interactions through a system of ordinary differential equations with two compartments, (ET), where environmental health follows logistic recovery toward carrying capacity K like that of a pray. While tourism volume, like a predator species, exhibits consumer-resource dynamics, governed by the Holling Type-II functional response. This paper derived analytical solutions, including Jacobian matrices, and eigenvalues, to characterize system behavior across parameter space. With this analysis using Mathematica, the model reveals three equilibrium states: tourism vanishes ($T\approx0$) if environment is collapsed ($E\approx0$), a pristine environment ($E\approx K$) with zero tourism ($T\approx0$), and sustainable coexistence, whose stability was analyzed using the Routh-Hurwitz Criterion and the Lyapunov function. The study identified two primary bifurcation mechanisms: a transcritical bifurcation at $h + Ks = \delta$, where h =destination attractiveness, s denotes tourism growth, and δ captures visitor departure, marking the threshold between sustainability and collapse, and a Hopf bifurcation boundary defining oscillatory dynamics. Then the sensitivity analysis quantifies how policy interventions, including conservation investment η, infrastructure development, and visitor management, directly influence equilibrium positions (E^*,T^*). Further with the numerical analysis using Python, we simulate the conditions to validate our model's predictions. The framework demonstrated practical utility for integrated destination management across diverse socio-ecological contexts while providing planners with transparent tools to evaluate intervention strategies.

Paper ID: ICSHSD-253

Toxicological Impact of Nanoplastic on The Pulmonary Surfactant Film at Alveolar Air-Water Interface

Khalid Bin Kaysar[1], Syed Rashedul Islam Sakil[1] , and Md. Zohurul Islam[1, *]
[1]High-Performance Computing (HPC) Laboratory, Department of Mathematics, Jashore University of Science and Technology, Jashore-7408, Bangladesh
[*]*Corresponding author: mz.islam@just.edu.bd*

ABSTRACT
Airborne microplastics (MPs) and nanoplastics (NPs) are increasingly found in various environmental settings, posing significant risks to respiratory health. The polyethylene oxide (PEO) nanoplastic inhalation allows them to travel through the branched pulmonary airways to the alveolar region. Here, these particles meet the alveolar surfactant monolayer, a crucial film that regulates surface tension and maintains alveolar stability. In this paper, we employed coarse- grained molecular dynamics (CGMD) to investigate the interfacial behavior of NPs on a model pulmonary surfactant monolayer. Our results indicate that surfactant lipids spontaneously adsorb onto NP surfaces, forming a lipid-rich corona that alters the interfacial properties of the NPs and impacts the lipid film structure.

Paper ID: ICSHSD-261

Integrating Control Theory with hdWGCNA for Enhanced Identification of Dynamic Gene Network Modules

Aoutul Nabi Purna[1], Most. Humaira Sultana[2], Mohammad Sahadet Hossain[2,] and Md. Alamin[2, *]
[1]Department of Electrical and Computer Engineering, School of Engineering and Physical Sciences, North South University, Dhaka-1229, Bangladesh
[2]Department of Mathematics and Physics, School of Engineering and Physical Sciences, North South University, Dhaka-1229, Bangladesh
[*]*Corresponding author: md.alamin06@northsouth.edu*

ABSTRACT
Traditional Gene Co-expression Networks (GCNs), while valuable for identifying gene modules, are often limited by their static and undirected nature, primarily reflecting correlations rather than causal relationships or dynamic processes. To overcome this, our research proposes an innovative integration of High Dimensional Weighed Gene Co-expression Network Analysis (hdWGCNA) with control theory. hdWGCNA, an extension of standard WGCNA, is particularly well-suited for large, high-dimensional datasets like whole transcriptomes, efficiently managing computational demands through block-wise processing. This approach allows for robust module detection and hub gene identification, which are crucial for understanding complex biological systems. By incorporating control theory, we aim to transition from simple observations of gene correlations to dynamic analysis and actual manipulations within gene networks. This will enable the identification of driver genes, the simulation of transcription factor (TF) perturbations, and the potential to steer gene expression. This novel methodology will be critical for pinpointing more robust and significant gene modules, especially those implicated in challenging conditions like cancer. Our objectives include developing a comprehensive model that integrates GCNs with control theory, identifying key biomarkers and driver regulators, and ultimately applying these findings to advance health science and accelerate drug discovery. This study seeks to move beyond static network analysis to unlock the dynamic control mechanisms underlying gene expression.

Paper ID: ICSHSD-262

Modified Simple Equation Method for Nonlinear Evolution Equations: (2+1)-d KP and Fifth-Order Model

A. K. M. Kazi Sazzad Hossain[1, 2, *], Md. Ismail Hossain[1], Md. Akher Chowdhury[1], Md. Ruhul Amin[1], Md. Hannan Miah[1], M. Ali Akbar[2]
[1]Department of Mathematics, Begum Rokeya University, Rangpur, Bangladesh
[2]Department of Applied Mathematics, University of Rajshahi, Bangladesh
[*]*Corresponding author: kazi_bru@yahoo.com*

ABSTRACT
This article utilizes the modified simple equation method to derive exact traveling wave solutions for the Kadomtsev-Petviashvili equation and the second extended fifth-order nonlinear equation. The Kadomtsev-Petviashvili equation, a two-dimensional generalization of the Korteweg-de Vries equation, models shallow water waves with nonlinear and dispersive effects and has applications in plasma physics, fluid dynamics, and nonlinear optics. The modified simple equation method effectively generates traveling wave solutions-such as solitons, kinks, and other localized structures-that are crucial in modeling nonlinear physical systems. These solutions are valuable in applied mathematics, physics, and engineering. The obtained solutions, expressed through trigonometric and exponential functions, include solitary and periodic wave profiles. Solitons, in particular, are widely observed phenomena; for example, they enable long-distance data transmission through optical fiber networks with minimal signal loss. Overall, the modified simple equation method proves to be an efficient and accurate tool for solving nonlinear evolution equations. It enhances the understanding of complex systems and holds promise for broad applications across scientific and engineering disciplines.

Paper ID: ICSHSD-265

Integrated Analysis of Gene Expression and Chromatin Accessibility in PBMCs

Mohammad Rakon Ud Doulla Sakib[1], Most. Humaira Sultana[2], Atikur Rahman Khan[2], and Md. Alamin[3, *]
[1]Department of Biochemistry and Microbiology, North South University, Dhaka-1229, Bangladesh
[2]Department of Management, North South University, Dhaka-1229, Bangladesh
[3]Department of Mathematics and Physics, North South University, Dhaka-1229, Bangladesh
[*]*Corresponding author: md.alamin06@northsouth.edu*

ABSTRACT
Understanding the intricate regulatory landscape of human peripheral blood mononuclear cells (PBMCs) is crucial for deciphering immune responses and disease mechanisms. This study investigated PBMC datasets using both CITE-seq and Multiome techniques, providing a comprehensive view of gene expression and chromatin accessibility. Our analysis focused on the cell-type-specific expression and chromatin accessibility of three key genes: Hemoglobin Beta Subunit (HBB), GZMB, and MS4A1. We observed that HBB expression was predominantly confined to erythroid lineage cells, such as erythroblasts, normoblasts, and proerythroblasts, with expression levels reaching up to 2×107. Conversely, lymphocytes and myeloid cells showed minimal to no HBB expression, underscoring its role in oxygen transport within red blood cells. GZMB showed concentrated expression in cytotoxic populations, specifically NK cells and CD8+ T cells, with peak values up to 78. Moderate expression was also noted in activated CD4+ T cells and CD16+ monocytes, consistent with its function as a cytotoxic protease. Lastly, MS4A1 expression was primarily restricted to B cell groups, including naive CD20+ B, B1, and transitional B cells, reaching levels up to 200, confirming its established role as a B cell surface marker. Non- B cells exhibited negligible MS4A1 expression. Further peak analysis identified 103 distinct peaks across nine significant clusters. These peaks largely aligned with the observed gene expression patterns, indicating lineage-specific regulatory regions. For instance, HBB-associated peaks were enriched in erythroid cells, GZMB peaks in cytotoxic cells, and MS4A1 peaks in B cells. These findings collectively confirm the expected cell-type-

specific transcriptional activity and chromatin accessibility profiles for these crucial genes within the PBMC datasets.

Paper ID: ICSHSD-288

Fractional-Order Modeling of SARS-CoV-2 Variant NB.1.8.1 Using Caputo Derivative: Comparative Analysis of Homotopy and Adams–Bashforth–Moulton Methods

Soumitro Kumar Das[1] and M. Ali Akbar[1,*]
[1]Department of Applied Mathematics, University of Rajshahi, Rajshahi-6205, Bangladesh.
*****Corresponding author: ali.akbar@ru.ac.bd*

ABSTRACT
The present work elaborates a mathematical fractional-order model to examine the dynamics in transmission of the new SARS-CoV-2 variant NB.1.8.1 (Nimbus). A five-compartment epidemiological model is developed in order to address the resulting fractional differential system; two different methodologies are used: the Homotopy Perturbation Method (HPM) and the Adams Bashforth Moulton predictor-corrector method. As shown in the analysis, Caputo fractional derivatives convincingly outperform classical integer-order solutions regarding accuracy and effectiveness in modeling as well as describing the dynamics of COVID-19 because they involve the memory and hereditary concept inherent in any epidemic problem. The comparative analysis of HPM versus the Adams-Bashforth-Moulton method proves that the fractional-order solutions are better able to estimate the nonlocal temporal dependences, as well as the consistency in both the analytical and numerical approximations. The model is empirically based because parameter estimates are consistent with known epidemiology data of the NB.1.8.1 variant. The results allow concluding about the reliability of fractional calculus to construct the elegant models of real epidemiological processes, based on which it is possible to predict the real conditions. This study offers a conclusive pattern in analyzing future forms, with a more analytical perspective.

Paper ID: ICSHSD-315

Dynamics of Human Gastric Acid Secretion of Somatostatin: A Delay Differential Equation Approach

Sanjida Hassan[1,*], M. Humayun Kabir[1], and M. Osman Gani[1]
[1]Department of Mathematics, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh.
[*]Corresponding author: sanjidahassan07@gmail.com*

ABSTRACT
Gastric acid secretion is regulated by a complex endocrine network involving gastrin, histamine, and somatostatin, where feedback timing plays a critical role in maintaining homeostasis. Most mathematical models of gastric acid regulation assume instantaneous feedback, overlooking physiologic delays that may destabilize secretion dynamics and contribute to acid-related disorders. This study presents a mechanistic delay differential equation (DDE) model explicitly incorporating three physiologic delays: antral somatostatin delay ($\boldsymbol{\tau_{SA}}$), corpus somatostatin delay ($\boldsymbol{\tau_{SC}}$), and gastrin-to-acid delay ($\boldsymbol{\tau_{G}}$). The reduced five-variable system captures the dynamics of antral and corpus gastrin (G_A, G_C), somatostatin (S_A, S_C), and acid (A), extending the foundational Marino et al. (2006) model with a delay-based physiological interpretation. Numerical simulations using MATLAB (*ode15s* for ODE baseline and *dde23* for DDE simulations) and two-parameter bifurcation analysis reveal that physiologic delays alone are sufficient to destabilize acid regulation. In the ODE model, gastric acid output remains stable, peaking at ~2.8 mmol/h, whereas the DDE model predicts a Hopf bifurcation at $\tau_{SA} \approx$ 12– 14 minutes and $\tau_{SC} \approx$ 28– 30 minutes, resulting in sustained oscillations with amplitudes exceeding 4.5 mmol/h. Antral delay primarily governs oscillation onset, while corpus delay tunes oscillation amplitude and persistence, demonstrating a delay-encoded control structure in acid regulation. This research bridges nonlinear dynamical systems and gastrointestinal physiology, offering quantitative insight into how feedback timing shapes gastric acid secretion. By explicitly separating antral and corpus feedback pathways, the model not only reproduces observed physiological patterns but also highlights novel intervention strategies: modulating delay timing rather than secretion intensity to restore gastric stability. These findings underscore the potential of mathematical modeling as a predictive tool for acid-related disorders, providing a foundation for future experimental validation and personalized treatment design.

Paper ID: ICSHSD-317

An Integrated SEIR Type Model to Understanding The Spread of Covid-19 in Bangladesh: The Role of Vaccination and Waning Immunity

Nusrat Jahan Nijhum* and M. Osman Gani
Department of Mathematics, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh
**Corresponding author: nijhum.stu2017@juniv.edu*

ABSTRACT

COVID-19 continues to pose a major public health challenge, especially in countries with limited healthcare infrastructure and constrained access to analytical tools. In Bangladesh, accurately modeling disease dynamics is crucial for guiding effective intervention strategies. This study extends the classical SEIR framework by incorporating both vaccination and waning immunity, targeting to provide a clearer understanding of how these factors influence the progression of COVID-19 outbreaks in the country. We constructed a modified SEIR model represented by a system of nonlinear differential equations that integrates vaccination and immunity loss. Epidemiological data for Bangladesh were collected from *Worldometer* and validated against figures reported in peer-reviewed studies. Model simulations were carried out to explore the effects of key parameters, such as vaccination coverage, transmission rates, and other disease-specific factors. Additionally, a sensitivity analysis was performed to determine which parameters most strongly affect outbreak dynamics. The findings show that infection and recovery rates primarily govern the peak of outbreaks, whereas vaccination coverage and waning immunity influence long- term trends. Vaccination alone is insufficient to control transmission without supplementary public health measures. By combining vaccination and waning immunity within a single framework, our model provides a more integrated and realistic depiction of COVID-19 dynamics in Bangladesh compared with conventional SEIR approaches that treat these factors separately.

Paper ID: ICSHSD-326

Understanding The Dynamics of Desertification in A Two Component Reaction-Diffusion System

M. Munna Hasan[1, *], M. Showkat Akber [1], and M. Osman Gani [1,2]
[1]Mathematical and Computational Biology (MCB) Group, Department of Mathematics,
Jahangirnagar University, Savar, Dhaka 1342, Bangladesh
[2]Center for Mathematical Modeling and Applications (CMMA), Meiji University, Tokyo 164-8525, Japan
**Corresponding author: mh.ju.math@gmail.com*

ABSTRACT

It is believed that semi-arid habitats with patterned plants are particularly vulnerable. This emphasizes how crucial it is to comprehend the dynamics of vegetation pattern creation. The Klausmeier model, which is composed of two partial differential equations, is a well-known mathematical model that describes the creation of such patterns. The impact of several parameters, including the as-yet-unconsidered evaporation, on the long-term model outcomes is examined analytically and numerically in this paper. This paper explores the mathematical formulation of the model, its key assumptions, and its implications for understanding desertification processes. We analyze the stability of homogeneous and patterned solutions, highlighting the role of water transport and plant growth dynamics in shaping spatial vegetation patterns. Finally, we discuss bifurcation simulations that provide insights into regime shifts leading to desertification.

Paper ID: ICSHSD-368

Dynamics of Phytoplankton–Zooplankton Interactions and Their Role in Harmful Algal Bloom Formation

Sadia Afrin[1,3*], M. Sahadet Hossain[2], and M. Humayun Kabir[3]
[1]Department of Basic Science, Primeasia University, Dhaka 1213, Bangladesh,
[2]Department of Mathematics and Physics, North South University, Bashundhara R/A, Dhaka 1229, Bangladesh
[3]Mathematical and Computational Biology (MCB) Group, Department of Mathematics, Jahangirnagar University, Savar, Dhaka 1342, Bangladesh
**Corresponding author: sadia.afrin@primeasia.edu.bd*

ABSTRACT
Harmful algal blooms (HABs) in the ecosystem are a global environmental issue that needs to be addressed. Generally, HABs are organisms responsible for reducing the oxygen level in natural waters, severely destroying marine life. These are the rapid growth of algae that can cause harm to animals, people, and the local ecology. It is essential to understand the occurrence of HABs: How and why they bloom, and to improve the detection and forecasting of these seasonal events. To understand the occurrence of HABs, we propose a reaction-diffusion model introducing three components of aquatic systems: non-toxic phytoplankton, toxic phytoplankton, and zooplankton. First, we restrict our attention to the spatially homogeneous case of the proposed system under various ecological circumstances. This talk presents the non-negativity of solutions and qualitative analysis of the system, such as the steady states and their corresponding stability analysis. Furthermore, numerical investigations of the system are performed to illustrate analytical findings under suitable parameter settings. The computational results provide robust ecological insights into preventing and controlling HABs in aquatic systems.

Paper ID: ICSHSD-406

Mathematical Investigation of Dual-strain Tuberculosis Spread in Bangladesh

Fiza Noor[1, *], M. A. Salek[2], J. Nayeem[3], and Sadia Afrin Tuli[1]
[1]Department of Mathematics, Bhawal Badre Alam Govt. College_National University, Bangladesh,
[2]Department of Mathematics, Jahangirnagor University, Bangladesh,
[3]Department of Arts & Sciences, Ahsanullah University of Science and Technology, Tejgaon, Dhaka, Bangladesh.
**Corresponding author: faizanoorpaper80773@gmail.com*

ABSTRACT
This abstract summarizes a mathematical analysis of a two-strain tuberculosis (TB) model in Bangladesh, differentiating between drug-susceptible (DS) and drug-resistant (DR) strains. The model incorporates a unique feature called "amplification," which describes how inadequate treatment of DS TB can lead to the emergence of DR TB. Through both analytical and numerical methods, the study explores the dynamics of the disease and its potential long-term outcomes. Key findings reveal that the long-term behavior of TB in a population is governed by the basic reproduction numbers for each strain, denoted as R0s and R0r. The disease naturally dies out if both reproduction numbers are less than one. However, if R0r is greater than R0s and one, DR TB will persist while DS TB is eliminated. If R0s is greater than R0r and one, both strains will coexist. The research also performed a sensitivity analysis to identify the most critical parameters influencing disease prevalence. It found that the transmission rates (βs and βr) of both strains have the greatest influence on disease prevalence. This highlights that public health interventions should prioritize measures that reduce contact between infected and uninfected individuals, such as patient education on respiratory protection and improved ventilation systems. The second most important factor is the treatment rate (τs and τr). The study's social impact is significant, as it suggests that the most feasible strategy for countries like Bangladesh is to enhance treatment accessibility by reducing costs through universal healthcare. Proper and timely treatment of DS TB is the best way to prevent resistance acquisition, while adequate treatment for DR TB is essential to curb its rise in the population.

Paper ID: ICSHSD-409

Mathematical Modeling and Sensitivity Analysis of Tuberculosis: Identifying Key Drivers for Effective Disease Control

Sadia Afrin Tuli[1, *], and Fiza Noor[1]
[1]Department of Mathematics, Bhawal Badre Alam Govt. College, National University, Bangladesh,
*Corresponding author: tuli94616@gmail.com

ABSTRACT
This study presents a mathematical model for the transmission dynamics of tuberculosis (TB), which is an extension of a previous model that includes a recovered compartment, assuming temporary immunity and the potential for reinfection. The model's feasibility and positivity of solutions were confirmed, establishing it as a biologically sound tool for analyzing TB dynamics. The disease-free equilibrium and the basic reproduction number (R0), a key epidemiological threshold, were computed using the next-generation method. A sensitivity analysis was performed to identify the model parameters that most significantly influence the basic reproduction number (R0) and should be targeted by intervention strategies. The analysis revealed that R0 is directly proportional to the infection rate (β), the recruitment rate (π), and the rate of progression from latent to active TB (α), meaning that an increase in any of these factors will lead to a proportional increase in disease spread. Conversely, R0 is inversely proportional to the TB-induced death rate (d), the natural death rate (μ), and the recovery rate (γ). The social impact of these findings is profound. The model suggests that public health initiatives should focus on widespread public health education campaigns to lower the infection rate (β), proper treatment to reduce the rate of progression TB (α) and to increase the recovery rate (γ). By targeting these specific parameters, communities and economic costs associated with the disease.

Paper ID: ICSHSD-414

Mathematical Analysis of The Truncated-Fractional Complex Kraenkel-Manna-Merle Model: Novel Soliton Solutions, Parameter Effects, and Bifurcation Analysis

S. M. Yiasir Arafat[1, 2, 3, *], and S. M. Rayhanul Islam[2]
[1]Institute of Natural Sciences, United International University, Dhaka 1212, Bangladesh.
[2]Department of Mathematics, Pabna University of Science and Technology, Pabna 6600, Bangladesh. [3]Department of Mathematics, Bangladesh University of Engineering and Technology, Dhaka 1000, Bangladesh.
*Corresponding author: yiasirarafat28@gmail.com

ABSTRACT
This paper examines the changing characteristics and analytical soliton solutions of the truncated-fractional complex Kraenkel–Manna–Merle (TFCKMM) model. The model is highly applicable to analyzing magnetized ceramic-type composites in electronic systems. This study uses two robust and widely used analytical methods: the extended hyperbolic function (EHF) method and the improved F-expansion (IFE) method. Using appropriate complex wave transformations, the TFCKMM model is transformed into an ordinary differential equation. This simplification allows the derivation of soliton solutions in several forms, including hyperbolic, trigonometric, exponential, and rational functions. Contour plots, two-dimensional composite graphs, and three-dimensional visualizations are used to investigate the changing characteristics of the wave pattern. The investigation is conducted by adjusting the selection values of the parameter. We also discuss the effects of nonhomogeneous terms and free parameters on the soliton dynamics. A bifurcation analysis, Hamiltonian function construction, and a stability evaluation are all performed on this model. Through bifurcation analysis, the structural transformations and dynamical properties of the model are more easily understood. This paper compares the results of previous studies with solutions obtained using EHF and IFE schemes. These methods also reveal several new soliton behaviors, such as periodic and single periodic forms, as well as kink and anti-kink behaviors. The findings demonstrate that analytical methods are both efficient and reliable in addressing nonlinear evolution problems. In particular, this study uncovers new solution families for the TFCKMM model, provides new insights into soliton theory, and deepens the understanding of nonlinear wave interactions.

Paper ID: ICSHSD-444

Integrative Analysis of Analytical and Numerical Solutions for Modeling Relapsing-Remitting Multiple Sclerosis

Dipankar Kumar[1], Baharul Islam[1*], Monazat Ali, and Taiyeb Hasan[1]
[1]Department of Mathematics, Bangabandhu Sheikh Mujibur Rahman Science and Technology University, Gopalganj 8100, Bangladesh
**Corresponding author: ibaharul2016@gmail.com*

ABSTRACT
The study aims to explore the dynamics of the multiple sclerosis (MS) model by analyzing its stability, sensitivity, and wave behavior through both analytical and numerical approaches. To achieve these objectives, the generalized Riccati equation method is applied to derive solitary wave solutions, including kink, anti-kink, bell, anti-bell, and singular solutions. Numerical simulations are performed using the Runge-Kutta 4th order method to investigate the effects of parameters changes on the model. Graphical results illustrate how the system responds to variations in these parameters. Sensitivity analysis reveals that the model is highly responsive to even small changes. To study stability and chaotic motion, bifurcation diagrams are employed, visually showing how the system transitions between different states for varying parameters. A comparison between analytical and numerical solutions is conducted to validate the accuracy of the methods used. Additionally, the study examines how wave velocity influences the formation of analytical solutions, further highlighting the model's dynamic characteristics. These findings enhance our understanding of the MS model's behavior and contribute to broader research on nonlinear dynamics in fields such as biology, physics, and engineering.

Paper ID: ICSHSD-472

Optimal Control Applied to The Neural Frequency Model in PTSD Patients

Rifah Tasnia[1, *], and Md. Haider Ali Biswas [1]
[1]Mathematics Discipline, Khulna University, Khulna, Bangladesh.
**Corresponding author: rifahtasnia191214@gmail.com*

ABSTRACT
Post-traumatic stress disorder (PTSD) is characterized by dysregulated neural oscillations and maladaptive frequency dynamics that impair cognitive and emotional processing. Mathematical models of neural frequency adaptation provide a framework to capture these dynamics by describing how neuronal populations shift their response properties across multiple time scales in response to stress-related stimuli. In this work, we formulate an optimal control problem on a neural frequency model for PTSD patients, where control inputs represent potential therapeutic interventions such as pharmacological modulation or neurostimulation. The objective functional minimizes both pathological oscillatory activity and treatment cost, while ensuring stability of neural adaptation. Using Pontryagin's Maximum Principle, we derive necessary conditions for optimality and analyze control trajectories under varying parameter regimes. Numerical simulations demonstrate that adaptive control strategies can selectively dampen pathological high-frequency oscillations while preserving healthy low-frequency rhythms, thereby restoring efficient coding of stimulus information. These findings suggest that optimal control applied to neural frequency models offers a rigorous, quantitative approach to designing interventions for PTSD, bridging theoretical neuroscience and clinical practice.

Paper ID: ICSHSD-479

Analyzing The Impact of Environmental Feedback Through Behavior Dynamics on SIP Ecological–Epidemic Dynamics with The Allee Effect

Md. Nazim Uddin Bhuiyan[1], Md. Saddam Hossain[1, *], and K. M. Ariful Kabir[1]
[1]Department of Mathematics, Bangladesh University of Engineering and Technology, Dhaka-1000 Bangladesh
**Corresponding author: saddam@math.buet.ac.bd*

ABSTRACT
This study develops an innovative eco-epidemiological SIP (Susceptible Prey-Infected prey-Predator) model that integrates infectious disease dynamics within predator–prey interactions and accounts for the influence of environmental feedback through behavioral dynamics with Allee effect. Using evolutionary game theory, this study investigates how cooperative and non-cooperative strategies influence disease transmission and the stability of populations. An analysis is conducted on the equilibrium states of the system along with their stability properties. Simulation results show that both the Allee effect and disease transmission rates play a critical role in determining population stability. The results offer important insights into the intricate relationships that maintain ecosystem stability and health, emphasizing the crucial roles that behavioral dynamics and epidemic factors perform in species conservation and disease control.

Paper ID: ICSHSD-522

Modeling and Analysis of Influenza a (H1N1) Dynamics with Asymptomatic Carriers

Most Halimatuj Sadia[1, *], Md. Mojammel Haque[2] and M. Osman Gani [3,4]
[1]Bangladesh University of Business and Technology (BUBT), Mirpur-2, Dhaka
[2]Dhaka University of Engineering and Technology (DUET), Gazipur, Bangladesh
[3]Mathematical and Computational Biology (MCB) Group, Department of Mathematics, Jahangirnagar University, Savar, Dhaka 1342, Bangladesh
[4]Center for Mathematical Modeling and Applications (CMMA), Meiji University, Tokyo 164-8525, Japan
[*]*Corresponding author: halimatuj@bubt.edu.bd*

ABSTRACT

Influenza A (H1N1) remains a pressing global health challenge due to its rapid transmission and seasonal reemergence. A critical factor complicating control efforts is the presence of asymptomatic carriers who, while exhibiting no clinical symptoms, continue to spread the infection unnoticed within communities. Traditional epidemic models often overlook this hidden transmission pathway, which can lead to underestimations of outbreak severity and ineffective intervention strategies. To address this gap, we develop a comprehensive mathematical model that extends the classical SIR (Susceptible–Infectious–Recovered) framework by introducing an explicit asymptomatic carrier class, along with vaccinated, quarantined, and recovered compartments. The model is formulated using a system of nonlinear ordinary differential equations, and key epidemiological thresholds, including the basic reproduction number $R_0$are derived to assess the potential for disease extinction or persistence. Analytical results establish the local and global stability conditions of both disease-free and endemic equilibria, while numerical simulations highlight the substantial influence of asymptomatic individuals on the overall epidemic dynamics. Our findings demonstrate that even a small proportion of asymptomatic carriers can significantly enhance transmission potential, prolong epidemic duration, and complicate eradication efforts. Control variables representing vaccination, treatment, and quarantine are introduced into the model. The results reveal that a combined strategy—balancing early vaccination with targeted quarantine and treatment—achieves the greatest reduction in infections. Sensitivity analysis further identifies the most influential parameters affecting transmission, thereby guiding policymakers toward interventions with the highest impact. This research highlights the necessity of considering asymptomatic transmission in epidemic modeling and control planning. By integrating rigorous mathematical analysis with practical intervention strategies, the study provides valuable insights for public health authorities seeking to design robust and cost-effective responses to future influenza outbreaks. The framework developed here can also be adapted to other infectious diseases where asymptomatic carriers play a central role, ensuring broader applicability in epidemiological modeling and policymaking.

Optimization and Operation Research

Paper ID: ICSHSD-43

Optimization of Thermal Conductivity Ratio of Al_2O_3–Water Nanofluid: A Comparative Study between Statistical and Machine Learning Approach

Md. Masud Parveg Nayon[1]* and Md. Shariful Alam[1]
[1]Department of Mathematics, Jagannath University, Dhaka-1100, Bangladesh
Corresponding author: masudjnu786@gmail.com

ABSTRACT

Nanofluids, created by dispersing nanoparticles into conventional base fluids, have gained significant attention for their superior thermal properties and potential to enhance the performance of heat transfer systems. This research presents a comprehensive study on modeling and optimizing the thermal conductivity ratio of aluminum oxide (Al_2O_3)–water nanofluid through a hybrid approach that combines response surface methodology (RSM) and artificial neural networks (ANN). The study is motivated by the need to design sustainable, high-efficiency cooling systems for industrial and technological applications. Experimental trials were designed using the Box–Behnken design (BBD) to systematically evaluate the influence of nanoparticle volume fraction, operating temperature, and surfactant concentration on the thermal conductivity ratio. Seventeen experimental runs were conducted, and canonical analysis was applied to capture nonlinear and interaction effects among the variables. The response surface methodology (RSM) model was statistically validated using the analysis of variance (ANOVA), residual analysis, and thorough checks for model adequacy. Concurrently, an artificial neural network (ANN) model was developed using the same dataset, offering a complementary machine learning approach. The predictive accuracy of both models was evaluated using key statistical indicators. Both RSM and ANN achieved strong predictive capability; however, the ANN model exhibited slightly superior accuracy, indicating its suitability for complex nonlinear prediction tasks. Optimization was carried out through numerical desirability functions, graphical overlay plots, and theoretical canonical analysis, with all approaches converging on consistent optimal conditions for maximizing thermal conductivity enhancement. The findings confirm that integrating statistical experimental design with machine learning techniques yields a robust framework for multiparameter optimization in thermal sciences. Beyond identifying optimal operating parameters, this study provides methodological insights applicable to a wide range of nanofluid-based thermal management systems. By improving heat transfer efficiency while minimizing energy consumption, the outcomes of this research align closely with the goals of sustainable development, offering practical solutions for next-generation cooling technologies in industrial, biomedical, energy, and electronic sectors.

Paper ID: ICSHSD-45

Optimization and Modelling of Viscosity of Copper-Water Nanofluid using Response Surface Methodology

Saima Tasnim[1]* and Md. Shariful Alam[2]
[1,2]Department of Mathematics, Jagannath University, Dhaka-1100, Bangladesh
Corresponding author: ritu138774@gmail.com

ABSTRACT

Nanofluids have emerged as potential candidates for improving heat transfer in thermal systems due to their enhanced thermal characteristics. Among these, copper water (Cu-H_2O) nanofluid offer significant potential, but this could be negated by the fact that they are more viscous. This paper presents a predictive viscosity model developed through a five-level spherical central composite design (SCCD) by response surface methodology (RSM) combined with canonical analysis, and ridge optimization. A modified theoretical viscosity model, integrating Brinkman's formulation and Brownian motion effects, was applied in the generation of viscosity data. The parameters that have been investigated are volume fraction (1-3%), temperature (280-400 K), and particle diameter (20-60 nm). The regression model was excellent in terms of predictive value (R^2 = 0.9858), with nanoparticles volume fraction emerging as the most influential factor, followed by particle diameter and temperature. The canonical analysis revealed a saddle point that was not inside the design space, so constrained ridge optimization was required. The goal was achieved by the optimum parameters (ϕ = 0.01, T = 280 K, d_p = 51 nm) that minimized viscosity (μ_f) to 0.00104093Pa s. Although the viscosity range was very small, the statistical significance was established through the residual analysis. Future work includes experimental validation and exploration of non-Newtonian behavior. This framework may be used as a foundation towards the development of energy-efficient nanofluid systems.

Paper ID: ICSHSD-226

Model Order Reduction of a Linear Crossbar Array

Md. Shariful Islam[1,*] and Md. Sumon Hossain[1]
[1]Department of Mathematics & Physics, North South University
Plot # 15, Block-B, Bashundhara, Dhaka-1229, Bangladesh
**Corresponding email: mdShariful.islam.251@northsouth.edu*

ABSTRACT

Resistive Random Access Memory (RRAM) at the intersections of the word line (WL) and bit line (BL) in crossbar arrays is utilized for efficient data storage. However, parasitic effects, including unintended capacitances and resistances, can increase computational complexity. This study employs Model Order Reduction (MOR) via Balanced Truncation (BT) to develop reduced-order models (ROMs) that replicate high-dimensional state-space models derived from Kirchhoff's Current Law (KCL) for a (p × q) junction grid with 2(p × q) dimensions, where p and q represent the numbers of WL and BL, respectively. These ROMs preserve input-output fidelity with minimal error, facilitating efficient simulations and rapid design optimization. The proposed approach reduces computational burden, providing a scalable framework for high-performance nanoscale memory systems. The original high-dimensional state-space model of the crossbar array is formulated as:

$$\dot{x} = Ax + Bu, \quad (1)$$
$$y = Cx + Du$$

Where, $A \in R^{n\times n}, B \in R^{n\times m}, C \in R^{f\times n}$ are systems matrices and x is the state vector. The crossbar array's node count, twice that of junctions, doubles the KCL equations, significantly increasing computational complexity for large-scale analysis. The ROM of the original system (1) is defined as

$$\dot{x_r} = A_r x_r + B_r u \quad (2)$$
$$y_r = C_r x_r + D_r u$$

Where, $A \in R^{r\times r}, B \in R^{r\times m}, C \in R^{f\times r}$ are systems matrices and x_r is the state vector for reduced systems. Three MOR methods are employed: BT truncates low-contribution states, IRKA optimizes frequency-domain matching, and TSIA maintains structural integrity. These ROMs aim to preserve the input-output behavior of the original system with minimal error, facilitating efficient simulations and design optimization. The analysis was conducted in MATLAB version 2021b on a crossbar array with 32 inputs and 32 outputs, resulting in a 2080-dimensional original system. The computation of the output response for this system required 110 seconds. In contrast, the ROM generated using BT produced the output response in 10 seconds, indicating a substantial reduction in computational time. The ROM maintained input-output fidelity, thereby enabling rapid and scalable design optimization for nanoscale crossbar arrays. This approach establishes a robust framework for advancing nano-electronic memory technologies, addressing the limitations of traditional analysis methods and supporting future innovations in high-density memory systems.

Paper ID: ICSHSD-269

Balancing Cost Efficiency and Emission Reduction Mechanism: An EOQ Model for Perishable Goods with Subsidy-Driven Green Investment

Md Abu Rumman[1], Md. Al-Amin Khan[1*]
[1]Jahangirnagar University, Savar, Dhaka-1342, Bangladesh.
[*]*Corresponding author: alaminkhan@juniv.edu*

ABSTRACT

In contemporary supply chain systems, installment-based payment mechanisms have become increasingly prevalent, particularly for managing products with limited shelf life. Upstream partial prepayment, wherein distributors remit purchase costs in installments prior to product receipt, and downstream partial delay payments, which allow retailers to defer payment after acquiring goods, create intricate financial and operational dynamics. This study develops an economic order quantity (EOQ) model that integrates both payment structures under a strict no-shortage constraint, focusing specifically on inventory decisions for perishable goods. A key contribution of this work is the integration of retailers' green investment decisions into the inventory model to reduce emissions and manage financial risks, supported by the evaluation of government subsidies as incentives for sustainable practices. To determine the optimal level of constrained green investment, the Karush–Kuhn–Tucker (KKT) method is applied, providing analytical rigor in solving the nonlinear optimization problem. Four distinct models, representing scenarios with and without emission investment, are examined to identify cost-effective and sustainable strategies. Results indicate that the model considering the green investment under the performance-based incentive offers the most balanced performance, while the model without investing money on the green investment entails significantly higher costs and requires reconsideration. Numerical findings suggest that 20% increasing the investment level within the interval decreases the emission level by 19%. This research underscores the importance of aligning flexible payment policies, optimization techniques, and environmental initiatives, offering actionable insights for both cost efficiency and sustainable supply chain management.

Paper ID: ICSHSD-286

Circular Economy-Driven Production Systems: Optimization with Warm-Up Effects and Carbon Trading

Rana Pervez[1*], Md. Al-Amin Khan[1]
[1]Jahangirnagar University, Savar, Dhaka-1342, Bangladesh.
[*]*Corresponding author: ranapervez2288@gmail.com*

ABSTRACT
Rapidly evolving market conditions necessitate highly efficient supply chain management and sustainable production strategies to meet increasing customer expectations and address environmental concerns. Building on recent developments in inventory and production modeling, this study presents a profit-maximizing production framework that incorporates circular economy principles, defective item considerations, and carbon emission management, emphasizing proactive approaches to sustainability. The model introduces a variable circularity index that directly affects both market demand and per-unit profitability, aligning with the growing influence of socially responsible consumer behavior. Additionally, the production process integrates a warm- up phase designed to improve operational efficiency and reduce defect rates, thereby addressing a critical challenge in manufacturing operations. Carbon emissions arising from setup activities, production processes, and warehousing are explicitly modeled, with carbon trading considered as a strategic decision variable to encourage environmentally responsible practices. The formulated nonlinear optimization problem with inequality constraints is analytically solved using Karush– Kuhn–Tucker (KKT) conditions to determine joint optimal production and circularity strategies. Sensitivity analysis highlights the impact of carbon trading costs, circularity incentives, and other system parameters on overall profitability and emission levels. Numerical experiments confirm the practical applicability of the proposed framework, demonstrating that optimal circularity and defect reduction strategies can substantially improve profitability while mitigating environmental impact. Specifically, enhancing circularity from 0 to 1 was found to increase the maximum profit rate by ~9.3% while reducing carbon emissions by ~33.1% per unit time, underscoring the dual economic and environmental benefits of circular operations. This framework demonstrates that circularity combined with emission management enhances economic performance and reduces environmental impact.

Paper ID: ICSHSD-295

Effects of Subsidy Policies in Sustainable EPQ System Incorporating Remanufacturing and Inspection Strategies

Md Rakib[1*], Md. Al-Amin Khan[1]
[1]Department of Mathematics, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh
[*]*Corresponding author: rakibahmed1415@gmail.com*

ABSTRACT
Balancing sustainability with operational efficiency is a major challenge in high-precision industries such as aerospace, pharmaceuticals, and electronics. Traditional Economic Production Quantity (EPQ) models overlook factors like defective products, strict inspection, remanufacturing, and government-backed green investments, limiting their relevance under inspection bottlenecks. This study develops EPQ models that integrate 100% inspection, scrap and rework, carbon-reducing green technologies, and government subsidies to achieve cost-efficient and sustainable production. The methodology involves formulating mathematical models under the EPQ framework, incorporating (i) inspection delays as production bottlenecks, (ii) defective items managed through remanufacturing and (iii) green investment initiatives offset by government incentives. Total cost functions are defined to include setup cost, holding costs for perfect and reworkable items, production and rework costs and net green investment cost (investment minus subsidy). Closed-form analytical solutions are derived to determine optimal production quantities and optimal investment. Numerical simulations using MATLAB, LINGO, and Python validate the models, while sensitivity analysis evaluates the impact of inspection rates, subsidy amounts, and green investment levels on cost efficiency. The results are expected to demonstrate that integrating government incentives with green investment decisions significantly reduces total system costs and carbon emissions by 8-10%. This study embeds government incentives, green investment, and remanufacturing into EPQ models with strict inspection, helping industries reduce costs, adopt sustainable practices, and align with development goals while bridging economic performance and environmental responsibility.

Paper ID: ICSHSD-298

A Circularity-Driven EOQ Model with Imperfect Quality and Index-Based Optimization

Afrin Jahan[1*], Md. Al-Amin Khan[1]
[1]Jahangirnagar University, Savar, Dhaka-1342, Bangladesh
[*]*Corresponding author: afrinjahantrina37@gmail.com*

ABSTRACT

The integration of circular economy principles is increasingly shaping inventory management by making circularity a pivotal factor in determining demand, cost structures, and pricing strategies. Manufacturing processes, however, frequently produce imperfect items that necessitate systematic inspection and effective handling. An advanced Economic Order Quantity (EOQ) framework is developed to simultaneously address circularity, defective item management, and inspection, with a primary focus on optimizing the reorder point. A circularity index ($0 \leq \omega \leq 1$) is incorporated as a decision variable to quantify its influence on demand, holding costs, and selling price. Each production batch undergoes inspection to segregate defective items, which are either resold at a discounted rate or managed to mitigate losses. The model accounts for inspection and holding costs for both conforming and nonconforming items. Closed-form solutions for the optimal order quantity and reorder point are derived, and the constrained optimization problem is addressed using the Karush–Kuhn–Tucker (KKT) conditions. Numerical illustrations highlight the responsiveness of key decision variables to different levels of circularity. Results indicate that higher circularity amplifies demand, leading to increased optimal order quantities and elevated reorder points. The inspection process ensures quality control while enabling value recovery from defective items, enhancing profitability. The integrated framework underscores the synergistic benefits of aligning circularity, inspection, and defective item management, demonstrating its potential to improve both operational efficiency and financial performance in modern inventory systems. The optimal order quantity rises with circularity, reflecting higher demand and profitability. Selling imperfect items generates additional revenue and reduces waste. The model boosts profitability, rising 3.9 percent at moderate circularity of 0.5 and 7.8 percent at full circularity of 1, showing that greener practices can deliver real financial impact.

Paper ID: ICSHSD-321

Profit Maximization of Production Systems for Circular Indexed Products with Green Investment Under Incentives

Most. Mahmuda Khatun[1*], Md. Al-Amin Khan[1]
[1]Department of Mathematics, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh.
[*]*Corresponding author: mahmudakhatunju15@gmail.com*

ABSTRACT

The transition to a circular economy (CE) necessitates operational models that harmonize economic and environmental objectives. This study develops an integrated profit-maximization model for a manufacturer designing products with a variable circularity index, which enhances both consumer demand and unit margin. However, production remains a significant source of carbon emissions. To address this, four models are formulated to determine the joint optimal strategy for a product's circularity level and green technology investment: a baseline without investment, a model with green technology investment to reduce emissions, and a subsidy- integrated model further divided into Investment-Based Subsidy (IBS) and Performance-Based Subsidy (PBS). Using calculus-based optimization and the Karush-Kuhn-Tucker (KKT) method, closed-form solutions are derived for the optimal circularity index, investment level, and production lot size. Numerical analysis validates the findings and demonstrates that all investment models significantly outperform the baseline. A comparative analysis reveals that, relative to the baseline, the green technology investment model improves profitability by 3.62%, the IBS model by 5.08%, and the PBS model by 5.63%—while also achieving the greatest emissions reduction. The results underscore the superiority of performance-based subsidies, which directly link financial incentives to ecological outcomes, ensuring stronger economic–environmental alignment. Sensitivity analysis provides managers with actionable insights into key system parameters. This research conclusively demonstrates that the synergistic integration of circular product design, strategic green investment, and well-structured government incentives is paramount for profitable and sustainable manufacturing, offering a rigorous decision-making framework for industry practitioners and policymakers.

Paper ID: ICSHSD-324

Eco-Friendly Lot-Sizing Model for Deteriorating Items with Supplier Financing, Deferred Customer Settlement and Control Backordering

Kamnur Nahar Kemi[1], and Md. Al-Amin Khan[1*]
[1]Jahangirnagar University, Savar, Dhaka-1342, Bangladesh.
Corresponding author: alaminkhan@juniv.edu

ABSTRACT

In today's evolving global supply chains—particularly those dealing with perishable goods—the integration of financial flexibility and environmentally responsible practices is increasingly vital. This study introduces a comprehensive Economic Order Quantity (EOQ)-based inventory model designed to address the unique challenges of managing perishable goods by incorporating three critical mechanisms: a partial pre-shipment financing to the supplier (where a retailer pays the manufacturer a portion of the total amount in advance, usually in instalment, before receiving the goods), partial deferred customer settlement (where a retailer receives a portion of the selling price from the customer sometime after the product is sold), and partial backordering (where only part of unmet demand is backordered, and the rest is considered lost). With environmental sustainability gaining prominence due to regulatory demands and corporate responsibility, companies are also investing in emission-reducing initiatives. To overcome the barrier of high upfront investment costs, the model incorporates two types of government subsidy schemes—one based on the amount of investment and the other on environmental performance. Four models are evaluated: Model1: Green technology investment is excluded from consideration; Model2: Green technology investment is actively implemented; Model3_1: Green technology investment is supported through investment-based subsidies; Model3_2: Green technology investment is incentivized via performance-based subsidies. The objective is to minimize total supply chain costs while advancing sustainability goals. The model considers perishability, shortage penalties, emission levels, green investment costs, and the impact of financial support mechanisms. To solve the constrained nonlinear optimization problem, the Karush-Kuhn-Tucker (KKT) method is applied to determine the optimal ordering and investment strategies. Results demonstrate that adopting green investment improves cost efficiency: 3.85% savings in Model 2, 4.06% in Model 3_1, and 4.29% in Model 3_2 compared to Model 1. Model 3_2 offers the greatest economic and environmental benefit due to its effective performance-based subsidy. In contrast, Model 1 results in the highest overall cost, underscoring the economic disadvantage of neglecting sustainability. This study provides strategic insights for policymakers aiming to integrate financial flexibility and green initiatives in perishable goods logistics.

Paper ID: ICSHSD-339

Efficacy Thermo-Viscoelastic Stress Analysis in Particle-Laden Polymer Melts Flowing Through Contraction Geometries

Shamima Akter[1], Riaz Hossain[1], Adaito Basak[1], and Muhammad Minarul Islam[1*]
[1]Department of Mathematics, Gopalganj Science and Technology University, Gopalganj 8105, Dhaka, Bangladesh.
Corresponding author: minarul_math@gstu.edu.bd

ABSTRACT

The flow behavior of particle-laden viscoelastic polymer melts through contraction geometries plays a critical role in determining the mechanical properties and consistency of extruded polymer products.This study presents a coupled Eulerian–Lagrangian numerical simulation to investigate the complex interactions between dispersed solid particles and the viscoelastic carrier fluid flowing through the contraction pipe. The polymer melt is modelled using logarithm form viscoelastic constitutive equation, while particles are tracked individually to capture their influence on the flow and stress fields. Critical transport and microstructural phenomena including particle migration, elastic stress localization, and mixing dynamics are systematically examined to evaluate their impact on flow uniformity and composite strength. The normalized average fluid-particle force f_p as a function of the volume fraction (ϕ) of the dispersed solid phase and the Weissenberg number (W_i) representing the relative magnitude of elastic to viscous stresses. The results demonstrate that particle–fluid interactions significantly alter the viscoelastic stress fields, particularly within high-strain regions near the contraction interface. These interactions induce non-uniform particle dispersion, localized stress amplification, and potential defect formation. Case studies involving hydraulic fracture operations and particle settling in both Newtonian and viscoelastic fluids show excellent agreement with experimental data, providing new insights into optimizing die geometries and processing parameters to improve product homogeneity, mechanical robustness, and overall reliability in polymer composite extrusion processes.

Paper ID: ICSHSD-356

Sustainable Fuzzy EPQ Model for Imperfect Items with Synchronous Rework and Emission Reduction Investment

Antor Ghosh[1*], and Md. Al-Amin Khan[2]
[1]Jahangirnagar University, Savar, Dhaka-1342, Bangladesh.
Corresponding author: antorju67@gmail.com

ABSTRACT
To address the uncertainties and randomness of defective percentages and shortages in real-life production systems, this paper develops a fuzzy economic production quantity (EPQ) model incorporating imperfect items, synchronous rework, and green technology considerations. To capture uncertainty, the parameters—set up cost, holding cost, and demand rate are considered as triangular and trapezoidal fuzzy numbers within the fuzzy EPQ framework. The production process may randomly shift from an in-control to an out-of-control state, generating defective items that are detected during screening and synchronously reworked alongside regular production. The total cost function is defuzzified using the Graded Mean Integration (GMI) method to determine the optimal production lot size and total system cost. Carbon emissions from production, setup, transportation, warehousing, and disposal are explicitly included. Emission control is implemented through emission reduction investment as well as carbon pricing regulations, including carbon taxes, cap-and-offset and cap-and-trade. The numerical example and sensitivity analysis are shown and the cap-and-trade policy works efficiently within constraints to curb carbon emissions. The results also indicate that exact solutions from fuzzy models are more practical, closely reflect real-life scenarios, and achieve lower expected total costs compared to crisp models.

Paper ID: ICSHSD-373

Optimal Screening Decision in Two-Stage Food Supply Chains for Growing Items Under Emission Tax Regulation

Md. Abdul Alim[1,2*], Md. Al-Amin Khan[1], and Aminur Rahman Khan[1]
[1]Department of Mathematics, Jahangirnagar University, Savar, Dhaka 1342, Bangladesh.
[2]BGMEA University of Fashion & Technology, Nishatnagar, Turag, Dhaka 1230, Bangladesh.
Corresponding author: abdulalim@buft.edu.bd

ABSTRACT
At present, the food supply chain is a notable contributor to carbon emissions, which is a great hazard to our environment, and thereby, this supply chain process needs to be more eco-friendly by ensuring sustainable environmental practices. There are certain items, such as chicken, cow, sheep, turkey, and others, known as growing items (GIs), that require a nurturing period to reach a target weight, after which they are slaughtered, processed into food, and sold to buyers. In this study, the supply chain process for GIs is divided into two stages: rearing GIs and production of processed food from the consumable part of GIs. In the production process, defects commonly occur, and removing the defective items by an early inspection reduces the production cost as well as the emissions. To minimize the total cost of the chain, a mathematical model is proposed, and analytical results are derived to establish the existence of the optimal screening time and replenishment time under stringent emission tax regulations for sustainable livestock farming. To ensure the applicability of the model, both the linear and nonlinear patterns of screening cost, defective detection rate, and carbon emission are adopted in this study. Numerical investigations indicate that increasing the initial screening duration raises inspection expenses yet facilitates the identification of a greater proportion of defects; additionally, the early removal of defective items during production contributes to cost reduction in subsequent phases.

Paper ID: ICSHSD-382

Linear Programming Approaches in Jute Crop Allocation for Profit Maximization

Md. Shariful Islam[1*], M. U. Ahammad[2], and Mohammed Forhad Uddin[3]
[1]Ph. D. Fellow, Department of Mathematics, Dhaka University of Engineering and Technology (DUET), Gazipur-1700, Bangladesh
[2]Department of Mathematics, Dhaka University of Engineering and Technology (DUET), Gazipur-1700, Bangladesh
[3]Department of Mathematics, Bangladesh University of Engineering and Technology (BUET), Dhaka-1000, Bangladesh
**Corresponding author: mdicsharifmaths@gmail.com*

ABSTRACT
Jute is one of the most important cash crops in Bangladesh, contributing significantly to the economy and rural livelihoods. This study develops a comprehensive optimization framework to maximize profit from jute production by strategically allocating land among three major varieties: White Jute, Tosha Jute and Mesta Jute across two distinct agricultural zones. Using a linear programming (LP) approach, the model incorporates multiple real-world constraints, including land availability, labor, capital, water use and environmental limitations ensuring a realistic representation of production challenges. The model has been solved using LINGO and optimal area allocations for each jute type are determined. Results reveal that Tosha Jute is the most profitable crop while White and Mesta Jute were not selected due to lower profitability. Among all resources, the water limit emerged as the key binding constraint, fully utilized in both zones while land, labor and capital showed surplus availability. These findings suggest that sustainable water management and improved irrigation practices are critical for maximizing profitability in jute cultivation and ensuring sustainable production and maximizing economic returns in Bangladesh.

Paper ID: ICSHSD-388

Facility Failure Uncapacitated Facility Location Problem with Time-Dependent Supply and Its Application in Emergency Logistics

Md. Sumon Ali[1], and Dr. Mohammad Babul Hasan[1*]
[1]Department of Mathematics, University of Dhaka
**Corresponding author babulhasan.math@du.ac.bd*

ABSTRACT
In disruption-prone urban environments, effective facility location planning is essential for ensuring the continuity of emergency supply chains. The classical Uncapacitated Facility Location Problem (UFLP) provides a strategic framework for facility placement but fails to capture real-world challenges such as facility failure and time-dependent supply dynamics. This study develops an extended stochastic UFLP model that integrates two critical uncertainties: (i) probabilistic facility failures and (ii) temporal fluctuations in supply availability. Using a two-stage stochastic programming approach, the model separates long-term facility opening decisions from adaptive recourse actions for customer allocation across multiple time periods. The framework is applied to a real-life case study of emergency supply distribution in Dhaka city, where facility disruptions and dynamic supply patterns are common. Computational analysis—supported by MATLAB and AMPL implementations—demonstrates that incorporating both facility failure probabilities and time-dependent supply significantly improves resilience, reduces unmet demand, and enhances cost efficiency compared to deterministic models. The results highlight the strategic value of risk-informed facility placement and adaptive allocation policies for urban planners and humanitarian organizations. This work contributes a theoretically rigorous and practically applicable decision-support tool for disaster-resilient logistics in megacities.

Pure Mathematics

Paper ID: ICSHSD-53

A Study of Uniform Doo–Sabin Subdivision for Surface Modelling in Animation, CAD, and Industrial Applications

Md. Rafiquzzaman Rafi[1] and Md. Nur Alam[2,*]
[1,2]Department of Mathematics, Pabna University of Science & Technology, Pabna-6600, Bangladesh.
**Corresponding author: nuralam23@pust.ac.bd*

ABSTRACT
Subdivision techniques are critical when smooth and accurate surfaces are required for polygonal meshes in computer graphics, computer-aided geometric design (CAGD), shipbuilding, automotive, and aerospace engineering. Among these techniques, the Doo–Sabin (DS) subdivision method is one of the most widely used. However, previous studies have demonstrated that uniform subdivision may not necessarily produce the optimal surface quality, particularly when complex geometric constraints are involved. This work solves this limitation by focusing on generating high-quality limit surfaces using the DS subdivision approach. It bridges the gap between theoretical formulations and accurate surface modelling in industrial designs. Using a free-form surface modelling framework, numerical experiments examine and evaluate current subdivision curves and surface characteristics. The results show that, although the DS approach produces visually appealing surfaces appropriate for interactive computer animations, CAGD, and industrial modelling, further improvements in precision and smoothness are still achievable. Importantly, the study demonstrates that the DS scheme's surface quality is enhanced for complex applications in scientific visualisation, animation, and geometric modelling when non-uniform subdivisions are used. This work significantly contributes to both academia and industry by improving the understanding of subdivision surface modelling, strengthening the connection between theoretical advancements and practical design requirements, and paving the way for more reliable surface modelling methods in contemporary computational design.

Paper ID: ICSHSD-63

A Mass Conserving Polynomial Growth Kernel in Smoluchowski Coagulation Equation

M. Sahidul Islam[1,*], K. E. Hoque[2], and Masato Kimura[3]
[1]Department of Mathematical and Physical Sciences, East West University (EWU), Dhaka, Bangladesh
[2]Department of Arts and Sciences, Faculty of Engineering, Ahsanullah University of Science and Technology (AUST), Dhaka, Bangladesh
[3]Faculty of Mathematics and Physics, Kanazawa University, Kanazawa 920-1192, Japan
**Corresponding author: sis@ewubd.edu*

ABSTRACT
In this paper we have studied a mass-conserving polynomial growth kernel. A key challenge in designing coagulation kernels is mass conservation while capturing realistic growth behaviors, such as polynomial growth in cluster size. In this work, we construct and analyze a class of new coagulation kernels exhibiting polynomial growth that strictly holds mass conservation. We provide sufficient conditions for mass conservation, demonstrate the well-posedness of the equation under the proposed kernel, and present numerical results to validate our approach. Here we have used generalized moment concepts.

Paper ID: ICSHSD-111

Study of The Qualitative Analysis on the Solutions of Nonlinear Differential Equations

Md. Azmol Huda[1,*], Alamin Hossain[2], and Sejuty Mandal[3]
[1,2,3] Mathematics Discipline, Khulna University, Khulna-9208, Bangladesh
**Corresponding author: azmol@math.ku.ac.bd*

ABSTRACT
There are many differential equations especially nonlinear differentail equations which are difficult to solve analytically. Therefore, it is important to think about of finding their solution an alternative approach. Numerical methods provide another method to tackle these types of challenges. There is also another approach that is geometrical in nature and yields a qualitative insight of how solutions behave. In this method the qualitative insights might be gained about their solutions without actually solving the equations as well as instead of providing precise quantitative data. In this paper, our main goal is to explain how geometrical techniques can be applied to derive significant qualitative information directly from the differential equation without solving it explicitly.

Paper ID: ICSHSD-157

Analytical Solutions and Qualitative Analysis to the Generalized Nonlinear Fractional Schrodinger Model using the Extended Riccati Equation Method

Saikh Shahjahan Miah[1,*], M. Ali Akbar[2] and Kamruzzaman Khan[3]
[1]Department of Mathematics, Mawlana Bhashani Science and Technology University, Tangail-1902, Bangladesh
[2]Department of Applied Mathematics, University of Rajshahi, Rajshahi-6205, Bangladesh.
[3]Department of Mathematics, Pabna University of Science and Technology, Pabna-6600, Bangladesh
**Corresponding author: skhshahjahan@gmail.com*

ABSTRACT
The generalized nonlinear Schrödinger equation (GNLSE) builds upon the standard NLSE to model how complex wave envelopes change in nonlinear and dispersive environments. It plays a key role in areas like nonlinear optics, plasma dynamics, Bose-Einstein condensates, and surface wave studies. In this study, we investigate exact soliton solutions for the space-time GNLSE using a traveling wave transformation based on the Beta derivative. We apply the extended Riccati equation approach (EREA) to find the solutions like rational, trigonometric, and hyperbolic which led the graphical representations such as periodic and general solitons. We study the bifurcation, chaotic, and sensitivity analysis of the mentioned model with graphical representation. Upcoming research can build on this study by examining the GNLSE using broader forms of fractional derivatives beyond the Beta derivative, potentially uncovering novel soliton structures and dynamic characteristics.

Paper ID: ICSHSD-230

Solitons and Chaos in Shallow Water Waves: Insights from the Modified Spectral Kdv Equation

Md Nur Hossain[1,*], and Ashabul Hoque [1]
[1]Department of Mathematics, University of Rajshahi, Rajshahi-6205
**Corresponding author: nur@ru.ac.bd*

ABSTRACT
Nonlinear wave transformations in shallow water—such as shoaling, refraction, diffraction, and breaking—are fundamental processes that govern nearshore dynamics, including sediment transport, seabed morphology, and coastal circulation. Accurate modeling of these processes is essential for predicting wave behavior in coastal regions, which directly impacts hazard assessment, coastal management, and the design of resilient shoreline protections. This study employed the one-dimensional modified spectral Korteweg-de Vries (mSKdV) equation as a governing model to describe the intricate dynamics of shallow water waves. The equation is inherently nonlinear and highly complex, making analytical solutions challenging. To address this, exact soliton solutions were derived using the improved Sardar subequation method enabling a detailed exploration of the system's nonlinear behavior. Due to the sensitive and potentially unpredictable nature of nonlinear wave systems, chaos analysis was performed to investigate the dynamics further. This analysis revealed various nonlinear wave structures, including periodic multi-solitons, bright and dark solitons, breather and quasi-breather modes, and kink-type solutions. These solutions provide a robust theoretical framework for visualizing the transitions of waves as they propagate from offshore to nearshore regions. By capturing both regular and complex wave behaviors, the study provides deeper insights into phenomena such as tsunami generation, tidal bores, and solitary internal waves, which are critical for coastal hazard mitigation and early warning systems.
The combination of soliton analysis and chaos investigation allows for a comprehensive understanding of nonlinear wave dynamics, bridging the gap between mathematical modeling and physical interpretation. The results demonstrate how the mSKdV equation can capture the rich diversity of wave behaviors in shallow water environments, offering a predictive tool for both theoretical and applied studies. Furthermore, the findings have practical applications in sediment transport modeling, coastal engineering, and resilient infrastructure development along vulnerable shorelines.

Paper ID: ICSHSD-532

ANALYTICAL INVESTIGATION OF SOLITARY WAVE SOLUTIONS FOR NONLINEAR BURGERS EQUATION

Md. Amirul Islam[1, *], Mehedi Hasan[2]
[1, 2] Department of Mathematics, Mawlana Bhashani Science and Technology University
Santosh, Tangail-1902, Bangladesh
[*]*Corresponding email: amirul.math@gmail.com*

ABSTRACT

The study of nonlinear evolution equations has been a central topic in applied mathematics and theoretical physics due to their ability to describe a wide range of natural phenomena. Among these, the Burgers equation occupies a fundamental position as it models diverse processes including turbulence, shock wave formation, fluid mechanics, plasma physics, acoustics, and traffic flow dynamics. Analytical investigations of such equations provide valuable insights into the qualitative and quantitative behavior of nonlinear systems, complementing numerical simulations and experimental studies. In this work, we focus on the nonlinear Burgers equation and explore its solitary wave solutions through the application of the (G'/G)-expansion method. The (G'/G)-expansion method is a powerful analytical technique that enables the systematic construction of exact solutions to nonlinear partial differential equations. It is based on representing solutions in terms of a ratio of derivatives of an auxiliary function that satisfies a second-order linear ordinary differential equation. By carefully balancing the highest-order derivative terms with nonlinear contributions, a variety of wave structures can be derived. Applying this method to the nonlinear Burgers equation, we obtain several classes of exact solitary wave solutions. These include hyperbolic function solutions such as kink- and anti-kink-type waves, trigonometric function solutions exhibiting periodic wave structures, and rational function solutions that describe localized behaviors under specific parameter regimes. Each derived solution is rigorously verified by substituting it back into the original equation, confirming the consistency and accuracy of the method. The richness of the solution set demonstrates the versatility of the (G'/G)-expansion method in capturing different dynamical behaviors associated with the nonlinear Burgers equation. Importantly, these solutions provide deeper understanding of the nonlinear dynamics governing physical systems where the Burgers model is applicable. The results of this analytical investigation not only reinforce the effectiveness of the (G'/G)-expansion method but also broaden the catalog of known exact solutions for the Burgers equation. This contributes to the development of reliable analytical tools for studying nonlinear systems, offering potential applications in fluid mechanics, nonlinear optics, and plasma dynamics. Furthermore, the approach outlined here can be extended to other nonlinear evolution equations of higher dimensions, thus serving as a foundation for future theoretical and applied research.

Data Science and Machine Learning

Paper ID: ICSHSD-017

Forecasting Co_2 Emissions Using Machine Learning and Deep Learning Models: A Comparative Study Across Techniques

Md. Tawhidul Islam Siam[1*], Anika Tahsin Biva[2], and Dr. Shahansha Khan[3]
[1]Student, Department of Mathematics, Uttara University, Dhaka, Bangladesh
[2]Lecturer, Department of Mathematics, Uttara University, Dhaka, Bangladesh
[3]Professor, Department of Mathematics, Uttara University, Dhaka, Bangladesh
*Corresponding author email: *tawhidulislamsiam42@gmail.com*

ABSTRACT

This study explores how advanced machine learning (ML) and deep learning (DL) techniques can be used to predict carbon dioxide (CO_2) emissions in 93 countries over a long time period, from 1970 to 2031. The main reason for doing this research is the urgent need to fight climate change by understanding and reducing CO_2 emissions more effectively. We used historical emission data from 1970 to 2023. The models were trained using data up to 2015, then tested on data from 2016 to 2023 to check how well they could predict. After that, we used the models to forecast emissions from 2024 to 2031.Several modern ML and DL models were used in this study, including Artificial Neural Networks (ANN), Bayesian Neural Networks (BNN), Recurrent Neural Networks (RNN), Convolutional Neural Networks (CNN), Deep Neural Networks (DNN), Long Short-Term Memory (LSTM), Random Forest (RF), and Gradient Boosting Machines (GBM). These models were chosen because they are very good at finding patterns in time-based and complex data. To measure how well the models worked, we used common error-checking methods like RMSE, MAE, MAPE, and MFE. Our results showed that while some traditional models like ANN and RF gave decent predictions, advanced models like LSTM and BNN did a better job capturing time-based changes and dealing with uncertainty. CNN models also worked well, especially in spotting patterns across different countries. We also compared how well the models performed in different countries and found 15 countries where the predictions were most accurate. These countries usually had more stable or improving CO_2 trends, which could be due to better environmental laws, new clean technologies, or improved data tracking. The goal of this research is to help global efforts to cut carbon emissions by offering smart, data-based forecasts. It also helps decision-makers and researchers choose the best model for their needs. Overall, this work shows how powerful AI tools can be in understanding environmental changes and guiding actions for a better climate future.

Paper ID: ICSHSD-039

Cubic B-Spline Method: A Comprehensive Study in Approximating Boundary Value Problems

Md. Shahid Hasan[1,2] and Md. Nur Alam[3]
[1]Department of Mathematics, Pabna University of Science & Technology, Pabna-6600,
[2]Department of Mathematics, European University of Bangladesh, Gabtoli, Dhaka,
[3]Department of Mathematics, Pabna University of Science & Technology, Pabna-6600, Bangladesh
**Corresponding author: nuralam23@pust.ac.bd*

ABSTRACT

This paper presents a detailed study of the cubic B-spline method for solving second-order linear boundary value problems (BVPs), with a comparative analysis against the finite difference method (FDM). After a brief introduction to cubic B-spline functions, the method is formulated and applied to selected test problems alongside FDM. The computed results are compared with exact solutions, and the errors are thoroughly analyzed. Graphical illustrations further highlight performance differences. The findings reveal that the cubic B-spline method consistently delivers higher accuracy and greater numerical stability than FDM, demonstrating its effectiveness and reliability for solving complex BVPs across various application domains.

Paper ID: ICSHSD-060

Empowering Clinical Decision Support: Machine Learning for Early Detection of Diabetes Mellitus

Farhad Hossain[1] and Md. Nur Alam[2,*]
[1,2]Department of Mathematics, Pabna University of Science & Technology, Pabna-6600, Bangladesh.
**Corresponding author: nuralam23@pust.ac.bd*

ABSTRACT

Diabetes mellitus is a fast-growing metabolic disorder that is associated with chronic hyperglycemia and serious long-term complications. Although there is an abundance of literature focused on the development of predictive models for early detection of diabetes, many existing approaches involve limitations, including poor feature pre-processing, the absence of good validation, or underutilizing a limited number of algorithms, which constrain their generalizability for clinical use. This study aims to address this void by developing and evaluating multiple machine learning (ML) models for predicting diabetes, with both clinical and lifestyle features. The dataset is pre-processed using advanced imputation, scaling, and feature engineering to maximize reliability and robustness. Several ML algorithms are utilized, including: Logistic Regression, Support Vector Machines, Random Forest, Gradient Boosting, and Deep Neural Networks, which are each optimized using grid search through 5-fold CV. The models were evaluated using available metrics of accuracy, precision, recall, F1-score, and ROC-AUC. In summation, ensemble-based models, specifically Gradient Boosting and Random Forest, demonstrate better prediction against traditional classifiers like LR, SVR, and DNN approaches. These results also demonstrate ensemble learning as a reliable framework for early detection of diabetes, and could provide a valuable framework for real-time data collections provide support healthcare practitioners in clinical decision-making, as well as supporting the advancement of healthcare as a data-driven approach.

Paper ID: ICSHSD-079

Machine Learning-Enhanced Fem Analysis of Cu–H_2O Nanofluid Heat Transfer in Corrugated Trapezoidal Cavities with Heat Generating Star Shaped Obstacles

Sree Pradip Kumer Sarker[1*], Md. Mahmud Alam[2]
[1,2]Department of Mathematics, Dhaka University of Engineering and Technology (DUET), Gazipur-1707, Bangladesh.
[*]Corresponding author: pradip.duet@gmail.com

ABSTRACT

This study presents a machine learning (ML)-enhanced finite element method (FEM) framework for analyzing Cu–H_2O nanofluid heat transfer in corrugated trapezoidal cavities containing internally heated star-shaped obstacles. FEM simulations were conducted in COMSOL by solving coupled continuity, momentum, and energy equations under the Boussinesq approximation, considering Rayleigh numbers (10^3–10^6), Hartmann numbers (0–50), cavity inclinations (0°–45°), and nanoparticle volume fractions (ϕ = 0.02, 0.04, 0.08). A total of 1344 datasets of thermophysical metrics, Nusselt number (Nu), entropy generation (St), and ecological coefficient of performance (ECOP), were generated. These data were employed to train supervised ML models: Support Vector Regression (SVR), Decision Tree (DT), and Random Forest (RF). The ML workflow included preprocessing, cross-validation, hyperparameter tuning, and performance evaluation using R^2, MSE, and MAE. Results showed that higher Rayleigh numbers promoted strong convection and enhanced Nu, while larger Hartmann numbers suppressed flow intensity, lowering thermal transport. Inclination angle strongly influenced recirculation patterns, with $\lambda = 30°$ producing optimal heat transfer. Comparative ML analysis indicated that RF consistently achieved the best accuracy ($R^2 \approx 0.999$, MAE < 0.02), outperforming SVR and DT in capturing nonlinear thermo-fluid interactions. This integrated FEM-ML framework demonstrates that machine learning can serve as an efficient surrogate model, drastically reducing computational cost while preserving high accuracy. The findings highlight the potential of ML-driven strategies for predictive modeling and optimization of nanofluid-based MHD convection in complex enclosures, providing valuable insights for energy and thermal system design.

Paper ID: ICSHSD-078

AI-Powered Traffic Congestion Prediction and Management: A Data-Driven Framework for Sustainable Urban Mobility in South Asian Cities

Toukir Ahamed[1*], Shathy Khan [2], and Dr. Ferdous Sarwar[3]
[1] Department of Industrial and Production Engineering, Bangladesh University of Engineering and Technology
[2] Department of Mathematics, Jahangirnagar University
[3] Department of Industrial and Production Engineering, Bangladesh University of Engineering and Technology
**Corresponding author: toukir.buet1@gmail.com*

ABSTRACT

The fast pace of urbanization in South Asia has increased challenges related to transportation infrastructure, which now increasingly manifests itself as traffic congestion and negatively impacts economic productivity, worsens air pollution, and hinders Sustainable Development Goals (SDG 11: Sustainable Cities and Communities; SDG 13: Climate Action).Smart cities in development rely predominantly on reactive or static traffic management methodologies, and hence they do not incorporate the predictive and adaptive methodologies better suited to their respective socio- economic and infrastructural conditions. The present study offers an innovative data-driven approach using Artificial Intelligence (AI) and Machine Learning (ML) for the prediction, study, and relief of urban traffic congestion in key metros of South Asia, while incorporating sustainability issues into transportation planning paradigms. The research methodology combines heterogeneous datasets comprising GPS trajectory data, traffic flow data, mobile network traffic data, and socio-economic variables from urban areas in Bangladesh, India, Pakistan, Nepal, and Sri Lanka. The preprocessing of the data removes unnecessary noise, treats issues of missing data, and regulates seasonality by advanced imputation and normalization processes. To foretell congestion zones and peak traffic capacities, different artificial intelligence models are used and evaluated, such as Random Forest, Long Short-Term Memory (LSTM) networks, and Graph Neural Networks (GNNs). Additionally, a hybrid ensemble model is constructed for improving the robustness and accuracy of the predictions. These include temporal dependencies, spatial correlations, and contextual factors like meteorological conditions and public holidays. The empirical evidence reveals the new hybrid artificial intelligence framework to deliver higher performance than standard baselines, achieving accuracy up to 93% during short-term congestion prediction, and significant improvement in the Root Mean Squared Error (RMSE) and R^2 performance indices. Beyond accuracy in prediction, an innovative sustainability assessment layer of our framework evaluates the environmental and social impacts of future congestion, thus bridging traffic dynamics and carbon footprint, fuel consumption, and commuter welfare. Case studies from Dhaka, Mumbai, and Colombo are presented here to exemplify the adaptive traffic signal control, public transit system optimization, and congestion pricing strategies derived from these predictive inputs. This research provides a new contribution by combining AI-based congestion prediction with transportation planning for sustainability, with a focus on South Asia. Our method, in addition to traditional traffic prediction, not only enhances urban mobility but also contributes to climate policy-making and resilient urban development. The study outlines various potential pathways for policymakers, urban planners, and stakeholders, with a focus on sustainability in the development of evidence-based, sustainable transport systems that can effectively address the twin challenges of congestion and climate resilience for one of the world's fastest-growing urban agglomerations.

Paper ID: ICSHSD-137

MULTIMODAL AI FOR MATH EDUCATION: AN INTEGRATED FRAMEWORK WITH OCR, SYMBOLIC COMPUTATION AND RAG

Ahsanul Karim Raiyan [1], Raiyan Ahmed[1] and Atia Afroz [2*]
[1]Department of Electrical and Computer Engineering, North South University, Dhaka, Bangladesh
[2]Department of Mathematics and Physics, North South University, Dhaka, Bangladesh
[*]*Corresponding email: atia.afroz@northsouth.edu*

ABSTRACT

Mathematics learning is a major challenge in Bangladesh. Here students often struggle with problem solving and conceptual understanding of math. On the other hand, access to personalized support is also limited. That is the reason AI-powered tools can solve this by providing an interactive visualizations and instant answers. This is possible because recent advancements in Retrieval-Augmented Generation (RAG) have significantly improved LLMs by reducing hallucination and outdated knowledge issues. Furthermore, multimodal integration of text, images and videos has given rise to Multimodal RAG frameworks, which outperform traditional text-only approaches. This study explores a multimodal-AI framework that incorporates OCR, symbolic computation and RAG for mathematics education in Bangladesh.

Paper ID: ICSHSD-143

Deep Learning-Based Coronary Segmentation and Centerline Extraction

M. M. Rahman[1], K. E. Hoque[1,*], M. Sajjad Hossain[1], N. Islam Nima[2] and A. H. M. M. Rahman[3]
[1]Department of Arts and Sciences, Faculty of Engineering, Ahsanullah University of Science and Technology. Dhaka -1208
[2]Department of Physical Sciences, Independent University Bangladesh (IUB), Dhaka 1229, Bangladesh
[3]Department of Mathematics and Natural Sciences, BRAC University, Kha 224, Merul Badda, Dhaka 1212, Bangladesh
**Corresponding email: ekram_math.as@aust.edu*

ABSTRACT

This study investigates coronary artery segmentation and centerline extraction from computed tomography angiography (CTA) images through the application of deep learning methodologies. Precise segmentation and centerline extraction are critical for the assessment of coronary artery disease (CAD). CAD constitutes a significant health issue that is frequently evaluated through manual interpretation of CTA images, a process that requires considerable time and has limitations in accuracy. Deep learning offers a more efficient and reliable solution. In this study, SimVascular and 3D Slicer were utilized for vessel segmentation and anatomical information derivation, while the Vascular Modeling Toolkit (VMTK) was applied for coronary centerline extraction. Raw CTA datasets of the cardiovascular system were imported into 3D Slicer. First, vascular images were segmented to isolate different anatomical structures, and then the coronary arteries were extracted. Meanwhile, a Conda environment was created to set up the VMTK environment. The exported *.stl* file from 3D Slicer was processed using the command `vmtkcenterlines -ifile vessel.stl -ofile centerline.stl -seedselector openprofiles` to obtain the centerlines. Finally, an evaluation of the workflow was performed. The deep learning method for coronary segmentation and centerline refinement presented in this study enhances the delineation of arterial boundaries, facilitates vessel tracking, and improves visualization of stenosis. The results demonstrate the potential of this approach to improve diagnostic accuracy and support disease prevention.

Paper ID: ICSHSD-150

Impact of Mid-Tropospheric Instability on Developing Versus Non-Developing Cyclonic Systems over the Bay of Bengal

Md. Shakil Hossain[1*], and Md. Abdus Samad[2]
[1]Department of Mathematics, Khulna University of Engineering & Technology, Khulna-9203, Bangladesh
[2]Department of Applied Mathematics, University of Dhaka, Dhaka-1000, Bangladesh
[*]*Corresponding email: shakil@math.kuet.ac.bd*

ABSTRACT
Forecasting the occurrence and consequences of cyclonic systems across several ocean basins is a challenging task for operational forecasters. Several meteorological factors, as well as complex atmospheric processes, influence the formation and intensification of cyclonic systems. Mid-tropospheric instability is a crucial component in understanding the dynamics of cyclonic systems in advanced weather forecasting research. Previous research has studied the genesis and intensification parameters of tropical cyclones over several ocean basins, but this study is the first to examine the impact of mid-tropospheric instability using six cyclonic systems of varying intensities over the Bay of Bengal. This study uses the WRF-ARW model to conduct 12 simulations of six systems with up to 48-hour lead times. The study reveals that the positive temporal variation in the maximum temperature of the mid-tropospheric instability distribution promotes the system's vertical growth, but extreme mid-level westward wind dominance and negative temporal variation in the maximum temperature can restrict it. It is also found that high-severity systems in this region show a significant negative correlation between sea surface temperature and mid-tropospheric instability distribution. The results of this research have the potential to mitigate complexity and uncertainty in operational cyclone forecasting. The findings of this study may enhance our understanding of atmospheric cyclogenesis processes and improve operational weather forecasting over the Bay of Bengal.

Paper ID: ICSHSD-155

Predicting Kickstarter Campaign Success Using Logistic Regression and Artificial Neural Networks

Md Eabad Ali[1*], **Ibukun Amusan[2] and Al Mamun Bhuiyan[3]**
[1*] Department of Educational Specialties, Austin Peay State University, Clarksville-37040, Tennessee, United State of America (USA)
[2] Department of Mathematics and Statistics, Austin Peay State University, Clarksville-37040, Tennessee, United State of America (USA)
[3]Department of Mathematics and Statistics, Austin Peay State University, Clarksville-37040, Tennessee, United State of America (USA)
* *Corresponding author: eabad.ali87@gmail.com*

ABSTRACT
This study investigates the predictive capabilities of two modeling approaches—Logistic Regression (LR) and an Artificial Neural Network (ANN)—for forecasting the success of Kickstarter campaigns. Utilizing a comprehensive dataset from Kaggle comprising over 300,000 campaign records, the analysis was grounded in meticulous data preprocessing steps, including the transformation of skewed financial variables through logarithmic scaling, rigorous feature engineering, and one-hot encoding of categorical variables to enhance model performance. Both models were evaluated using robust metrics, namely accuracy, precision, recall, F1-score, and ROC-AUC. The comparative model evaluation reveals exceptional performance for both approaches, with Logistic Regression achieving accuracy of 99.74%, perfect recall, and near perfect values across other metrics, while the ANN closely follows with an accuracy of 99.57%, recall of 99.90%, and similarly high scores in precision, F1-score, and ROC-AUC. These results demonstrate that traditional statistical models, despite their simplicity and interpretability, can rival advanced deep learning techniques in predictive power when applied to well-preprocessed, large scale crowd funding data. The findings provide actionable insights for campaign creators and investors by identifying key determinants of campaign success, thereby informing strategic decision-making. Moreover, the study highlights the potential for employing hybrid approaches that combine the interpretability of Logistic Regression with the non-linear modeling strengths of ANNs to further optimize predictive performance in dynamic online crowd funding environments. Future research may extend these findings by incorporating additional data sources and exploring the integration of temporal and textual features to capture evolving campaign dynamics.

Paper ID: ICSHSD-210

Comparative Evaluation of ARIMA, LSTM, and XGBoost Models for Predicting COVID-19 Confirmed Cases in Bangladesh

Apurbo Roy Chowdhury [1, *], Shobha Islam [1], and Bitu Joydhar [1]
[1]Department of Mathematical and Physical Sciences, East West University, Dhaka 1212, Bangladesh
[*]*Corresponding email: apurbo.roy@ewubd.edu*

ABSTRACT
Accurate forecasting of COVID-19 cases is essential for effective public health planning and timely decision-making. This study compares the performance of three forecasting approaches—Autoregressive Integrated Moving Average (ARIMA), Long Short-Term Memory (LSTM), and Extreme Gradient Boosting (XGBoost)—using daily confirmed COVID-19 case data from Bangladesh. To reduce irregular fluctuations and reporting inconsistencies, a seven-day moving average is applied to the raw data. The ARIMA model, a classical statistical method, demonstrates reasonable performance in capturing short-term linear trends but struggles with nonlinear dynamics. The LSTM model, a deep learning technique designed to handle temporal dependencies, effectively learns sequential patterns but requires careful tuning and large training samples. In contrast, XGBoost, a tree-based ensemble machine learning method, consistently achieves the lowest forecast error across all evaluation metrics. Model performance is assessed using Mean Absolute Error (MAE), Mean Squared Error (MSE), and Root Mean Squared Error (RMSE), with results showing that XGBoost outperforms both ARIMA and LSTM in short-term epidemic forecasting. Ensemble methods therefore appear well suited to short-term epidemic prediction under noisy and rapidly changing conditions.

Paper ID: ICSHSD-213

Forecasting Climate Variables in Sylhet Region of Bangladesh with Hybrid Seasonal Arima-Ann Models

Md Azizul Baten[1,*] and Panna Shil[1]
[1]Department of Statistics, Shahjalal University of Science and Technology Sylhet-3114, Bangladesh
[*]*Corresponding email: baten-sta@sust.edu*

ABSTRACT
The northeastern region of Bangladesh, comprising Sylhet and Sreemangal, faces significant climatic challenges characterized by high rainfall levels and temperature fluctuations. Traditional statistical models, such as ARIMA, often struggle to effectively capture the complex, non-linear patterns inherent in climate data. Conversely, hybrid models that combine ARIMA with Artificial Neural Networks (ANN) have demonstrated considerable improvements in predictive accuracy and in understanding the impacts of climate change within the Sylhet region. This study aims to develop and validate robust forecasting models for rainfall and temperature in the Sylhet region. Data for this analysis were obtained from the Bangladesh Meteorological Department (BMD), Dhaka, Bangladesh, covering the period from 1974 to 2022. To forecast these climate variables, three modeling approaches were employed: the Autoregressive Integrated Moving Average (ARIMA) model, Artificial Neural Networks (ANN), and a hybrid ARIMA-ANN model. The performance of these models was evaluated and compared using several metrics—including Mean Error (ME), Root Mean Square Error (RMSE), and Mean Absolute Error (MAE)—to determine their relative forecasting accuracy. The results indicate that the Hybrid ARIMA-ANN model outperformed both SARIMA and ANN models across most climatic variables—particularly rainfall and temperature—in both regions studied. An exception was observed in the Sreemangal region, where the ANN model demonstrated superior performance in predicting rainfall. Overall, by integrating SARIMA's strength in capturing temporal patterns with ANN's capacity to model nonlinear relationships, the hybrid approach achieved enhanced predictive accuracy, as evidenced by lower ME, RMSE, and MAPE values. This study underscores the effectiveness of the hybrid ARIMA-ANN model in significantly improving climate forecasting accuracy in the Sylhet and Sreemangal regions. Future research should focus on refining hybrid modeling techniques and exploring additional machine learning approaches to further enhance forecasting precision, thereby better addressing emerging climate-related challenges.

Paper ID: ICSHSD-232

Physics-Informed Deep Learning for Modeling Nonlinear Dynamics

Md. Abdullah Al Zayed[1,*] and Md. Sumon Hossain[1]
[1]Department of Mathematics and Physics, North South University, Dhaka-1229, Bangladesh.
[*]*Corresponding email: mdabdullah.zayed.251@northsouth.edu*

ABSTRACT
Modeling nonlinear dynamical systems is a central challenge in engineering, physics, and biology, where dynamics are governed by nonlinear interactions and constraints from physical laws. Traditional machine learning methods often suffer from overfitting, poor interpretability, and limited generalization. To address these challenges, we develop a framework that combines Gated Multi-Layer Perceptrons (gMLP) and Physics-Informed Neural Networks (PINNs) for robust learning of nonlinear dynamics. Numerical experiments on benchmark systems demonstrate that the proposed approach achieves improved accuracy, interpretability, and data efficiency compared to standard black-box neural networks.

Paper ID: ICSHSD-260

Machine Learning Powered Exploration of Single-Cell Data for Therapeutic Development

Md. Alamin[1*], and Most. Humaira Sultana[1]
[1]Department of Mathematics & Physics, School of Engineering and Physical Sciences, North South University, Dhaka-1229, Bangladesh.
[*]*Corresponding author: md.alamin06@northsouth.edu*

ABSTRACT
The advent of single-cell multi-omics is revolutionizing biomedical research, offering an unprecedented resolution into gene regulation and cellular heterogeneity. This rapidly expanding interdisciplinary domain presents significant opportunities for engineering students and faculty, particularly in data science, machine learning, and advanced computational modeling. The capability to analyze intricate high-dimensional single-cell data is paramount for driving progress in precision medicine, neuroscience, and comprehensive disease research. However, this field is not without its hurdles, including pervasive data sparsity, the complexities of multimodal data integration, and the demand for scalable computational tools. Overcoming these challenges necessitates a strong foundation in statistical modeling, innovative algorithm development, and high-performance computing, making it a fertile ground for engineers and computational scientists. This study will illuminate how cutting-edge analytical approaches to single-cell data, powered by machine learning and statistical methods, can reveal critical biomarkers that orchestrate early brain development and facilitate targeted drug discovery for Parkinson's Disease (PD). Through the synergistic integration of transcriptomics and epigenomics at single-cell resolution, the molecular mechanisms governing neurogenesis, synaptic regulation, and neuronal differentiation can be explored for biomarker identification. Simultaneously, these methods will be highlighted for their potential in identifying novel therapeutic targets and validating drug candidates for PD. The ultimate aim of this study is to forge a crucial link between biological inquiry and data science, fostering new collaborations and accelerating breakthroughs specifically in PD drug discovery and the understanding of early brain development.

Paper ID: ICSHSD-276

Data Driven Meteorological Forecasting for Divisional Cities in Bangladesh: An ANN-Based Climate Study

Badhan Das[1*], Munnujahan Ara[1], Tashbiha Tabassum Poroma [1], B M Refatuzzaman Labib[1], Brotidev Biswas[1]
[1]Mathematics Discipline, Khulna University, Bangladesh
[*]*Corresponding author: dasbadhan466@gmail.com*

ABSTRACT

Bangladesh is highly susceptible to the impacts of climate change, where variations in temperature, rainfall, humidity, wind speed, cloud coverage, and sunshine duration can strongly influence agriculture, public health, and socio-economic conditions. Accurate, city-level climate predictions are essential for informed planning, yet most existing research focuses on national-level trends, often overlooking local variability. This study aims to bridge that gap by forecasting climate parameters for eight divisional cities of Bangladesh: Dhaka, Khulna, Rajshahi, Rangpur, Chittagong, Sylhet, Barishal, and Mymensinghfor the period 2023 - 2042. We utilized historical meteorological records from NASA (1949 - 2022), analyzing seven features: maximum temperature, minimum temperature, rainfall, relative humidity, wind speed, cloud coverage, and bright sunshine. Correlation analysis among these variables provided insight into their interdependencies and combined effects on regional climate behavior. Two machine learning techniques, Artificial Neural Networks (ANN) and Recurrent Neural Networks (RNN), were applied to predict maximum temperature, rainfall, and relative humidity, with model performance assessed via MAE, MSE, RMSE, and R^2. ANN emerged as the most reliable model for these predictions. The results reveal distinct spatial patterns. Cities including Khulna, Dhaka, Rajshahi, Rangpur, and Chittagong show an increase in maximum temperatures (+0.45°C to +0.76°C) coupled with reductions in rainfall and relative humidity. Conversely, Sylhet and Barishal exhibit declining temperatures (-0.43°C and -0.71°C) while rainfall and humidity rise, and Mymensingh demonstrates simultaneous increases in all three parameters. These findings underscore that climate change effects are heterogeneous across Bangladesh. Understanding these patterns is crucial for developing effective regional adaptation strategies. Areas experiencing rising temperatures and reduced rainfall may face heightened heat stress and water scarcity, whereas wetter regions may encounter increased flooding and humidity-related challenges. This research provides city-specific, data-driven insights that can assist policymakers, researchers, and planners in designing targeted interventions to mitigate climate risks. While the study is limited to monthly forecasts at the city level, it establishes a foundation for incorporating additional climate indicators and hybrid modeling approaches in future work, potentially enhancing prediction accuracy and supporting proactive adaptation planning.

Paper ID: ICSHSD-285

Enhancing Color Image Segmentation Through a Hybrid PSO-GWO Algorithm with Graph-Based Refinement

Md. Ashikur Rahman[1], Israt Jahan[1], Md. Azizur Rahman[1], Raju Roy[1], and Lasker Ershad Ali[1]*
[1]Mathematics Discipline, Khulna University, Khulna-9208, Bangladesh
[*]*Corresponding author: ershad@math.ku.ac.bd*

ABSTRACT

Image segmentation is a critical task in computer vision with applications in medical imaging, remote sensing, surveillance, and object recognition. Traditional segmentation techniques, including thresholding and clustering, often fail on noisy or complex color images with low contrast or irregular textures. To address these challenges, this paper proposes a hybrid framework integrating Particle Swarm Optimization (PSO), Grey Wolf Optimizer (GWO), and graph-cut refinement within a multi-objective optimization setting for image segmentation. Our proposed PSO-GWO hybrid aims to combine the rapid convergence of PSO with the adaptive exploration of GWO, enhancing solution diversity and robustness. This optimizer is embedded into a Strength Pareto Evolutionary Algorithm 2 (SPEA-2) framework to simultaneously optimize intra-region homogeneity, edge strength, and spatial connectivity. Subsequently, graph-cut refinement enforces spatial continuity and sharpens segmentation boundaries. The method is evaluated on the benchmark BSDS300 dataset and compared with existing approaches using quantitative metrics, including Probabilistic Rand Index (PRI), Structural Similarity Index Measure (SSIM), and Boundary F-score. The experimental results demonstrate improved segmentation accuracy, enhanced boundary precision, and increased noise resilience, achieving competitive performance relative to state-of-the-art methods. The proposed approach has potential applications in healthcare diagnostics, satellite image analysis, and autonomous systems, particularly in scenarios with limited data and computational resources.

Paper ID: ICSHSD-294

Enhanced Image Segmentation Via Wavelet Transform and CNN Models

Soumyo Joti Chakraborty[1], Yeamin Hasan[1], Raju Roy[1], Md. Rafiqul Islam[1], and Lasker Ershad Ali[1]*
[1]Mathematics Discipline, Khulna University, Khulna-9208, Bangladesh
*Corresponding author: ershad@math.ku.ac.bd

ABSTRACT
Image segmentation is the process of dividing an image into several distinct regions by grouping pixels with similar characteristics such as texture, gray level, and brightness, making it a key step in computer vision and image analysis. It allows meaningful information to be extracted from images for applications in areas like medical diagnosis, remote sensing, and pattern recognition. Traditional segmentation methods such as Maximum Variance Segmentation, Bimodal Segmentation, and Valley Threshold Segmentation often suffer from limitations, including sensitivity to noise, loss of local details, and reduced effectiveness across different types of images. To address these challenges, this study proposes an image segmentation framework based on the wavelet method integrated with deep learning models. The wavelet transform is employed to decompose the histogram of an image across multiple scales, first identifying rough threshold values at larger scales and then refining them at smaller scales to achieve accurate segmentation. This decomposition process effectively reduces the influence of noise and preserves fine image details. To enhance the performance further, Convolutional Neural Networks (CNNs) are adopted to work in conjunction with the wavelet-based segmentation, enabling automatic feature extraction, categorization, and classification from complex datasets. The proposed methodology is tested on the FER2013 dataset, which contains diverse facial images across seven emotion categories, with the data split into training, testing, and validation sets. Experimental results demonstrate that the wavelet-based deep learning approach achieves higher segmentation accuracy, better feature preservation, and improved robustness compared to traditional segmentation techniques, highlighting its potential as a more effective solution for practical image analysis tasks.

Paper ID: ICSHSD-301

Advanced Clustering Techniques for Precision Image Segmentation

Badhan Roy[1], Md. Rakib Molla[1], Raju Roy[1], Md. Rafiqul Islam[1], and Lasker Ershad Ali[1]*
[1]Mathematics Discipline, Khulna University, Khulna-9208, Bangladesh
*Corresponding author: ershad@math.ku.ac.bd

ABSTRACT
Image segmentation refers to the process of partitioning a digital image into meaningful regions where homogeneity of attributes like color or texture exists among the pixels of the same region, and it forms an integral component of the workflows in computer vision, like in medical imaging, imaging satellites, or even image-based object detection and recognition. K-means and Fuzzy C- means, which are classical clustering techniques, are known to be quite fast in processing, but have issues with noisy or irregular borders and a fixed number of clusters, which is quite a common limitation in many fields. In this case, this research proposes the framework called Spatial- Contrastive Adaptive Clustering (SCAC), which combines self-supervised contrastive feature learning, adaptive density-based clustering, and spatial consistency refinement. The framework includes a contrastive encoder that processes unlabeled images to derive features with rich semantics. The features are reduced to lower dimensions to improve the clustering results. Adaptive clustering techniques such as DBSCAN and subtractive clustering are able to find the number and shape of clusters on their own. However, spatial constraints work to ensure neighborhood coherence to reduce noise and fragmentation and preserve structure. The proposed approach is evaluated using several performance indicators like IoU, Dice coefficient, and border F1-score on benchmark datasets, including BSDS500, Cityscapes, and domain-specific medical and satellite pictures. Experimental results indicate that SCAC outperforms conventional clustering techniques, achieving cleaner boundaries, greater noise robustness, and higher segmentation accuracy, thereby establishing it as an effective framework for unsupervised image segmentation.

Paper ID: ICSHSD-307

Singular Spectrum Analysis for Forecasting Nonlinear Time Series

Atikur Khan[1*] Md. Alamin[1], and Bashir Khan[1]
[1]North South University, Dhaka, Bangladesh.
[*]*Corresponding author: atikur.khan@northsouth.edu*

ABSTRACT
Singular spectrum analysis is a popular method in reconstructing and forecasting signals from noisy stationary, nonstationary, linear, and nonlinear time series. This constructs a trajectory matrix by embedding a noisy time series into a higher dimensional space and reconstructs a signal series from a lower dimensional space via a singular value decomposition. Normalization of data often improves the predictive performance of a model and provides better forecasting outcome. Though data normalization is straightforward for stationary and linear time series as the mean and variance are constant over time, these statistics are not time invariant for nonlinear and nonstationary time series. We develop an affine transformation of trajectory matrix that naturally adopts data normalization for decomposition and reconstruction of signal form stationary, nonstationary and nonlinear time series. Vector forecasting algorithm is developed under this affine transformation, and the performance of this algorithm is examined by generating data from nonlinear Logistic map and Mackey-Glass series. Results obtained from simulation experiments are also reflected in real world data analysis. Applications of our developed affine transformed singular spectrum analysis demonstrate relative advantages over the basic singular spectrum analysis in forecasting industrial production indices and cryptocurrency prices.

Paper ID: ICSHSD-427

Evaluation of Sensible Heat Flux of Super Cyclonic Storm Amphan Using WRF Model

Most. Fatema Amin Akhi[1*], Kh. Hafizur Rahman[1,2], and M. A. Taher[1]
[1]Department of Mathematics, Dhaka University of Engineering & Technology, Gazipur-1700
[2]Bangladesh Meteorology Department, Agargaon, Dhaka
**Corresponding author akhi@duet.ac.bd*

ABSTRACT
The Bay of Bengal (BoB) frequently experiences low-pressure systems, though only a few intensify into severe tropical cyclones (TCs). Accurate prediction of TC intensification remains challenging due to their short lifespan and rapid intensity changes. This study examines the super cyclonic storm (SuCS) Amphan (May 2020) using the Advanced Research Weather Research and Forecasting (WRF-ARW v4.2) model with a 9 km resolution. Amphan originated over the south Andaman Sea on 13 May 2020 and rapidly intensified into a SuCS by 18 May before weakening over northern Bangladesh on 21 May. Model simulations employed the WSM3 microphysics, Kain-Fritsch cumulus, and Yonsei University (YSU) PBL schemes. The analysis focuses on sensible heat flux (SHF) and its relationship with TC intensity. ERA5 reanalysis data were used for model validation. Results indicate a large correlation between SHF and TC intensity, although the overall correlation between SHF and TC intensity is generally weak.

Paper ID: ICSHSD-433

Identification of the Effects of Socio-Demographic and Health Related Characteristics on Ever Attending School of Street Children of Dhaka City in Bangladesh Using Logistic Regression Model

Md. Shahiduzzaman[1*], M. Korban Ali[2], Md. Nurul Islam[3], and Md. Rafiqul Islam[4]
[1]Department of Electrical and Electronic Engineering, Northern University Bangladesh, Dhaka-1230, Bangladesh
[2]Department of Population Science and Human Resource Development, University of Rajshahi, Rajshahi-6205, Bangladesh
[3]Department of Statistics, University of Rajshahi, Rajshahi-6205, Bangladesh
[4]Department of Population Science and Human Resource Development, University of Rajshahi, Rajshahi-6205, Bangladesh
**Corresponding author: shahidnub@yahoo.com*

ABSTRACT
Sustainable development of any country is not possible without proper education. Thus, schooling is the main way of getting proper education which is difficult for street children. In spite of the limitations, some of the street children were attending school during the time of interview, and some street children were not attending school but a number among them attended school in past. So, it is important to identify the factors which influence the street children for attending the school.

Paper ID: ICSHSD-435

Role of Rolling Statistics in Predicting Weibo Closing Prices Using Long-Short Term Memory Networks

Ahanaf Rasheed[1], Zahin Ferdusi Khan[1*], and Atikur Rahman Khan[1]
[1]Department of Management, North South University, Dhaka 1229
Corresponding author: zahin.ferdausi.khan@gmail.com

ABSTRACT

Feature engineering is an integral part of machine learning in forecasting stock prices. Often used in time series analysis, lagging of rolling statistics is a popular method to generate lagged features to train a machine learning model. Lagging rolling statistics capture both short-term and long-term dynamics by computing statistics over a rolling window and then lagging them to incorporate memory of the recent past. Long-term nonlinear trends and short-term fluctuations are common properties of stock prices, and utilization of rolling statistics features is likely to better train Long Short-Term Memory (LSTM) networks for forecasting stock prices. This paper develops a set of rolling statistics induced lagged features and examines the importance of these features in forecasting Sina Weibo's closing prices by employing long short-term memory (LSTM) networks. Though many other features related to price and volume momentums are commonly used in stock price prediction, lagged rolling statistics features are found more dominant in LSTM. Utilization of selected lagged rolling statistics features in LSTM provide highly accurate 5-minute and 30-minute ahead predictions of Weibo's stock prices. Moreover, mean square forecast error obtained by using LSTM networks with the selected subset of features is lower than obtained by using Bidirectional LSTM (BiLSTM) and Gated Recurrent Unit (GRU) networks. Application of LSTM with our developed features will enable investors to obtain highly accurate prediction of Weibo's stock price to make more informed decisions.

Paper ID: ICSHSD-449

Predicting Anxiety, Depression, and Stress in Bangladeshi University Students: An Ensemble ML and XAI Approach

Md. Raihan Tapader[1], Ariful Islam Shiplu[1], and Most. Nasrin Akhter[2*]
[1]Department of Computer Science and Engineering, Dhaka University of Engineering & Technology, Gazipur
[2]Department of Mathematics, Dhaka University of Engineering & Technology, Gazipur
Corresponding author: nasrin@duet.ac.bd

ABSTRACT

Anxiety, depression, and stress are common mental health challenges that often arise from excessive pressure, persistent worry, or prolonged sadness. In recent years, a significant number of university students in Bangladesh have tragically committed suicide or dropped out form studies, with most of them suffering from undiagnosed or untreated psychological problems. This alarming trend emphasizes the urgent need for effective methods to detect students at risk. While existing machine learning models can provide useful predictions, there remains a need for more accurate and precise prediction accuracy, as well as a deeper understanding of the underlying causes of these psychological problems. In this study, we focus on predicting the occurrence of psychological issues specifically anxiety, depression, and stress among Bangladeshi university students using the "EDA + Predicting Mental Health" dataset from Kaggle. The dataset was analyzed using eleven machine learning algorithms, including K-Neighbors Classifier, Support Vector Classifier (SVC), Decision Tree Classifier, Random Forest Classifier, Gradient Boosting Classifier, XGBoost, AdaBoost, LightGBM, CatBoost, Gaussian Naive Bayes, and Bernoulli Naive Bayes and, grouped into four categories: traditional machine learning, tree-based methods, probabilistic models, and ensemble techniques. Furthermore, voting techniques such as soft voting and hard voting were employed to enhance prediction accuracy. To ensure transparency and interpretability, Explainable AI (XAI) techniques, particularly the LIME method, were utilized to analyze model behavior and identify potential biases. Among all models, the CatBoost Classifier and Support Vector Classifier (SVC) achieved the highest accuracy in predicting anxiety, depression, and stress. These findings demonstrate the effectiveness of ensemble and kernel-based methods in handling complex mental health prediction tasks. The goal of this research is to develop prediction models that can identify at-risk university students and uncover the underlying causes of anxiety, depression, and stress. Early detection of these mental health conditions can help minimize their negative impact on students' academic performance and overall well-being.

Paper ID: ICSHSD-510

Comparative Study of Self-Supervised and Supervised Learning for Crop Disease Detection in Low-Resource Agricultural Data

Sagor Kumar Mitra[1] and Protima Roy [2]
[1]Mechanical Engineering, Rajshahi University of Engineering & Technology (RUET)
[2]Leather Engineering, Khulna University of Engineering & Technology (KUET)
[*]*Corresponding email: sagor.ruet@gmail.com*

ABSTRACT

The rapid advancement of machine learning has opened new opportunities for sustainable agriculture, particularly in plant disease detection, which is vital for ensuring food security in resource-constrained regions. Traditional supervised learning has demonstrated promising results in image-based disease classification but depends heavily on large volumes of labeled data, which are costly and time-intensive to obtain. In contrast, self-supervised learning (SSL) has emerged as a potential alternative, enabling effective representation learning without extensive manual annotation. Despite its growing popularity, a systematic comparison of SSL and supervised learning in the context of agricultural datasets remains underexplored. This study presents a comparative analysis of supervised and self-supervised approaches for crop disease detection using publicly available datasets. We employ the PlantVillage dataset, which provides clean laboratory images, and the PlantDoc dataset, which represents more complex field conditions. Several supervised baselines, including convolutional neural networks and state-of-the-art transfer learning models, are evaluated against SSL frameworks such as SimCLR and BYOL. To simulate low-resource conditions, experiments are conducted under different labeled data availability scenarios (5%, 10%, and 20% of training labels). The evaluation highlights the performance gap between laboratory and real-world data, demonstrating how SSL methods generalize better under data scarcity. Experimental results indicate that SSL models achieve competitive or superior accuracy with fewer labeled samples, showing their potential for practical deployment in developing regions where annotated agricultural datasets are limited. Furthermore, the study emphasizes the importance of considering both clean and real-world datasets when benchmarking learning paradigms for agricultural applications. By integrating sustainability into the design and evaluation of machine learning models, this research contributes to the development of AI tools that can support farmers in early disease diagnosis, reduce crop losses, and strengthen food production systems. The findings underline the promise of SSL in enabling efficient and scalable agricultural solutions, thereby aligning artificial intelligence research with the broader goals of sustainable development.

Artificial Intelligence

Paper ID: ICSHSD-12

AI's Role in Bangladesh's Economic Growth: A Comprehensive Sectoral and Policy Analysis

Nazmus Sakib Apurba[1] and Sadiya Afrin Reba[2]

[1]Department of Computer Science and Engineering, International University of Business Agriculture and Technology, Dhaka, Bangladesh

[2]Department of Economics, International University of Business Agriculture and Technology, Dhaka, Bangladesh

Corresponding email: *nazmussakibapurbo@gmail.com*

ABSTRACT

Artificial intelligence has become an important part of Bangladesh's economic shift towards a digital economy. In this study we collected and analyzed 500 data points from various sectors using a structured questionnaire to examine AI's effects on Information technology, agricul- ture, textiles, pharmaceuticals, fintech, manufacturing, healthcare, education, disaster manage- ment etc. We have observed the highest impact score in Agriculture (54.5%) as our country is an agricultural country. Agriculture plays an important role in our economy. Our key find- ings suggest a potential productivity boost and improvements in economy. Here we have also identified challenges like- skill shortages and ethical concerns that need attention. Our recom- mendations emphasize partnerships, education, infrastructure and reskilling. By analyzing the primary data, we have proposed a formula to determine the AI impact on different economic sectors of Bangladesh.

Paper ID: ICSHSD-93

Automated Bangla to IPA Transliteration Using Sequence-to-Sequence Models with Attention Mechanism

Nazmus Sakib Apurba

[1]Department of Computer Science and Engineering, International University of Business Agriculture and Technology, Dhaka, Bangladesh

Corresponding email: nazmussakibapurbo@gmail.com

ABSTRACT

The International Phonetic Alphabet (IPA) offers a standardized way to transcribe spoken language sounds. This system is important for linguistic research, language learning, and speech therapy. Bangla(বাংলা), a widely spoken language with complex sounds, gains a lot from precise IPA transcription. This research introduces a sequence-to-sequence (Seq2Seq) model that includes an attention mechanism to convert Bangla text into IPA. The model is trained on a dataset of 21,999 Bangla-IPA pairs from Kaggle. It reaches a token accuracy of 99.24%, a test loss of 0.8172, an average BLEU score of 0.9873 and an exact match rate of 85%. This paper discusses the dataset, preprocessing, model structure, training process, and evaluation results. It also includes a thorough review of existing literature on Bangla transliteration and Seq2Seq modeling.

Paper ID: ICSHSD-105

Explainable AI to Detect Malaria Parasite Using Deep Learning

Syeda Mashiat Tabassum[1*]
[1]North South University, Dhaka-1229, Bangladesh.
*Corresponding author: mashiat.tabassum.251@northsouth.edu

ABSTRACT

Malaria, a deadly disease, is spread by bites from female anopheles mosquitoes. The victim's life is threatened by the numerous plasmodium parasites that spread throughout their blood cells. If not treated early, malaria can even kill. Microscopy is a common technique for diagnosing malaria, taking blood samples, and counting the parasite and red blood cells. However, the microscopy procedure is time-consuming and occasionally produces inaccurate findings. With the recent success of machine learning and deep learning in medical diagnosis, it is possible to reduce diagnosis costs and improve overall detection accuracy in comparison to the conventional microscopy method. The procedure consists of three steps: the phases of training, feature extraction, and testing and validation. Using deep learning technologies, the system learns from a variety of malaria photographs. Predicting malaria-related diseases accurately is the primary objective of this system. In terms of speed, affordability, and accuracy, the methods used never waver. In order to treat and prevent the disease, they are absolutely necessary. We compared the research's overall findings. We are getting closer to classifying malaria and healthy blood samples in order to assist in the detection of advanced illness thanks to the performance of a DL model that has already been pre-trained as distinct extractors. It is determined which model layers are best suited for extracting attributes from the experimentally underlying records. A wide range of malaria disease image samples are included in the dataset. We used dominant characteristics like size, color, form, and cell size to get a precise result. Count the number of photographs to facilitate the arrangement interaction. Pre-trained CNNs are currently producing attribute extraction output, which could be used to ascertain this. It is supported by statistics. Because it is a straightforward, cost effective, and dependable method for identifying malaria, microscopy may be of great assistance in the pursuit of a cure as a result of these modifications and automation. The validation was 977 percent accurate, and our model was accurate by 96%. With a train loss of 10% and a validation loss of 9%, VGG-16 has a training accuracy of 96% and a validation accuracy of 97%, respectively.

Paper ID: ICSHSD-136

Leveraging Interactive System Design and Retrieval Augmented Generation Model for Learning Mathematics

Raiyan Ahmed[1], **Ahsanul Karim Raiyan** [1], **Dr. Atia Afroz** [2*]
[1]Department of Electrical and Computer Engineering, North South University, Dhaka, Bangladesh.
[2]Department of Mathematics and Physics, North South University, Dhaka, Bangladesh.
*Corresponding author: atia.afroz@northsouth.edu

ABSTRACT

Only one-third of sixth-grade and above students in Bangladesh can solve basic mathematical problems like multiplication and subtraction involving carryovers and remainders. This indicates a huge problem with mathematics education. For UNESCO, reported teacher-to-pupil ratio of 1:64, which is twice than the recommended 1:30 for effective instruction so existing resources fall short in meeting the needs of students. Appropriate instruction, progress assessment, and remedial guidance are hindered by this shortage. This gap can be closed by digital tools that support autonomous, interactive learning with detailed error feedback. Hence, we propose, Ongko_Shikhi, a web application that uses interactive-system-design to engage students in mathematics. It is combined with a Retrieval-Augmented-Generation model to provide thorough tutorials and check the mistakes of students' workings. This study presents a multimodal AI-framework for teaching mathematics that provides immediate answers, interactive visualizations, and step-by-step solutions. Retrieval-Augmented-Generation (RAG) is preferred over large-language-models (LLMs) as they can produce inaccurate and inconsistent results. RAG tackles this issue by using a carefully curated knowledge base. Three main components make up the framework: RAG for interpreting math textbook content; symbolic computation for algebraic manipulations, equation solving, and reasoned steps; and Optical-Character-Recognition (OCR) for processing handwritten expressions and diagrams. This integration facilitates intelligent tutoring, content creation, real-time feedback, and analysis of students' state with adaptable input/output formats for various contexts. The work suggests using these to improve and expedite math learning.

Paper ID: ICSHSD-241

Data Augmentation for Robust Learning: A Performance-Centric Analysis in Agriculture and Social Media

Ariful Islam Shiplu[1], and Most. Nasrin Akhter [2*]
[1]Department of Computer Science and Engineering, Dhaka University of Engineering & Technology, Gazipur
[2]Department of Mathematics, Dhaka University of Engineering & Technology, Gazipur
[*]*Corresponding author: nasrin@duet.ac.bd*

ABSTRACT
In recent years, machine learning (ML) has established itself as a transformative technology with remarkable applications in agriculture, healthcare, and social media. These models can learn complex patterns from data and generate accurate predictions that facilitate effective decision-making in real-world applications. However, the effectiveness of ML models is often constrained by the quality and quantity of the training data. A major challenge in this regard is data imbalance, where certain classes are significantly underrepresented. Such imbalance restricts the ability of models to generalize across all classes. Consequently, they often produce biased predictions and achieve lower overall accuracy. Similarly, a limited dataset size can prevent models from capturing the full diversity of patterns. This further hinders their ability to achieve robust performance. To overcome these challenges, data augmentation has been widely adopted as a practical solution. Data augmentation expands the dataset by creating new training samples using transformations. In this study, we performed a performance-centric analysis to evaluate the impact of data augmentation on two domains: social media and agriculture (crop disease detection). The experimental setup compared baseline model performance on the original datasets with performance after applying augmentation. Our findings indicate that data augmentation significantly improves model performance. For the social media dataset, accuracy increased to 95%, reflecting an improvement of about 15%, while the crop disease dataset achieved an accuracy of 97%, marking a 3% gain.

Paper ID: ICSHSD-277

Integrating Deep Features with PCA and Machine Learning Models for Human Emotion Recognition

Md. Mehedi Hasan Tonmoy[1], Mohammad Mahadi Hassan[1], Sheikh Mehrin Rinvi[1], Abdullah Al Akash[1], and Lasker Ershad Ali[1]*
[1]Mathematics Discipline, Khulna University, Khulna-9208, Khulna
[*]Corresponding author: *ershad@math.ku.ac.bd*

ABSTRACT
Facial expression recognition, a key area of affective computing, has growing applications in healthcare, surveillance, education, and human-computer interaction, supporting sustainable development through adaptive and intelligent systems. Accurately identifying emotions from facial cues remains challenging due to variations in pose, lighting, and limited dataset size. To address these challenges, this paper proposes an integrated deep feature extraction technique with machine learning classifiers to develop a robust framework for emotion recognition. Specifically, the proposed approach employs VGG16 and VGG19 deep learning models for feature extraction, followed by hybrid feature fusion. After that, the principal component analysis (PCA) is utilized to reduce the feature dimensionality. The extracted features are subsequently classified using a range of classical machine learning algorithms, including K-Nearest Neighbors (KNN), Support Vector Machine (SVM), Decision Tree, Random Forest, Multi-Layer Perceptron (MLP), Extreme Gradient Boosting (XGB), Gaussian Naïve Bayes, Extra Tree Classifier, AdaBoost, and Extreme Learning Machine (ELM). The experimental evaluation is carried out on the publicly available Extended Cohn–Kanade (CK+) dataset, which includes seven basic emotion classes. Model performance is evaluated using accuracy, precision, recall, and F1-score, while confusion matrices and ROC curves offer detailed insights into recognition performance at the class level. The experimental results demonstrate that combining VGG16 and VGG19 features with PCA, along with the MLP classifier, yields the highest performance on the CK+ dataset, achieving a precision of 0.987, a recall of 0.985, an F1-score of 0.984, and an accuracy of 98.47%, outperforming other classification models. These findings demonstrate that integrating deep feature extraction with an optimal combination of machine learning classifiers substantially enhances recognition performance in facial emotion tasks. Overall, this study advances affective computing and human- centric AI by introducing a mathematically grounded and computationally efficient framework for emotion recognition, supporting Sustainable Development Goals (SDG 3 and 9) through more natural and adaptive machine intelligence.

Paper ID: ICSHSD-358

Federated Learning in Healthcare: Opportunities, Challenges, and Research Gaps

Golam Mostafa Rabby[1], and Most. Nasrin Akhter [2*]
[1]Department of Computer Science and Engineering, Dhaka University of Engineering & Technology, Gazipur-1700, Bangladesh
[2]Department of Mathematics, Dhaka University of Engineering & Technology, Gazipur-1700, Bangladesh
Corresponding author: nasrin@duet.ac.bd

ABSTRACT
Federated Learning (FL) is a novel machine learning technique that enables hospitals and clinics to train models without sharing sensitive data. This paper addresses fundamental challenges to the general adoption of federated learning in healthcare, including data heterogeneity, privacy concerns, communication complexity, and limited customization. To overcome these issues, it investigates safe aggregation, differential privacy, and lightweight communication strategies that can increase the reliability and efficiency of FL in healthcare environments. The findings suggest that overcoming these challenges will enable FL to provide secure, collaborative, and scalable AI solutions in healthcare. However, strong privacy restrictions such as HIPAA and GDPR continue to limit the transmission of patient data between institutions. Federated Learning (FL) solves this by training models locally and sharing only model updates. Despite this advantage, research gaps remain: (1) heterogeneous data across hospitals reduces model accuracy, (2) privacy leakage from gradients is still possible, (3) high communication and computation costs slow adoption, and (4) global models often fail to adapt to local hospital needs. Addressing these gaps is crucial for real-world FL applications in healthcare.
This study applies a structured review and analytical approach. The approach strongly emphasizes how secure aggregation, differential privacy, and communication based on compression may reduce risks. To adapt global models to local hospital data, personalized FL algorithms were studied as well.

Paper ID: ICSHSD-471

AI-Driven Smart Irrigation and Crop Monitoring System for Empowering Rural Farmers

Rashidul Islam Sifat*
Department of EEE, Dhaka University of Engineering & Technology, Gazipur
*Corresponding Email: sifatduet01@gmail.com

ABSTRACT
Water scarcity, inefficient irrigation, and climatic uncertainty are a few of the greatest concerns for small and medium-scale rural farmers. The present study proposes an AI-based smart irrigation and crop monitoring system that focuses on water optimization, improving the productivity of crops, and sustainable agriculture with particular reference to social impacts on rural farmers. The system integrates soil moisture sensors, humidity and temperature sensors, an ESP32 microcontroller, and solar-powered automation to facilitate data-driven decision-making in irrigation in real time. The collected data is processed through machine learning algorithms to predict crop water requirements, detect early signs of crop stress, and suggest optimal irrigation schedules to reduce water and manual labor wastage. In addition to technology, the system focuses on accessibility and ease of use for the local farmers. It incorporates mobile and web interfaces with simple dashboards, enabling farmers to monitor and control irrigation remotely. This approach promotes knowledge sharing, social inclusion, and community empowerment by providing rural farmers with decision support tools for farming. By leveraging IoT and AI, the system creates resilience to climate variability, ensures efficient resource management, and enables rural livelihood improvement. Field trials demonstrate that the system can reduce water consumption by a significant margin without reducing or even improving crop yields, making it an economical alternative for smallholder farming. The project demonstrates how the convergence of emerging technology and social interests can facilitate sustainable and socially responsible farming practices.

Paper ID: ICSHSD-476

An Efficient INCEPTIONV3 Based Customized Transfer Learning Model for MRI Brain Tumor Classification

Md. Arafat [1*]
[1]Department of Computer Science and Engineering, Dhaka University of Engineering & Technology, Gazipur
*Corresponding author: arafatkhan.7232@gmail.com

ABSTRACT
A brain tumor is a growth or mass of abnormal cells in or around the brain. Such uncontrolled cell growth can cause pressure within the skull, resulting in brain damage and even death. One of the most dangerous medical ailments worldwide, brain tumors have both patient survival and treatment success relying on an accurate diagnosis. Magnetic resonance imaging (MRI) is one of the most well-liked imaging technologies. To overcome interpretation by hand issues and help medical professionals with diagnosis, automatic classification methods are being suggested. In this work, the brain tumor classification from MRI images was carried out using transfer learning with the InceptionV3 model. Data cleaning, normalization, and preprocessing were applied to the dataset as preprocessing techniques. Data augmentation has also been conducted to improve class imbalance handling and generalization. In observing the learning process during training and validation, accuracy and loss curves were utilized. The model's performance in its ability to differentiate between classes was examined using ROC–AUC curves (properly labeled and zoomed), whereas classification performance per tumor type was examined with a confusion matrix. The results show that the system generalizes well to unseen data consistently, as corroborated by the model's 99.5% training accuracy, 96.31% validation accuracy, and 96% test accuracy. Additional studies can be carried out by constructing a hybrid model system where image data and text data (other physical condition data of the patients) is combined for detecting the diseases precisely.

Paper ID: ICSHSD-495

AI-Based Predictive Modeling of Energy Demand in Smart Grids

Sadia Tasnim Shara[1*], **Sadi Mohammad Meraj** [2], **Raiyan Yusuf** [2], **Tamim Hasan Apurbo**[2], **and Md. Mortuza Ahmmed**[3]
[1]Undergraduate Student, Department of Electrical and Electronic Engineering, American International University-Bangladesh, Dhaka, Bangladesh
[2] Undergraduate Student, Department of Computer Science Engineering, American International University- Bangladesh, Dhaka, Bangladesh
[3]Associate Professor, Department of Mathematics, American International University-Bangladesh, Dhaka, Bangladesh
[*]Corresponding email: *22-48622-3@student.aiub.edu*

ABSTRACT
Nowadays, understanding the demand for electricity is an very important component of contemporary energy systems, mostly as nations transition to smart grids and incorporate renewable energy sources. Constantly growing urbanization, industrialization, and climate change are all putting a lot of strain on Bangladesh's national grid. As a result, supply and demand can't match up with each other. Popular statistical models have mostly been used but they are ineffective due to the complexity, nonlinearity, and weather-dependent nature of electricity use. In this recent situation, artificial intelligence (AI) offers new opportunities for creating forecasting systems that are more accurate and flexible. To solve this problem, we have used open-access datasets relevant to Bangladesh that includes historical energy consumption data (1975–2021), regional demand- weather records of the Sylhet division, and national daily power demand and generation reports (2019–2024). Preprocessing steps added filling missing values, normalizing the data, and generating new features from weather variables. We developed a comparative modeling framework that applied AI techniques such as Random Forest, XGBoost, and Long Short-Term Memory (LSTM) networks alongside baseline statistical models, including ARIMA and linear regression. Model performance was evaluated using standard error metrics such as RMSE, MAE, and MAPE. Our study reveals that AI-based models always do better than old-fashioned ones. LSTM models, in instance, cut predicting errors by up to 30% when it came to capturing daily and seasonal changes compared to ARIMA. The temperature turned out to be the best predictor of peak demand, and adding weather data made the model even more accurate. Regional case studies from Sylhet showed how AI models can change based on changes in demand in specific areas. Long- term estimates at the national level predicted a constant increase in electricity demand, which was closely linked to forecasted population and industrial expansion. The study represents that using AI for forecasting greatly enhances Bangladesh's ability to predict energy demand over the long and short terms. These findings imply that forecasting systems must incorporate meteorological and regional data because standard models aren't always reliable which is a matter to look over. More precise forecasts help Bangladesh's future smart grid use more renewable energy while reducing the risk of load shedding and grid instability that improves the efficiency.

Paper ID: ICSHSD-500

From Chaos to Clarity: AI-Integrated Crisis Simulations for Faster and Smarter Disaster Management

Raiyan Yusuf[1*], Sadi Mohammad Meraj[1], Sadia Tasnim Shara[2], Tamim Hasan Apurbo[1], and Md. Mortuza Ahmmed[3]
[1]Undergraduate Student, Department of Computer Science, American International University-Bangladesh, Dhaka, Bangladesh
[2] Undergraduate Student, Department of Electrical and Electronic Engineering, American International University-Bangladesh, Dhaka, Bangladesh
[3]Associate Professor, Department of Mathematics, American International University-Bangladesh, Dhaka, Bangladesh
[*]Corresponding email: 23-54376-3@student.aiub.edu

ABSTRACT

Natural disasters such as floods, earthquakes, and pandemics often outstrip traditional response capabilities, because they rely on non-integrated modelling systems, long turnarounds, and unconnected data analyses. Physics-based simulations whether hydrodynamic for flooding, seismic for earthquakes, or epidemiological for pandemics, tend to be computationally demanding and takes too long to develop and can't be used quickly enough to inform decisions. This is starting to change, with AI breaking down these limitations. One such example is a neural surrogate model of coastal ocean circulation that accelerates the 12-day forecasts, from a runtime of 9,908 seconds on 512 CPU cores to 22 seconds on a single A100 GPU, while maintaining high-fidelity results, at a speedup of 450× or higher. Likewise, an ML emulator for predicting flood inundation across Chicago reached R-squared values over 0.96 and median relative errors close to 1 percent and ran in about 0.006 s/event. Following such advancements, in this study we introduce an AI directed "crisis twin" that integrates fast physics-based surrogates with reinforcement learning and social-economic knowledge. In this framework, the flood dynamics are simulated alongside structural fragilities and disease spread. During post-disaster recovery and reconstruction, proposed deep reinforcement learning model outperform that of Monte Carlo algorithms with 33.6% reduction on delays, 46.4% in comparison to genetic algorithms and overall cost reduced by up to 18.6%. At the other end of the spectrum, social media-enhanced RL frameworks have enabled the attainment of up to 30% increase in resource satisfaction and equity scores as high as 0.5 as against traditional allocation schemes. The crisis twin framework grounds these components as a single pipeline: AI-powered simulations for near real-time high-fidelity, high-speed hazard modeling; reinforcement learning for adaptive resource allocation in dynamic environments; and socio-economic data for equitable, targeted, context-aware response strategies. This allows decision-makers to virtually test out many "what-if" interventions, compare alternate outcomes, fine-tune policies before deploying them in the real world, and therefore be better prepared, with fewer casualties, less economic damage, and better long-term resilience. In the end, this approach realises disaster response scenarios from reactive, silo models to proactive and integrated simulations, by exploiting the speed of neural surrogates, flexibility of reinforcement learning, and realistic socio-economic context. Attendees will learn about how AI can enable faster, more intelligent and more equitable crisis response and thereby offer a glimpse of its potential as a life-saving, decision-support technology for the layered, multi-hazard emergencies of today's world.

Poster Papers

Paper ID: ICSHSD-331

Impact of Mrt Line 6 (Dhaka Metro Rail) on Commuter Modal Shift, Travel Time Reduction, And Future Expansion Prospects

Prottoy Roy1* , Jannatul Ferdousi Ayshe1 , Md. Ishraq Al-Din Sarker Arnob1 , Md. Imran Hossain Bappy1 , Noshin Tabassum Mithila1 , and Dr. Mahfuza Khatun 2
1Department of Computer Science and Engineering, American International University-Bangladesh, 408/1, Kuratoli, 1229, Dhaka, Bangladesh
2Department of Mathematics, American International University-Bangladesh, 408/1, Kuratoli 1229, Dhaka, Bangladesh
*Corresponding email: 23-53570-3@student.aiub.edu

ABSTRACT
With nearly 25 million residents, Dhaka is one of the most densely populated cities in the world and faces severe traffic congestion. In addition to examining how more MRT lines could ease extreme traffic congestion in Dhaka, this study assesses how the city's first metro system, MRT Line 6, has shifted commuters from private vehicles, buses, and para-transit services to rapid transit. It also examines the system's effect on travel time, work efficiency, and economic activity. Mode shares and travel times before and after MRT launch were analyzed using data from news reports, academic publications, and a survey of about 200 residents from various socioeconomic backgrounds. Since its launch, MRT Line 6 has offered shorter travel times, regular schedules, and better comfort. Subsequently, the daily ridership has grown significantly, reaching nearly 400,000 in 2025. Previously, around 59.41% of passengers traveling between Uttara and Motijheel used public transport; now these individuals use MRT-6. According to post-launch surveys, the average daily commute time decreased by 66.67%, from roughly two hours to about forty minutes, providing commuters with a faster, dependable, and comfortable alternative to congested roads. The success of MRT Line 6 has transformed Dhaka's urban mobility and has prompted the government to accelerate the planning and development of additional MRT corridors.

Paper ID: ICSHSD-363

Fake News Detection Using Textual and Visual Data: A Mobile Application Framework with Multiple Machine Learning Models

Abdul Owadud Islam Raton[1*], and Khawja Imran Masud[1]
[1]Department of Computer Science and Engineering, Dhaka University of Engineering & Technology (DUET).
Corresponding author: imranraton599@gmail.com

ABSTRACT
Fake News has high potential to change opinions, facts and can be the most dangerous weapon in influencing society. The spread of false information on social media and other platforms is alarming. It presents a serious threat because it can cause significant social and national harm with devastating effects. Many researchers have already studied how to detect fake news. This paper reviews existing research on fake news detection and compares multiple machine learning models to identify the most effective one for building a supervised algorithm that can classify news as true or false. This research extracts textual and visual data from mobile applications using NLP and image processing, comparing them based on predefined accuracy and relevance criteria. Next, we will use feature selection methods to test and identify the features that give us the highest precision based on the confusion matrix results.

The rapid spread of news through social media and online platforms has transformed how we consume news but also made discerning the truth more challenging. A great deal of fake news is roaring through the various social media platforms like Facebook, Twitter etc. Fake news is a news designed to deliberately spread hoaxes, propaganda and disinformation This paper describes a simple fake news detection method based on multiple machine learning algorithms - Logistic Regression, Decision Tree Classifier, Gradient Boost Classifier, Random Forest Classifier. The aim of the research is to test how these algorithms work for this specific problem, given a manually labeled news dataset, and to support (or not) the idea of using artificial intelligence for fake news detection. Moreover, this technique can be easily implemented by adding recent news to social platforms like Facebook and Twitter and improving the dataset regularly. The difference between this paper and other papers on the same topic is that in this work multiple models were used for fake news detection; we tested the difference in accuracy by taking textual and visual articles of different lengths from mobile apps for fake news detection; Also introduced was a concept of web scraping which gave us an insight into how we can regularly update our dataset to check the authenticity of recently updated Facebook posts.

Paper ID: ICSHSD-471

AI-Driven Smart Irrigation and Crop Monitoring System for Empowering Rural Farmers

Rashidul Islam Sifat[1*]
[1]Department of EEE, Dhaka University of Engineering & Technology, Gazipur
Corresponding author: sifatduet01@gmail.com

ABSTRACT

Water scarcity, inefficient irrigation, and climatic uncertainty are a few of the greatest concerns for small and medium-scale rural farmers. The present study proposes an AI-based smart irrigation and crop monitoring system that focuses on water optimization, improving the productivity of crops, and sustainable agriculture with particular reference to social impacts on rural farmers. The system integrates soil moisture sensors, humidity and temperature sensors, an ESP32 microcontroller, and solar-powered automation to facilitate data-driven decision-making in irrigation in real time. The collected data is processed through machine learning algorithms to predict crop water requirements, detect early signs of crop stress, and suggest optimal irrigation schedules to reduce water and manual labor wastage. In addition to technology, the system focuses on accessibility and ease of use for the local farmers. It incorporates mobile and web interfaces with simple dashboards, enabling farmers to monitor and control irrigation remotely. This approach promotes knowledge sharing, social inclusion, and community empowerment by providing rural farmers with decision support tools for farming. By leveraging IoT and AI, the system creates resilience to climate variability, ensures efficient resource management, and enables rural livelihood improvement. Field trials demonstrate that the system can reduce water consumption by a significant margin without reducing or even improving crop yields, making it an economical alternative for smallholder farming. The project demonstrates how the convergence of emerging technology and social interests can facilitate sustainable and socially responsible farming practices.

PHYSICS

Invited Papers

Invited-01

Max Phase Materials for Thermal Barrier Coating Applications

Md. Ashraf Ali
Advanced Computational Materials Research Laboratory (ACMRL), Department of Physics, Chittagong University of Engineering and Technology (CUET), Chattogram-4349, Bangladesh
*Corresponding email: ashrafphy31@cuet.ac.bd

ABSTRACT
MAX phase materials combine excellent metallic and ceramic properties, making them promising for various applications. For example, MAX phases are ideal for high-temperature use, especially as thermal barrier coatings (TBC), to protect structural components at elevated temperatures. Their nanolaminated structure, along with covalent and ionic bonds, enhances their stability at high temperatures. The strong covalent bonds between M-X atoms give them a ceramic-like, brittle character, high oxidation and corrosion resistance, and the ability to maintain high mechanical properties at elevated temperatures, along with a high melting point. Meanwhile, the weaker M-A bonds exhibit metallic traits, including good thermal and electrical conductivity, high machinability, and excellent thermal shock resistance, which enables them to withstand extreme heat and thermal stress. This combination results in a high melting point, low lattice thermal conductivity at elevated temperatures, a favorable coefficient of thermal expansion, lightweight qualities, and improved mechanical properties—making them ideal for TBC applications. As a case study, the potential of the predicted $Mo_2A_2AlC_3$ (A = Zr, Nb, Ta) MAX phases as TBC materials has been examined using Density Functional Theory (DFT), an effective method for designing potential materials and guiding their experimental synthesis.

Invited-02

Tailoring Functional Thin Films: A Cross-Cutting Approach to Electronics, Sensing and Photovoltaics

Md Rasadujjaman

Department of Physics, Mawlana Bhashani Science and Technology University
Santosh, Tangail, Bangladesh
*Corresponding email: rasadphy@mbsu.ac.bd

ABSTRACT
The relentless progression of technology is fundamentally a story of nanoscale material mastery. This study presents a journey through functional thin films, demonstrating how a fundamental understanding of materials chemistry and deposition science can be applied across diverse technological areas. This presentation begins by outlining foundational work on tailoring metallic films and organ silicate glass (OSG) for ultra-large-scale integration (ULSI), where controlling properties like conductivity at nanoscale and dielectric constant was paramount. The core of the work focused on the strategic tailoring of metal oxide semiconductors and their doped variants. The composition, doping and morphology was tailored to steer these materials towards specific applications, such as enhancing sensitivity and selectivity of gas sensing or optimizing the optoelectronic properties of transparent electronics. Finally, this study explores the new frontier of sustainable photovoltaics. Applying these cross-cutting principles of materials design, the current research focuses on developing lead-free perovskite-inspired thin films. This work will highlight how the same fundamental concepts of solution processing and interface engineering are critical for overcoming challenges in stability and efficiency; and concludes by synthesizing these themes, offering a unified perspective on thin film design for next-generation electronics, sensors and energy-harvesting devices.

Invited-03

Nano-materials: Removal of antibiotics from water

Dr. Md. Abdul Gafur
Professor, Dept. of Textile Engineering, Daffodil International University, Birulia, Savar, Dhaka, Bangladesh
*Corresponding email: dr.abdul.gafur999@gmail.com

ABSTRACT
Nanomaterials have become foundational in the development of multifunctional materials due to their exceptional surface properties, tunable reactivity, and structural versatility. Different types of Nps are either synthesized or imported for the removal of antibiotics. UV/TiO_2 photodegradation were used to remove multi-antibiotics (Metronidazole, MNZ; Ciprofloxacin, CIP; and Sulfamethoxazole, SMX) from water. UV/persulfate-peroxide were also used to remove CIP, MNZ separately and in combination from water. Ag-doped ZnO nanorod through Graphite hybridization also used to remove CIP from water. The degradation, kinetic will be discussed.

Invited-04

Magnetic Tunnel Junctions Based on Perpendicular Magnetic Materials

Mohammed Nazrul Islam Khan
Materials Science Division, Atomic Energy Centre, Dhaka, Bangladesh
*Corresponding email: ni_khan77@baec.gov.bd

ABSTRACT
Spintronics utilizes both the spin and charge of electrons for advanced information processing. It enables low-power, high-speed, and non-volatile devices using magnetic materials like magnetic tunnel junctions (MTJs). This technology underpins innovations such as MRAM and has potential applications in quantum computing. There has been growing interest recently in spin transfer torque magnetic random-access memory (STT-RAM) using perpendicularly magnetized magnetic tunnel junctions (*p*-MTJs) because of advantages for both better scalability and higher storage density. From the viewpoint of device reliability of STT-RAM, it is necessary to realize small critical switching current and high thermal stability. The problem of thermal fluctuation of magnetization has become a general issue in nanometer-scale magnetic devices. $L1_0$ ordered FePd is a candidate ferromagnetic material that can overcome this problem because the high magnetocrystalline anisotropy energy. There are few works on the preparation and investigation of the structure and magnetic properties in $L1_0$-ordered FePd films have been performed to date. However, tunnel magnetoresistance has never been examined in MTJs and granular film including $L1_0$-ordered FePd alloys due to some difficulty in preparation of highly ordered $L1_0$- FePd alloys in the film state. To achieve the status of truly next-generation technology, bit cell size of MTJs has to be reduced to the submicron dimension or smaller. The FePd electrode for the free bottom layer of the MTJs in our previous study was reported and CoFeB layer was inserted between $L1_0$-FePd and MgO barrier for the reduction of the thickness of free layer as well as for lowering the switching current density. The annealing effect on PMA and $L1_0$ order parameter of FePd/CoFeB/MgO trilayer was systematically investigated in another report for the further reduction of the thickness of the free layer of MTJs. We obtained PMA~7 Merg/cc for 2.0 nm thick FePd with annealing at 350°C. In this study, the top reference layer was optimized for the fabrication of MTJs. For the investigation of the top reference layer to fabricate MTJ, we inserted a pinning layer of CoFeB between MgO and FePd to increase the interfacial spin polarization remaining high PMA. We obtained PMA~5 Merg/cc for FePd film of 15.0 nm with CoFeB (0.5 nm) pinning layer on MgO buffer. MTJs were fabricated successfully using the $L1_0$-FePd bottom layer. TMR and related properties of the MTJs have been investigated.

Invited-05

Laser–Plasma Interactions: Fundamentals, Mechanisms, and Advances

Prof. Dr. Md Masum Haider
Chairman, Department of Physics, Mawlana Bhashani Science and Technology University, Santosh, Tangail-1902, Bangladesh
*Corresponding author email: masum.phy@mbstu.ac.bd

ABSTRACT

Ultra-intense laser fields interacting with matter allow us to study extreme physical conditions. When an ultra-short, ultra-intense laser pulse ($\geq 10^{18}$ W/cm^2) interacts with neutral atoms, rapid ionization occurs, resulting in the removal of multiple electrons and the formation of a plasma characterized by energetic electrons and highly charged ions. Such interactions contribute to the production of relativistic electrons with energies from hundreds of MeV to several GeV. These relativistic electrons serve as the foundation for various particle acceleration mechanisms, among which Target Normal Sheath Acceleration (TNSA) is one of the most widely studied. Depending on the laser intensity, polarization, angle of incidence, and target geometry, other acceleration processes, such as Radiation Pressure Acceleration (RPA) and Collisionless Shock Acceleration (CSA), may also become dominant. Recent advancements in theory and experiments show promise for creating a small particle accelerator that can produce high-energy particle beams with precise focus. Moreover, the rapid development on laser technologies with higher peak intensities, shorter pulse durations, and faster repetition rates is driving significant progress in this field. These advancements are not only deepening our understanding of fundamental plasma physics but are also opening up new opportunities in applied physics, including fusion reactors, medical physics, materials science, and next-generation particle acceleration technologies.

Invited-06

Lensless Digital Holographic Microscopy: A Low-Cost Platform for Biomedical and Agricultural Applications

Md. Alamgir Kabir[1*], Aniruddha Ray[2]
[1]Department of Physics Jahangirnagar University, Savar Dhaka 1342
[1]The University of Toledo, Ohio, USA
*Corresponding email: alamgirjuphy@juniv.edu

ABSTRACT

Modern microscopy has revolutionized how we study cells and materials, but many of the advanced systems available today are expensive, bulky, and often unsuitable for high-throughput use. Lensless digital holographic microscopy (LDHM) offers a practical alternative—a compact and low-cost platform that can capture rich structural and functional information without the need for lenses or scanning.

In the biomedical domain, LDHM has been explored as a platform for drug screening. Chemotherapy drugs induce cell death through different pathways such as apoptosis, necrosis, and non-apoptotic processes. LDHM was able to track subtle morphological changes during these processes in real time. With the support of deep learning models, the system classified cell death mechanisms with over 93% accuracy. This label-free approach not only reduces costs to below $200 but also provides a reliable, accessible tool for research and drug discovery in laboratories where conventional high-content imaging systems are out of reach.

In parallel, LDHM was also applied to the characterization of cotton fibers. This is particularly relevant in Bangladesh, where the garment industry is central to the economy but most cotton is imported. LDHM enabled assessment of fiber maturity, structure, and cellulose content, while swelling studies provided an additional metric for classifying fiber quality.

Taken together, these results highlight LDHM as a versatile, affordable, and scalable platform with strong potential for advancing biomedical research while also supporting sustainable agricultural and industrial practices.

Invited-07

Nanoscale Design of Porous Orthoferrites and Stabilized Halide Perovskites for Solar Photocatalysis and Energy Storage

M A Basith
Nanotechnology Research Laboratory, Department of Physics, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh.
*Corresponding email: m.basith75@gmail.com

ABSTRACT

We present the synthesis and multifunctional performance of porous dysprosium orthoferrite ($DyFeO_3$) nanoparticles with an average pore size of 3.41 nm. Reproducible porosity was achieved by using water as the solvent, optimizing ethylene glycol concentration as the gel precursor, and fine-tuning calcination under N_2. The resulting porous architecture, combined with intrinsic oxygen vacancies, enhances surface area and promotes efficient charge separation, yielding superior photocatalytic activity. Photodegradation of Rhodamine B (RhB) and Levofloxacin (LFX) was used to assess performance. The activation energy for RhB degradation decreased from 55 to 35 kJ mol^{-1} and for LFX from 38 to 34 kJ mol^{-1}. Apparent quantum yields reached 29% for RhB and 33% for LFX, demonstrating efficient solar energy harvesting and pollutant remediation capabilities. Symmetric supercapacitors fabricated with porous $DyFeO_3$ electrodes in a neutral 0.5 M Na_2SO_4 aqueous electrolyte achieved a record 2.5 V operating window. The devices exhibited high energy and power densities, with 86% capacitance retention and 90% Coulombic efficiency after 10,000 charge–discharge cycles. Stability over 600 hours showed minimal performance loss. Additionally, we synthesized MoS_2-incorporated $CsSnCl_3$ perovskite via a hot-injection method to address moisture-induced instability in lead-free tin halide perovskites. MoS_2 nanosheets form stable heterojunctions that provide hydrophobic shielding, catalytic edge sites, and efficient charge transport. This strategy offers a generalizable route to stabilize tin-based perovskites for optoelectronic and energy applications. Our work highlights nanoscale design principles that advance photocatalysis, energy storage, and perovskite stabilization, bridging fundamental insights with practical implementation.

Invited-08

Perovskite And Spinel Oxides: Structure-Property Correlations and Emerging Functionalities

A. K. M. Akther Hossain
Department of Physics, Bangladesh University of Engineering & Technology
Dhaka 1000, Bangladesh.
*Corresponding email: akmhossain@phy.buet.ac.bd

ABSTRACT

Perovskite- and spinel-type oxides, such as manganites, ferrites, and multiferroic compounds, have emerged as a rich playground for condensed matter research due to their diverse and highly tunable functionalities. These materials exhibit phenomena ranging from superconductivity, colossal magnetoresistance, and spin-glass behavior to ferroelectricity, multiferroicity, and magnetoelectric coupling. Their physical properties are strongly influenced by cation distribution, oxidation states, and lattice distortions, which provide powerful routes for tailoring material performance.

This talk will present a systematic overview of how substitutions at the A- and B-sites in perovskite (ABO_3) and spinel (AB_2O_4) lattices control charge transport, magnetic ordering, and ferroic responses. Special emphasis will be placed on the role of mixed-valence states, Jahn–Teller distortions, super exchange interactions, and spin-lattice coupling in shaping emergent behaviors. Examples will include doped manganite's, spinel ferrites, and multiferroic systems. Experimental insights from X-ray diffraction, magnetization, and resistivity studies will be linked with theoretical concepts to establish structure-property correlations.

Finally, by highlighting the synergistic effects in perovskite-spinel composites and their magnetoelectric response, the presentation will outline design strategies for multifunctional oxides with potential applications in spintronics, sensors, energy-efficient devices, and advanced memory technologies.

Contributed Papers

Session-1: Theoretical and Computational Physics

Paper ID: ICSHSD-26

Study of Self-Diffusion in Liquid Au_xAg_{1-x} Alloy Using Linear Trajectory Approximation

Aswariya Roy[1]* and Ratan Chandra Gosh[2]
[1]Department of Mathematical and Physical Sciences, East West University, Dhaka 1212, Bangladesh
[2]Department of Physics, University of Dhaka, Dhaka 1000, Bangladesh.
**Corresponding author: aswariya.roy@ewubd.edu*

ABSTRACT

We present a theoretical study of atomic transport in liquid Au_xAg_{1-x} alloy near its melting point, focusing on the self-diffusion coefficients (D1 and D2). Using the Linear Trajectory Approximation (LTA), atomic motion is linked to the effective pair potential V (r), pair correlation function g(r), and their momentum-space counterparts through friction coefficients. The effective pair potential V (r) is modeled using the Bretonnet–Silbert (BS) pseudopotential with local field corrections from Ichimaru–Utsumi (IU) and Vashishta–Singwi (VS), while the pair correlation function g(r) is obtained using the Linearized Weeks–Chandler–Andersen (LWCA) theory. At 1423 K, increasing Au content in AuxAg1−x alloy reduces the self-diffusion coefficient of Au (D1) while increasing that of Ag (D2). Both IU and VS local field corrections yield nearly identical results, supporting the reliability of the model. This composition-dependent diffusion behavior shows how atomic size, bonding strength, and vacancies work together to influence atomic movement. This finding not only deepen our understanding of diffusion in noble metal alloys but also help guide experiments, especially in situations where direct measurements are difficult due to extreme temperatures. This work contributes to the design and optimization of noble metal alloys for applications such as electronics, catalysis, and high-precision manufacturing, where control of atomic mobility is crucial.

Paper ID: ICSHSD-264

A First-Principle Study of the Impact of Transition Metals (Ag & Au) on Aluminum Phosphide Nanotube

Aoly Ur Rahman[1*] and A.T.M.K Jamil [1]
[1]Department of Physics, Dhaka University of Engineering and Technology
**Corresponding authoraolyurrahman@gmail.com*

ABSTRACT

Nanomaterials consisting of a few to 10^6 atoms exhibit distinct structural, electrical, chemical, magnetic, and thermodynamic properties, making them unique and potentially comparable to bulk materials. Among them, nanotubes are notable for sustainable applications owing to their unique physicochemical properties, high surface areas, chemical stability, and polyaromatic electronic structures. Moreover, researchers have a particular focus on group III-V nanotubes, with phosphide-based ones, especially aluminum phosphide (AlP), attracting attention for optoelectronic and nano-electrochemical sensor applications. Inspired by the unmatched potential of AlP nanotubes, this work explored a theoretical investigation of the impact of the transition metals (TMs)- Ag, Au on AlP nanotubes using density functional theory in the Gaussian 09 software package. Initially, a pristine nanotube with 10 atoms of each species, one $Al_{10}P_{10}$ structure, has been designed with armchair geometry having a chirality (2, 2) configuration, and tube lengths of 8Å each and relaxed to the lowest ground state energy. Further, one Al atom and one P atom have been subsequently doped with two TMs- Ag, Au, and made four different doped variants: $Al_9P_{10}Ag$, $Al_{10}P_9Ag$, $Al_9P_{10}Au$, and $Al_{10}P_9Au$, and then compared with the initial pristine structures and understand the effect of dopants on the AlP nanotube. The binding energy per atom E_{BE} of the doped structures slightly decreases and ranges from 3.20 eV ~ 3.30 eV, which was ~3.40 eV for the pristine structure, which signifies the improvement in sensitivity of the doped structure, further validated by the enhancement of average bond lengths of the doped AlP nanotubes (2.43 Å ~ 2.60 Å for doped nanotubes whereas 2.42 Å is for pristine nanotube). The IR spectrum analysis reveals that, except for $Al_9P_{10}Au$ structures, no imaginary frequencies have been observed for both pristine and doped AlP nanotubes, which signifies that these systems are likely to be formed in true energy minima, and in the highest structurally stable. The obtained negative values of both Gibbs free energy and enthalpy confirm the thermodynamic stabilities of the studied nanotubes. Moreover, the study of the HOMO-LUMO gap reveals that all doped structures in semiconductor industries have an energy gap ranging from 1.20 eV to 1.90 eV. Considering all factors, $Al_9P_{10}Ag$ exhibits the highest feasibility in developing sustainable functional material.

Paper ID: ICSHSD-325

Optimizing Lead-free $CH_3NH_3SnI_3$ Perovskite Solar Cells: A SCAPS-1D Simulation and Machine Learning Approach for Enhanced Power Conversion Efficiency

Md. Khorshed Alam[1]*, Md Nurnabe Sagor[1], Rayhan Miah[1], Shahariar Emon[1], and Keya Alam[2]
[1]Department of Physics, University of Barishal, Kornokathi, Barishal-8254, Bangladesh
[2]Electrical, Electronic and Communication Engineering Pabna University of Science and Technology Pabna 6600, Bangladesh.
**Corresponding author: dmkalam@bu.ac.bd*

ABSTRACT

Perovskite solar cells (PSCs), a third-generation solar cell, are emerging photovoltaic technologies that aim to improve the power conversion efficiency, cost, and flexibility of traditional solar cells. However, there are concerns regarding the use of lead (Pb) in traditional PSCs, particularly its potential impact on the environment and human health. Consequently, the advancement of lead-free perovskite solar cells is of utmost importance to safeguard both the environment and human well-being. Tin-based $CH_3NH_3SnI_3$ perovskites present a promising alternative to lead-based PSCs, which have shown promising optoelectronic properties. This study offers a thorough integration of SCAPS-1D device simulations with machine learning (ML) algorithms to enhance the performance of $CH_3NH_3SnI_3$ PSCs. Systematic device modeling demonstrated that inorganic transport layers, particularly TiO_2 as the electron transport layer (ETL) and Sb_2S_3 as the hole transport layer (HTL), significantly outperformed their organic counterparts, such as PTAA and P3HT. The optimized Al/FTO/TiO_2/$CH_3NH_3SnI_3$/Sb_2S_3/Au heterojunction configuration achieved a remarkable power conversion efficiency (PCE) of 32.88%, with an open-circuit voltage (V_{oc}) of 1.08 V, a short-circuit current density (J_{sc}) of 34.39 mA/cm², and a fill factor (FF) of 88.26%, representing a 28% improvement over organic-based configurations. Device optimization involved a systematic analysis of layer thickness, acceptor density, defect density, and interfacial properties, along with a thorough evaluation of series and shunt resistance effects and temperature dependence to ensure experimental validation.

Eleven Machine Learning (ML) models, including XGBoost, Random Forest, ANN, and LightGBM, were trained on 29,766 unique device configurations to predict PSC efficiency. Among these models, XGBoost showed exceptional predictive ability with high performance metrics: training R^2 = 0.9992 (MAE = 0.0361, MSE = 0.0025) and testing R^2 = 0.9986 (MAE = 0.0454, MSE = 0.0047). Feature importance analysis revealed electron affinity as the most influential absorber layer parameter for efficiency prediction, accounting for 29.5% of the relative importance. This combined simulation and machine learning framework provides a solid method for creating high-efficiency, eco-friendly perovskite solar cells, delivering valuable insights to improve sustainable photovoltaic technology.

Paper ID: ICSHSD-370

Thermoelectric Properties of Herein Predicted Double Perovskite Oxides, Ba_2GaX_{O6} (X = Nb, Ta): a DFT-Based Study

S.S. Saif, M.M. Hossain, M.M. Uddin, N. Jahan, and M. A. Ali*
Advanced Computational Materials Research Laboratory (ACMRL), Department of Physics,
Chittagong University of Engineering and Technology (CUET), Chattogram-4349, Bangladesh.
**Corresponding author: ashrafphy31@cuet.ac.bd*

ABSTRACT

Double perovskite oxides, with their tunable structural and functional versatility, have garnered considerable attention due to their potential applications in renewable energy, thermoelectric (TE) devices, and solar energy conversion. This motivated us to conduct a DFT investigation into the structural, electronic, thermoelectric, optical, elastic, and thermal properties of Ba_2GaXO_6 (X = Nb, Ta). First-principles density functional theory (DFT) calculations have been performed using the FP-LAPW method as implemented in the WIEN2k code to study the physical properties of the titled compounds Ba_2GaXO_6 (X = Nb, Ta), where two different exchange-correlation functionals, namely GGA-PBE and TB-mBJ, were employed. The dynamical and mechanical stability of the titled compounds has been confirmed by calculating the phonon dispersion curve (PDC) and elastic constants (C_{ij}), respectively. The thermoelectric transport parameters were obtained by the BoltzTraP2 code under Boltzmann's theory. The optimized lattice constants were obtained by minimizing the total energy. The electronic band structure, density of states (DOS), and charge density mapping (CDM) are analyzed to confirm the semiconducting nature and bonding characteristics of Ba_2GaXO_6 (X = Nb, Ta). Thermoelectric performance assessed via the BoltzTrap2 code yields an outstanding figure of merit (*ZT*) value of 1.63 and 1.65 at 1100 K for Ba_2GaNbO_6 and Ba_2GaTaO_6, respectively, signifying their potential for waste heat management. The band structure and thermoelectric properties revealed that Ba_2GaXO_6 (X = Nb, Ta) are expected to be promising materials for renewable energy and thermoelectric (*TE*) applications.

Paper ID: ICSHSD-400

DFT Prediction Of New O-MAX Phases: Mo_2AAlC_2 (A = Zr, Nb) And Study Of Their Physical Properties

M.I.A. Tanim, M.M. Hossain[1], M.M. Uddin, N. Jahan, and M. A. Ali*
Advanced Computational Materials Research Laboratory (ACMRL), Department of Physics,
Chittagong University of Engineering and Technology (CUET), Chattogram-4349, Bangladesh.
**Corresponding author: ashrafphy31@cuet.ac.bd*

ABSTRACT

The distinctive coexistence of metallic conductivity and ceramic resilience in o-MAX phases has substantially heightened their prominence in contemporary materials research. This exceptional duality in functional materials motivated us to conduct a comprehensive DFT investigation into the structural, electronic, mechanical, thermal, and optical properties of novel o-MAX phases Mo_2AAlC_2 (A = Zr, Nb). The lattice constants were refined through energy minimization, achieving structural equilibrium and reflecting the most stable atomic arrangement. This study computationally evaluated chemical, dynamical, thermodynamic, and mechanical stability by calculating the formation energy (E_F), phonon dispersion curve (PDC), ab initio molecular dynamics (AIMD) simulations, and elastic constant (C_{ij}), respectively. Analysis of electronic band structure, density of states (DOS), and charge density mapping (CDM) collectively revealed the metallic characteristics and bonding nature of Mo_2AAlC_2 (A = Zr, Nb). Thermal properties, including melting temperature (T_m), minimum thermal conductivity (kmin), lattice thermal conductivity (K_{ph}), thermal expansion coefficients (TEC), and Debye temperature (Θ_D), were determined to assess the suitability of these phases for high-temperature applications. These evaluations indicate that Mo_2ZrAlC_2 and Mo_2NbAlC_2 phases manifest comparatively higher values of (Θ_D = 616 K and 628 K), (T_m = 2024 K and 2199 K), along with lower values of (K_{min} = 0.86 W/mK and 0.88 W/mK) and $K_{ph,}$ suggesting their candidacy as advanced thermal barrier coating (TBC) materials. The computed elastic constants (C_{ij}), moduli (*B*, *G*, *Y*), hardness (H_v, H_{macro}, H_{micro}), and fracture toughness (K_{IC}) confirm that the studied compounds exhibit significant mechanical resilience, suggesting their applicability in extreme environments that require high mechanical durability.

Paper ID: ICSHSD-419

A Predictive DFT Study on Structural, Electronic, and Optical Properties of New Double Half-Heusler Material $YNbRh_2Bi_2$

C. Talukder, N. Jahan, M.M. Hossain, M.M. Uddin, and M. A. Ali*
Advanced Computational Materials Research Laboratory (ACMRL), Department of Physics,
Chittagong University of Engineering and Technology (CUET), Chattogram-4349, Bangladesh.
**Corresponding author: ashrafphy31@cuet.ac.bd*

ABSTRACT

This study explores the structural, electronic, mechanical, vibrational, and optical properties of the Double half-Heusler compound YNbRh2Bi2 using density functional theory (DFT). The structural optimization reveals that YNbRh2Bi2 is an orthorhombic system with the non-centrosymmetric space group Pmn21 (No. 31). The negative formation energy, the absence of imaginary phonon modes, and elastic constants satisfying Born's criteria confirm the thermodynamic stability. Calculated Pugh's and Poisson's ratios demonstrated ductility. Electronic band structure calculations using the HSE06 hybrid functional indicate that YNbRh2Bi2 is an indirect-band-gap semiconductor with a band gap of 1.08 eV. The Frequency-dependent optical functions, including the real and imaginary parts of the dielectric function, absorption and extinction coefficients, reflectivity, loss function, optical conductivity, and refractive index, exhibit pronounced peaks across the infrared (IR) to ultraviolet (UV) regions, underscoring their potential for use in optoelectronic devices. The absorption edge in the visible range is observed at 3.3 eV (XX direction) and 3.6 eV (YY direction). In the ultraviolet (UV) region, the highest absorption peaks are exhibited along all crystallographic directions, with a maximum around 9.5 eV. The reflectivity remains moderate (~46–47%) in the low-energy infrared region (~1 eV), in the UV region, YNbRh2Bi2 exhibits the highest value of 60% (ZZ direction). The optical constants revealed the potential of YNbRh2Bi2 in optoelectronic applications.

Paper ID: ICSHSD-526

Outstanding thermoelectric properties of Zintl phases: XIn_2C_2 (X= Mg, Sr and Ba)

Md. Mukter Hossain[1,2]*, Aslam Hossain[1,2], , Hasina Akter[1,2], Md. Mohi Uddin[1,2], Md. Ashraf Ali[1,2], and Saleh Hasan Naqib[2,3]
[1]Department of Physics, Chittagong University of Engineering and Technology (CUET), Chattogram-4349, Bangladesh
[2]Advanced Computational Materials Research Laboratory, Department of Physics, Chittagong University of Engineering and Technology (CUET), Chattogram-4349, Bangladesh
[3]Department of Physics, University of Rajshahi, Rajshahi 6205, Bangladesh
**Corresponding author:* mukter_phy@cuet.ac.bd

ABSTRACT

Searching for a new thermoelectric material with a high figure of merit (ZT), at least 2.5, have a strong commercial motivation. Zintl phases are considered to be the most promising candidate for thermoelectric energy conversion through the recovery of waste heat. In the scope of the present research, we employed a combination of the first principles calculations with Boltzmann transport theory to study the transport properties of two predicted compounds, $SrIn_2C_2$ and $BaIn_2C_2$, and compared the results with those of the previously synthesized $MgAl_2C_2$. We carried out geometric optimization for stable phase development, and assessed their stability through various criteria, including formation enthalpies, reaction energy, decomposition energy, cohesive energy, and study of high temperature stability via ab initio molecular dynamics calculations. Additionally, we investigate their dynamic stability via phonon dispersion and phonon density of states indicating short phonon lifetimes, low phonon group velocities, and large scattering rates. The band gap values for $MgAl_2C_2$, $SrIn_2C_2$, and $BaIn_2C_2$ compounds are 2.46, 0.76, and 0.93 eV, respectively. It is noticeable that the total thermal conductivities (in the unit, $Wm^{-1}K^{-1}$) of $MgAl_2C_2$, $SrIn_2C_2$, and $BaIn_2C_2$ are 10.957, 1.538 and 0.383. The figures of merit of these three compounds at 300 K are 0.06, 0.19 and1.10, respectively. The ultra-low lattice thermal conductivity (0.24 $Wm^{-1}K^{-1}$) and high Seebeck coefficient (225 μVK^{-1}) at 300 K are the prime contributors to achieving the high ZT value of $BaIn_2C_2$. The unprecedented ZT value is 2.86 for $BaIn_2C_2$ and 1.93 for $SrIn_2C_2$ at a high temperature of 1000 K. Furthermore, the ductile nature and high melting point of $BaIn_2C_2$, renders it highly suitable for practical applications.

Session-2: Physics Thin Film and Nano-Structural Material-I

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Paper ID: ICSHSD-220

Enhancing Redox Activity and Surface Reactivity via α-MoO_3 Nanobelt Incorporation into Layered WS_2 Nanosheets for High Performance Supercapacitors

Md. Faysual Kabir[1], Md. Abdullah Zubair[2], Anwar Ul-Hamid[3], and Muhammad Rakibul Islam[1]*
[1]Department of Physics, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh.
[2]Department of Nanomaterials and Ceramic Engineering, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh
[3]Core Research Facilities, King Fahd University of Petroleum & Minerals, Dhahran 31261, Saudi Arabia
**Corresponding author: rakibul@phy.buet.ac.bd*

ABSTRACT

Nanostructured WS2 has drawn growing interest for its low cost, non-toxic nature, and electrochemical efficiency, yet it struggles to meet the requirements for practical use, including a broad potential window, excellent rate capability, high energy and power density, and operational stability. This study aimed to develop a redox-active (WS_2/α-MoO_3) nanocomposite electrode, synthesized via a facile hydrothermal method, and evaluate its performance for supercapacitor applications. Also, the influence of varying α-MoO_3 content (0, 1, 3, 5, and 7 wt.%) on the surface morphology, structural properties, and electrochemical performance of WS_2 nanosheets was systematically investigated using comprehensive characterization techniques. The hierarchical 2D–1D nanocomposite structure offers multiple electrochemical benefits: (i) enhanced redox activity: contributes to greater charge storage capability by enabling multiple and reversible redox reactions during cycling, (ii) increased surface reactivity: provides more accessible electroactive sites, accelerating ion–electron interactions, and (iii) the presence of oxygen vacancies and interfacial defects: serves as active channels for ion diffusion and charge transfer, reducing internal resistance. The incorporation of α-MoO_3 into the WS_2 matrix resulted in a notable increase in specific capacitance from 332 F $g^{-}1$ to 715 F $g^{-}1$ at the current density of 0.5 A $g^{-}1$. Additionally, the electrode demonstrated excellent cycling stability, maintaining 85% of its initial capacitance after 6,000 cycles at a high current density of 12 A $g^{-}1$. The WS2/α-MoO3 nanostructure, with higher stability and improved specific capacitance, synthesized by a simple, low-cost method, will drive the production of efficient and economical energy storage devices.

Paper ID: ICSHSD-228

Structural and dielectric properties of MoO_3 incorporated $CoFe_2O_4$ nanocomposites

Mahmudul Hasan, Kaniz Fatema Laizo, and Muhammad Samir Ullah*
Department of Physics, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
**Corresponding author: samirullah@phy.buet.ac.bd*

ABSTRACT

The effect of MoO_3 incorporated on the structural and dielectric properties of $CoFe_2O_4$/MoO_3 (0, 1, 3, 5, and 10) wt% has been reported in this study. The X-ray diffraction pattern confirms that the crystal structure of the studied samples is in a single-phase cubic spinel structure with the Fd3m space group. The microstructural analysis reveals that the samples strongly depend on the amount of MoO_3 content. Frequency-dependent dielectric measurements at room temperature reveal a significant increase in dielectric constant, particularly at 5 wt%, attributed to sample densification.

Paper ID: ICSHSD-284

Preparation and Characterization of Carbon Nanotube and Molybdenum Disulfide Reinforced Nanocomposite Film of Cellulose Nanocrystals

Md. Al-Amin[1], Mehedi Hasan[1], Md. Mahtabur Rahman[2], Md. Khorshed Alam[1], and Mohammad Jellur Rahman[2*]
[1]Department of Physics, University of Barishal, Barishal-8254, Bangladesh
[2]Department of Physics, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
**Corresponding Author: mjrahman@phy.buet.ac.bd*

ABSTRACT

Cellulose nanocrystals (CNCs) are synthesized by chemical treatment from the midrib fiber of the leaf of Banana Tree (*Musa acuminate*), an agricultural waste product, and CNC-based nanocomposites are synthesized using solution casting method. Varying amounts of carbon nanotubes (CNTs) and hydrothermally synthesized molybdenum disulfide (MoS_2) are integrated into the CNC matrix. The nanocrystalline structure of CNCs is confirmed by Transmission electron microscopy (TEM) analysis. Final yield of CNCs is 48.2%, indicating a substantial recovery of crystalline cellulose from the agro-waste source. DLS measurement also performed to estimate the particle size of CNCs to be ~348.5 nm. TEM reveals the multiwalled nature of the CNTs with an average diameter of 15 nm and length $\leq$ 10 μm, and the tightly packed multi-layered connected branch-like rose flower structure of MoS_2. The nanoflower structure of the MoS_2 and porous structure of the nanocomposite films are confirmed from the FESEM analysis. The structural qualities of the CNCs and CNTs are investigated through XRD analysis. UV-Vi's spectroscopy is used to reveal the optical properties, especially band gaps, absorption, and transmission of the nanocomposite. In addition, the current density (*J*) versus voltage (*V*) characteristics of the nanocomposite is studied to investigate electrical properties of the nanocomposite, where the effect temperature on *J-V* relationship is also observed. This study would help to find significant insights into adapting nanocomposites' properties, offering opportunities to tune properties and explore applications in the next-generation technologies.

Paper ID: ICSHSD-371

Solar-Driven n–n $DyCrO_3/MoS_2$ S-Scheme Heterojunction Photocatalyst for Sustainable Wastewater Remediation

Md. Mahbubar Rahman and Mohammed Abdul Basith*
Nanotechnology Research Laboratory, Department of Physics,
Bangladesh University of Engineering and Technology, Dhaka-1000.
*Corresponding author: *mabasith@phy.buet.ac.bd*

ABSTRACT

Access to clean water is increasingly threatened by domestic and industrial effluents, particularly non-biodegradable and toxic synthetic dyes and antibiotics. To address these challenges, an efficient n-$DyCrO_3$/n-MoS_2 semiconductor photocatalyst was synthesized for different loadings of MoS2 (5, 10, 15, and, 20wt%) in $DyCrO_3$ nanomaterials via a facile hydrothermal method. The engineered S-scheme n–n heterojunction generates a built-in electric field at the interface, promoting efficient charge separation, suppressing electron–hole recombination, and significantly enhancing photocatalytic degradation of levofloxacin (LFX) and methylene blue (MB) under solar irradiation. Characterization using XRD, FESEM, TEM, XPS, UV–Vis spectroscopy, photoluminescence, and Mott–Schottky analysis confirmed the nanocomposites' crystalline structure, well-dispersed MoS_2 nanosheets, oxygen vacancies, enhanced visible-light absorption, and favorable band positions. Incorporation of MoS_2, the particle size in the range from 28 ± 7 to 32 ± 12 nm, and reduced band gap (2.14 to 1.72 eV), improved light absorption, increased surface area by preventing $DyCrO_3$ aggregation, and markedly enhanced photocatalytic performance. Among tested compositions, the $DyCrO_3$–MoS_2 (85%:15%) nanocomposite containing 15 wt% MoS_2, at an optimized dosage of 10 mg, achieved 84.95% and 78.97% degradation of LFX and MB, respectively, after 240 minutes of solar irradiation. Activation energy, quantum yield, scavenger, and reusability studies confirmed high efficiency and durability, with quantum yields of 37.88% and 39.59%, and activity retention over 81% and 74% after four cycles for LFX and MB, respectively. Mechanistic investigations revealed especially photogenerated holes (h+) as the primary reactive species and provided insights into pollutant degradation pathways. These findings highlight n-$DyCrO_3$/n-MoS_2 heterostructures as a promising solar-active photocatalyst for sustainable wastewater remediation.

Paper ID: ICSHSD-380

Defect-Engineered α-MoO_3/CoS_2 Nanostructures with Improved Conductivity and Pseudocapacitive Performance for High-Energy Symmetric Supercapacitors

Mehedi Hasan[1], Md. Raihan Siddiki[2], Md. Abdullah Zubair[2], and Muhammad Rakibul Islam[1]*
[1]Department of Physics, Bangladesh University of Engineering and Technology (BUET), Dhaka-1000, Bangladesh.
[2]Department of Nanomaterials and Ceramics Engineering, Bangladesh University of Engineering and Technology (BUET), Dhaka-1000, Bangladesh.
**Corresponding author: rakibul@phy.buet.ac.bd*

ABSTRACT

In this study, α-MoO_3 is a promising electrode material for supercapacitors but suffers from low conductivity and poor cycling stability, limiting its practical application. To address these issues, α-MoO_3/CoS_2 nanocomposites with varying CoS_2 contents (0–7 wt.%) were synthesized using a one-step hydrothermal method. Structural and morphological characterizations confirmed successful integration of CoS_2 nanoparticles into α-MoO_3 nanobelts, leading to increased surface roughness, lattice strain, and the formation of defect states that enhanced ion intercalation and electron transport. Electrochemical performance was systematically evaluated using cyclic voltammetry (CV), galvanostatic charge–discharge (GCD), and electrochemical impedance spectroscopy (EIS). In the three-electrode configuration, among the prepared samples, the α-MoO_3/CoS_2 (5 wt.%) nanocomposite exhibited the best performance, achieving a specific capacitance of 553 Fg^{-1} at 0.5 Ag^{-1}, which is more than twice that of pristine α-MoO_3 (216 Fg^{-1}). The optimized electrode also demonstrated excellent cycling stability, retaining 82.1% of its initial capacitance after 5,000 charge–discharge cycles at 5 Ag^{-1}. The superior electrochemical performance arises from the synergistic effects of α-MoO_3 and CoS_2, which collectively enhance electrical conductivity, redox activity, and structural integrity. These results highlight α-MoO_3/CoS_2 nanocomposites as promising candidates for high-performance energy storage devices.

Paper ID: ICSHSD-411

Study the Structural, Morphological, Optical and Electrical Properties of Mixed Organic $MA_{(1-x)}HA_xPbBr_3$ Organometallic Perovskite Thin Film for Solar Cell Application.

Shaheen Alam[1], Mahbubur Rahman Bhuiyan[1], Md. Alamgir Kabir[1], Budrun Neher[1], Muhammad Shahriar Bashar[2], Humayun Kabir[1], and Farid Ahmed[1]
[1]Department of Physics, Jahangirnagar University, Dhaka 1342, Bangladesh;
[2] BCSIR, Dhanmondi, Dhaka 1205, Bangladesh
**Corresponding author: fahmed@juniv.edu*

ABSTRACT

Hybrid halide perovskites have emerged as highly promising materials for optoelectronic applications owing to their tunable bandgap, high absorption coefficient, and facile solution-based processing. In this study, methylammonium lead bromide ($MAPbBr_3$) thin films were compositionally engineered through partial substitution of methylammonium (MA) with hydrazinium (HA), with the aim of improving structural stability, optical response, and electrical performance. Thin films with varying HA concentrations (x = 0.0, 0.20, and 0.40) were synthesized using a cost-effective spin-coating method and comprehensively characterized.

X-ray diffraction analysis confirmed that all compositions retained the cubic perovskite structure. HA incorporation led to lattice expansion, crystallite growth, and significant reduction in microstrain, dislocation density, and stacking fault concentrations, indicating superior crystallinity and minimized structural defects. SEM micrographs revealed denser film morphology with enlarged grains and reduced porosity, while EDX analysis confirmed homogeneous elemental distribution and successful cation incorporation. FTIR spectra exhibited clear vibrational shifts, consistent with stronger hydrogen bonding interactions, thereby enhancing lattice cohesion and stability.

Optical characterization demonstrated a systematic blue shift in the absorption edge, corresponding to bandgap widening from 2.215 eV in pure $MAPbBr_3$ to 2.312 eV at 40% HA substitution. Enhanced absorbance and reduced reflectance were also observed, suggesting improved light-harvesting capability and minimized optical losses. These findings are particularly relevant for tandem solar cells, where wider bandgap absorbers are required.

Electrical properties assessed by Hall effect measurements confirmed n-type conductivity across all samples. Carrier mobility and electrical conductivity increased significantly with HA incorporation, while resistivity and magnetoresistance decreased, indicating enhanced charge transport and suppressed recombination losses. These improvements are attributed to the reduction of trap states and the stabilization of the perovskite lattice through strong hydrogen bonding provided by hydrazinium ions.

Overall, the results demonstrate that hydrazinium substitution effectively enhances the structural, optical, and electrical properties of $MAPbBr_3$ thin films. By suppressing defect density, stabilizing the lattice, and tuning the bandgap, HA-modified perovskite thin films present a promising pathway for developing stable, efficient, and cost-effective optoelectronic devices, including solar cells, photodetectors, and light-emitting diodes.

Paper ID: ICSHSD-490

Highly Transparent Plasma-Polymerized 2-Furaldehyde-n-Butyl Methacrylate Composite Thin Films of Tunable Optical Band Gap for Optoelectronics

Bablur Rahman[1], M. Hedayet Ullah[1,2], A. H. Bhuiyan[3], and Mohammad Jellur Rahman[1]*
[1]Departments of physics, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
[2]Department of Physics, Bangladesh University of Textiles, Dhaka-1208, Bangladesh
[3]University of Information Technology and Sciences, Baridhara, Dhaka-1212, Bangladesh
**Corresponding author: mjrahman@phy.buet.ac.bd*

ABSTRACT

Plasma polymerized (PP) homo and composite polymer thin films of 2-Furaldehyde (FD) and n-Butyl methacrylate (BM) are fabricated using capacitively coupled glow discharge plasma. The disappearance of certain absorption peaks in the FTIR spectra of the thin films indicate structural changes within the PP films during polymerization. FESEM image shows that compared to homopolymer films the composite films are smoother, pinhole-free and flawless. Optical analysis reveals that the composite films exhibit high transmittance (88–98%) within the visible region, along with a tunable bandgap ranging from 1.92 to 2.45 eV (indirect) and 2.65 to 3.02 eV (direct). The refractive index (/) aligns with the Moss, RG and HV models, where ⁄ values decrease with increasing BM content indicating enhanced photon-electron interactions in the thin PP films. The real dielectric constant (ε_1) is significantly higher than the imaginary dielectric constant (ε_2) demonstrating the material's strong response to the incident light. The Urbach energy for PPFD and PPBM films are 0.77 eV and 0.52 eV, respectively, but in the composite films these values decrease from 0.51 eV to 0.39 eV. These findings highlight the potential of PP(FD:BM) composite films for optoelectronic applications, offering tailored optical properties, high transparency, and tunable band gaps.

Session-3: Material Science

Paper ID: ICSHSD-29

Insight into The Substitution of Pb by Mg in $CsPbI_3$ As An Efficient Strategy to Improve Stability of Pb-Free Perovskite for Green Energy Applications: First-Principles Calculations

Sanzeda Parvin*, Monira Martin, Al Mahafujar, Tania Nusrat, and Md. Kamruzzaman
Department of Physics, Begum Rokeya University, Rangpur, Bangladesh
**Corresponding author: sanzeda42@gmail.com*

ABSTRACT

Perovskite solar cells (PSCs) represent state-of-the-art research. Initially developed in 2009 with a power conversion efficiency of 3.8% on a flexible substrate, their efficiency has remarkably advanced to 26.7% on a rigid substrate by 2024. These cells use lead (Pb)-based perovskites as absorbers. PSCs have revolutionized the field of photovoltaics due to their high efficiency, low cost, and ease of fabrication. However, the presence of Pb in conventional perovskite materials remains a major challenge due to its high toxicity and environmental concerns. The instability of Pb-based perovskites under operational conditions such as heat, moisture, and UV exposure further hinders their long-term application. Therefore, replacing toxic Pb with environmentally friendly and stable elements is crucial for sustainable development. Magnesium (Mg), a non-toxic, earth abundant, and chemically stable element, emerges as a promising alternative. First-principles density functional theory (DFT) calculations were performed using the CASTEP code software to investigate the structural, electronic, mechanical, and optical properties of CsMgI3 perovskite. The generalized gradient approximation (GGA) with the Perdew–Burke–Ernzerhof (PBE) functional was used to describe the exchange–correlation interaction. CsMgI3 is an all-inorganic metal halide perovskite that crystallizes in a hexagonal phase with space group P63/mmc. CsMgI3 shows a direct band gap of 3.188 eV, which is larger than that of CsPbI3 but still lies in the visible region. This means CsMgI3 can be useful as a wide-band-gap absorber. The density of states (DOS) shows that the Mg–I orbitals interact strongly, which helps in carrier mobility. This work investigates the structural, mechanical, and optical properties of CsMgI3 compared to CsPbI3. The obtained results suggest that Pb-free CsMgI3 perovskite could be used to create an eco-friendly and sustainable material for future optoelectronic devices.

Paper ID: ICSHSD-38

The Pressure Dependent Structural, Electronic, Optical and Elastic Properties of YMn_3Sn_2 Kagome Compound

Abrarul Karim Samim*, Hasibul Hasan Rizvee, Budrun Neher, and Farid Ahmed
[1]Department of Physics, Jahangirnagar University, Savar, Dhaka, 1342, Bangladesh.
**Corresponding author: abrarulkarim.sami@gmail.com*

ABSTRACT

The structural, electrical, optical, and elastic characteristics of the Kagome-lattice compound YMn_3Sn_2 are thoroughly examined at different pressure in this work. The effects of hydrostatic pressure (0-10 GPa) on lattice parameters, bonding properties, band structure, DOS, and other mechanical and optical metrics are examined using DFT and the CASTEP tool. This type of materials properties is ovserbed because of their fascinating and complex quantum phenomena, particularly for their novel electric and magnetic properties. It is found that the material shows metalic behaviour with increasing pressure and is a stable compound. This material is brittile in nature but it tends to ductile with increasing pressure. As its pughs ratio is found betwwen 0.73-0.54 within the pressure 0-10 Gpa and it is continuously decreasing with increasing pressure. It has a wide range of frequency response area of electrical properties. It may show superconductivity with increasing pressure.The absorption spectra for both [100] and [001] polarization orientations demonstrate that the material exhibits a pronounced absorption peak at low frequencies (below 5 eV). The absorption peaks get bigger and migrate to higher frequencies. YMn_3Sn_2 loses the most energy at 0 GPa, with [001] polarization losing about 12 eV and [100] polarization losing about 16 eV. The material's applicability for pressure-tuned photonic devices is confirmed by optical analysis conducted under various polarization orientations, which shows increased absorption, conductivity, and refractive properties with pressure. So this material can be used in photonic devices, spintronics and in optoelectronics application.

Paper ID: ICSHSD-123

Structural, Mechanical and Thermal Characteristics of Sodium Hydroxide Treated Banana Fiber-Reinforced Epoxy Resin Composites

M. Y. Arafat[1*], M. A. Kaysar[1,2], S. J. Ahmed[1], and A. T. M. K. Jamil[1]
[1]Department of Physics, Dhaka University of Engineering & Technology, Gazipur, Bangladesh
[2]Textile Physics Division, Bangladesh Jute Research Institute, Bangladesh.
**Corresponding author:* arafat142806@gmail.com

ABSTRACT

Composite materials are progressively utilized as a substitute for much conventional material. The features of the corresponding composites of fiber-matrix interactions are very important. Consequently the work is intended on expansion use of natural fiber by analyzing banana fiber reinforced epoxy resin composites for industrial use. Fiber is collected from retting banana tree and it is undertaken alkaline treatment using 2, 4, 6 and 8 wt% of sodium hydroxide (NaOH). Fiber fineness, brightness, and strength are carried out and observed greatly influenced by the chemical treatments. The composites are prepared with untreated and NaOH treated banana fiber as reinforcement in epoxy resin matrix with 10 wt% of fiber loading by a simple hand lay-up cold press molding process. It is found that the treated fiber composites have better properties as compared to the untreated fiber composites. Fourier transform infrared spectroscopy is used to identify the chemical compounds of untreated and NaOH treated fibers and composites. It is found that the absorption bands intensity is increased and is shifted to the higher wavenumber region with the increase of alkali treatment. The treatment has changed the hydrophilic nature of the fiber to hydrophobic nature and the fiber moisture resistance properties are increased. The sample roughness and cross-sectional view are studied from scanning electron microscopy, which reveal the regular and good stacking of fibers in the epoxy resin matrix in the preferred direction. The interfacial adhesion between fiber and matrix is improved with NaOH treatment. The effects of alkaline treatment on the mechanical characteristics such as tensile and flexural properties are examined by an universal testing machine. It is observed that the tensile and flexural properties of the composites are gradually increased with the increase of NaOH treatment up to 6% while a further increase to 8% led to reduce in trend. Finally, thermal properties are investigated by thermogravimetric analyzer and differential scanning calorimetry. NaOH treated banana fiber reinforced epoxy resin composites show better thermal property compared to the untreated substance.

Paper ID: ICSHSD-236

Unveiling the Optical Nonlinearity of Bio-Fabricated Silver Nanoparticles Employing Z-Scan Technique

F. Sabeth[1], B. Paul[1], S. A. Tarek[1*], and S. M. Sharafuddin[2]
[1]Department of Physics, American International University-Bangladesh, Dhaka, Bangladesh
[2]Non-linear BioOptics Laboratory, Department of Physics, Shahjalal University of Science and Technology , Sylhet, Bangladesh.
**Corresponding author: satarek@aiub.edu*

ABSTRACT

Silver nanoparticles (Ag-NPs) are critically important nanomaterials due to their unique optical, electronic, and antimicrobial properties, making them applicable in a wide range of fields including biosensing, targeted drug delivery, and photothermal therapy. Their significance is derived from unique plasmonic behavior, biocidal activity, and a large surface-to-volume ratio. Green synthesis using plant extracts offers a sustainable route, avoiding toxic chemicals while introducing natural stabilizing agents. This study aimed to investigate the linear and nonlinear optical properties of such green-synthesized Ag-NPs, with an emphasis on their potential utility in nonlinear optical devices and biosensing. Ag-NPs were synthesized via a green approach employing Dolenix regia flower extract as both a reducing and stabilizing agent. The phytochemical constituents of the extract, particularly flavonoids responsible for the reduction process, were confirmed through UV–Vis absorption measurements. Structural and morphological characterization was performed using X-ray diffraction (XRD) to determine the crystallite size and phase. The linear optical properties, including the localized surface plasmon resonance (LSPR) absorption profile, were evaluated using UV–Vis spectroscopy. The nonlinear optical (NLO) properties were investigated using the continuous-wave (CW) Z-scan technique. In this method, the nanoparticle suspension was translated through the focal point of a focused Gaussian laser beam while the resulting transmittance was monitored through a finite aperture in the far-field. The observation of a characteristic Z-shaped trace allowed for the direct measurement of the peak-to-valley transmittance difference (ΔT_{pv}), from which the nonlinear phase shift ($\Delta\Phi_0$) was calculated. UV–Vis spectroscopy revealed a broad absorption band centered at 442 nm upon interaction with silver ions, attributed to the localized surface plasmon resonance (LSPR) of the formed nanoparticles. XRD analysis confirmed their crystalline nature, with an average crystallite size of approximately 6.78 nm. On the other hand, CW Z-scan experiments demonstrated a pronounced enhancement in nonlinear optical response, with the nonlinear phase shift showing a 26-fold increase compared to solvent baseline measurements. This significant enhancement is attributed to the nanoscale dimensions and strong surface plasmon effects of the synthesized Ag-NPs. These findings demonstrate that the green-synthesized Ag-NPs exhibit both desirable linear optical features and a remarkable nonlinear optical response, making them highly promising candidates for integration into advanced applications such as optical limiters, switches, and highly sensitive biosensing platforms.

Paper ID: ICSHSD-328

Band Gap Engineering of Phyto-Synthesized Ag-Modified ZnO Nanocomposites for Enhanced Photocatalytic Performance

Md. Al Imran[1*], Monika Paul[2], and Bithi Paul[3]
1Department of Physics, Jagannath University, Dhaka 1100, Bangladesh
2Department of Biochemistry and Molecular Biology, Jagannath University, Dhaka 1100, Bangladesh
3Department of Physics, American International University-Bangladesh, Dhaka, Bangladesh
**Corresponding author: mdalimran.jnu@gmail.com*

ABSTRACT

The present study investigates the influence of silver incorporation on the structural, optical, and morphological properties of ZnO nanoparticles synthesized via a green approach, as well as its effect on photocatalytic activity. ZnO nanoparticles and ZnO/Ag nanocomposites were prepared using *Bryophyllum pinnatum* leaf extract as a reducing and stabilizing agent, with zinc acetate dihydrate [$Zn(CH_3COO)_2 \cdot 2H_2O$] and silver nitrate ($AgNO_3$) serving as precursors, followed by controlled heating, stirring, and calcination. The synthesized samples were characterized using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), UV-Vis spectroscopy, and field-emission scanning electron microscopy (FESEM). XRD analysis confirmed the formation of a wurtzite hexagonal phase for ZnO, while the ZnO/Ag nanocomposites exhibited additional diffraction planes associated with the cubic phase of silver nanoparticles. UV–Vis spectroscopy revealed a reduction in band gap upon Ag incorporation, indicating band gap tailoring. FESEM micrographs provided insights into the morphological features of the synthesized nanostructures, whereas FTIR spectra confirmed the presence of phytochemicals responsible for nanoparticle stabilization during green synthesis. Photocatalytic performance was evaluated through the degradation of methylene blue (MB) dye under UV light irradiation, where both ZnO and ZnO/Ag nanocomposites demonstrated excellent photocatalytic efficiency, with the Ag-modified samples exhibiting enhanced activity. These findings highlight that silver incorporation effectively tailors the optical properties of ZnO nanoparticles, thereby improving their potential as efficient photocatalysts for environmental remediation applications.

Paper ID: ICSHSD-338

Time-Resolved Investigation of Photoirradiation-Induced Changes in Ionic Conductivity of Polycrystalline β-AgI at Room Temperature (298 K) and Cryogenic Temperature (77 K)

Farzana Sabeth[1,2,*], Toshifumi Iimori[1], and Nobuhiro Ohta [1,3,]
[1]Research Institute for Electronic Science, Hokkaido University, Sapporo 001-0020, Japan,
[2]Department of Physics. American International University – Bangladesh, Dhaka, Bangladesh
[3] Department of Applied Chemistry and Institute of Molecular Science, National Chiao Tung University, 1001 Ta-Hsueh Road, Hsinchu 30010, Taiwan
**Corresponding author: fsabeth@aiub.edu*

ABSTRACT
The inherent physical properties of solid-state ionic conductors have sparked a surge of interest for many decades, as they demonstrate high technological potential, particularly in the fabrication of solid-state electrochemical devices. Silver iodide (AgI) is one of the most intensively studied fast ionic conductors. It exhibits at least six crystalline polymorphs and undergoes phase transitions induced by temperature and pressure. In the present work, time-resolved measurements of the photoirradiation effect on ionic conductivity have been carried out to elucidate the carrier dynamics in the polycrystalline ®-AgI at 298 K and 77 K. ®-AgI pellets were prepared by grinding and pressing the reagent powder uniaxially and then immersed in Potassium Iodide solution. The samples were characterized by measurements of XRD and the complex impedance spectra. The Time-resolved Measurement (TRM) of photocurrent spectra was carried out with a nanosecond pulse laser and different DC voltages. The ®-phase was confirmed with X-ray diffraction (XRD) patterns. The impedance spectra were also measured to characterize the samples. Two different excitation wavelengths lying in the band gap edge (450nm) and in the sub-band gap region (532nm) were used to irradiate the samples. The observed photoconductivity, which had shown enhancement at 295 K, was rather suppressed at 77K with the photoirradiation. In comparison to the relaxation time (2-3⌈s) observed at room temperature, a faster relaxation of the photocurrent in the submicrosecond (0.3-0.4⌈s) range of time was observed at 77K. TRM was done for different excitation wavelengths with different applied DC voltages at two different temperatures to elucidate the excitation dynamics and ionic conductivity of ®-AgI. The excitation wavelength and laser power dependencies of the conductivity were also studied. Time-resolved measurements provide an intimate understanding of the processes involved in photoexcited systems.

Paper ID: ICSHSD-360

Enhanced Photocatalytic Degradation of Methylene Blue Dye for Sol-Sel Synthesized BaTiO3 Nanoparticles Reinforced PMMA Polymer Nanocomposites

Abdullah Wasif Rafin[*], Tanzim Shahriar, Foysal Anwar, and Mohammad Shahed Hasan Khan Tushar
Department of Mechanical Engineering, RUET, Rajshahi , Bangladesh
**Corresponding author: wasifabdullah23@gmail.com*

ABSTRACT
This study focuses on sol-gel synthesized barium titanate nanoparticles reinforcing poly (methyl methacrylate) (PMMA) polymer matrices to fabricate nanocomposite via convenient solvent-casting method. The structural and morphological properties of synthesized nanoparticles and nanocomposites were investigated through FTIR, XRD, SEM where FTIR ensured various absorption bands including Ba-O, Ti-O bonds. The photocatalytic activities of aqueous solution of methylene blue (MB) were attributed under UV-Vis light for BaTiO3/PMMA nanocomposites. Photocatalytic nanocomposites have attracted more attention due to their potential for solving environmental and energy problems.

Session-4: Magnetic Material-I

Paper ID: ICSHSD-19

Synthesis of Mg-Ce-Zn Nano Ferrites and to Investigate the Dielectric And Magnetic Properties

Muhammad Samir Ullah*, Kaniz Fatema Laizo, Mahmudul Hasan, Rizwana Afrin, Suzam Gifary, and Md. Rasel Shikder
Department of Physics, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
**Corresponding author:samirullah@phy.buet.ac.bd*

ABSTRACT
The effect of Ce substitution on the electrical and magnetic properties of Mg-Zn ferrites has been investigated in this study, with varying Ce doping concentration, x = 0.00, 0.03, 0.06 and 0.10. XRD confirms a single-phase cubic spinel structure. It is shown that particle size decreased from 17.41 to 14.54 nm with the Ce contents. Frequency dependent dielectric constant of all the synthesized samples has been observed at room temperature. It demonstrates that the value of dielectric constant is higher x = 0.03, which can be happened due to the densifications of the samples. Magnetic measurements show that the softness property of the materials has been enhanced due to the lowering value of coercivity.

Paper ID: ICSHSD-224

Magnetocaloric Properties of Lanthanum-Dysprosium-Barium manganites

Md. Ataul Haque and Muhammad Samir Ullah*
Department of Physics, Bangladesh University of Engineering and Technology, Dhaka-1000
Corresponding author: samirullah@phy,buet.ac.bd

ABSTRACT
An X-ray diffraction patterns show that the crystal structures for all the samples are in the rhombohedral structure with the $R\underline{3}c$ space group without any impurity peak. The microstructural study shows a growth in average grain size (D) from 111.3 nm at x = 0.02 to 121.8 nm at x = 0.06. Interestingly, a noticeable reduction to 89.40 nm is observed at x = 0.08, which is likely attributed to an increase in porosity at higher doping levels. The second-order magnetic phase transition has been confirmed from the Arrot plots for all the samples. A significant enhancement in relative cooling power is observed for x = 0.06, indicating its potential as a candidate for cooling technologies.

Paper ID: ICSHSD-359

Investigation of the Effect for Ba, Cd Co-doping on Structural and Morphological Properties of Bismuth Titanate Nanoparticles Approach for Photocatalytic Activities

Abdullah Wasif Rafin*, Tanzim Shahriar , Foysal Anwar, and Mohammad Shahed Hasan Khan Tushar
Department of Mechanical Engineering, RUET, Rajshahi, Bangladesh
**Corresponding author: wasifabdullah23@gmail.com*

ABSTRACT
This paper represents current study on Ba and Cd co-doped bismuth titanate ceramics consisting general formula Bi4BaxTi3-yCdyO12 (x=0.02, y=0.01) prepared by sol-gel method: (i) Bi4BaxTi3-yCdyO12 having A-site Ba doped and (ii) Bi4BaxTi3-yCdyO12 having B-site Cd doped, calcined at 800oC for 1h 20mins. The effect of Ba, Cd co-doping on the structure of Bi4Ti3O12, and the structural, morphological and photocatalytic activities were investigated with FTIR, XRD, SEM, EDS and UV-Vis spectroscopy. The FTIR and XRD ensured proper Ba and Cd doping on base ceramics. The photocatalytic degradation and absorption kinetics of aqueous solution of Methylene Blue were observed under UV-Vis light for both undoped and co-doped bismuth titanate. This study attributed that the substitutional doping of appropriate ions could alter crystal structure and band gap energy with enhanced electron transportation in catalysts, which enhances photocatalytic activities.

Paper ID: ICSHSD-381

Pressure-Dependent Structural, Mechanical, Electronic, and Thermophysical Properties of Lead-Free Ligex$_3$ (X = Cl, Br, I) Perovskites: A First-Principles Study

Monira Martin Mitu*, Tania Nusrat[1],Shah Azharul Islam, Sanzeda Parvin, Al Mahafujar, and Md. Kamruzzaman*
Department of Physics, Begum Rokeya University, Rangpur, Bangladesh
Corresponding author: mitu.sagc@gmail.com

ABSTRACT
Lead-free inorganic perovskites offer several advantages over their lead-based counterparts, including exceptional efficiency in optical absorption, high structural stability, high carrier mobility, tunable bandgaps, non-toxicity, and affordability. The fundamental properties, such as structural, mechanical, optical, electronic, and thermophysical of $LiGeX_3$ (where X=Cl, Br, I) were calculated using the PBE functional within the GGA framework under DFT conditions at both ambient and hydrostatic pressure. The analyzed lattice parameters and electronic bandgap show strong consistency with existing theoretical studies. The optimized lattice parameters, cell volume, and bandgap decrease as pressure increases. The elastic constant and related characteristics, including bulk modulus, shear modulus, Young's modulus, and Poisson's ratio, were determined. Additionally, elastic anisotropy, machinability index, Pugh ratio, and Vickers hardness were evaluated. Moreover, the Debye temperature, sound velocity, and melting temperature were estimated. The Pugh ratio and Poisson ratio confirm that the material exhibits ductile characteristics. The electronic band structure indicates that these materials act as direct bandgap semiconductors with a low energy bandgap values of 0.6,0.429 and 0.413 respectively, but transition to metallic behavior under increased pressure. DOS analysis reveals that VBM is primarily dominated by I-5p orbital, while CBM is influenced by Ge-4p orbital. Anisotropy is confirmed through 3D visualizations. Additionally, the thermodynamic properties reveal the thermal stability. From the optical properties, it can be concluded that the titled materials can be used in optoelectronic and solar cell applications.

Paper ID: ICSHSD-395

A Comprehensive Study of the Mechanical and Thermodynamic Properties of Fluoroperovskite Xcaf$_3$ (X= Ag, K, Cs, And Rb) Compounds Using First Principle Calculations.

Md. Mozahar Ali[1]*, Md. Shahazan Parves[2], and Md. Zahid Hasan[2]
[1] Department of Physics, American International University-Bangladesh (AIUB), Kuratoli, Khilkhet, Dhaka 1229, Bangladesh,
[2] Materials Research and Simulation Lab, Department of Electrical and Electronic Engineering, International Islamic University Chittagong, Kumira, Chittagong, 4318, Bangladesh,
Corresponding author: mozahar.ali@aiub.edu

ABSTRACT
This article presents a comprehensive investigation into the mechanical and thermodynamic properties of $XCaF_3$ (X= Ag, K, Cs, and Rb) cubic fluoroperovskite compounds. These properties were studied through first-principles calculations using plane-wave pseudo-potential within the framework of density functional theory (DFT). Our investigated results revealed excellent agreement with the reported theoretical and experimental results. The elastic constants, shear moduli, bulk moduli, and Young moduli have been studied to analyze the mechanical stability of the materials. The elastic constants fulfilled Born stability criteria and confirmed the mechanical stability and thermal stability of the entitled compounds. The ductile nature of the studied compounds was confirmed by using the values of Poisson's ratio, Pugh's ratio and Cauchy pressure. $AgCaF_3$ was identified as the most ductile of the compounds, suggesting that it may be particularly suitable for applications requiring materials that can withstand deformation without fracture. The high machinability index of $AgCaF_3$ also implies its potential in industrial application. The calculated low Debye temperature and minimal thermal conductivity in $AgCaF_3$ indicate its suitability as a thermal barrier coating (TBC). In contrast, $CsCaF_3$ exhibited high thermal conductivity, making it an excellent candidate for applications that require efficient heat transfer, such as heat sensors, heat sinks, heat exchangers, automobile cooling systems, and spacecraft.

Paper ID: ICSHSD-470

Neutron Activation Analysis Of A Novel Fe–C–Ti–V–Mo Alloy For Nuclear Structural Applications

Md Ruhul Amin[1*], Md. Arefin Kowser[2], Mohammad Asaduzzaman Chowdhury [2], and Mohammad Amirul lslam[3]
[1]Nuclear Safety, Security &Safeguard Division, Bangladesh Atomic Energy Regulatory Authority, Bangladesh
[2] Department of Mechanical Engineering, Dhaka University of Engineering and Technology, Gazipur-1707, Bangladesh
[3]Institute of Nuclear Science and Technology, Atomic Energy Research Establishment, Bangladesh Atomic Energy Commission, Ganakbari, Ashulia, Dhaka, 1349, Bangladesh
**Corresponding author: ruhul_rm@yahoo.com*

ABSTRACT
A novel iron-based alloy was fabricated with C, Ti, V, and Mo to study its structural and nuclear material properties. The composition focuses on wear resistance and underwent neutron irradiation to assess its activation behavior. Neutron activation analysis was conducted, and the induced radionuclides were identified using gamma-ray spectrometry. The results show the activation products formed, and relative activities. This information sheds light on the long-term radiological behavior of the alloy. Compared with conventional Fe-based steel alloys, the influence of the added elements on induced radioactivity becomes evident. The methodology and results presented here may guide the design of future low-activation alloys that balance mechanical properties with nuclear safety considerations.

Paper ID: ICSHSD-443

Influence of Bi_2O_3 Addition on the Structural, Microstructural, Magnetic and Electrical Transport Properties of Li-Cu-Mg-Zn Ferrites

Faruque Ahammed[1], M.N.I. Khan[2], Muhammad Samir Ullah [3], M.A.H. Badhan[4], Redwan N. Sajjad[5], and A.T.M. Kaosar Jamil [1]
[1]Department of Physics, Dhaka University of Engineering and Technology, Gazipur 1707, Bangladesh
[2]Materials Science Division, Atomic Energy Center, Dhaka 1000, Bangladesh
[3]Department of Physics, Bangladesh University of Engineering and Technology, Dhaka 1000, Bangladesh
[4]Bose Center for Advanced Study and Research in Natural Science, University of Dhaka, Dhaka 1000, Bangladesh
[5]Department of Nanomaterials and Ceramic Engineering, Bangladesh University of Engineering and Technology, Dhaka 1000, Bangladesh
Corresponding email: faruqueahammed2@gmail.com

ABSTRACT
Influence of Bi_2O_3 addition on the microstructure and magnetic properties of Lithium-Copper-Magnesium-Zinc mixed ferrites having the compositions $Li_{0.25}Cu_{0.10}Mg_{0.10}Zn_{0.30}Fe_{2.25}O_4 + xBi_2O_3$ (where, x = 0.0, 0.3, 0.4, 0.6 and 0.8 wt.%) are investigated in this study. X-ray diffraction analysis reveals that all the samples are formed with cubic spinel phase. Microstructural analysis demonstrates that the grain growth of the samples is influenced by the amount of Bi_2O_3 addition and the average grain size increases from 0.84 (for x= 0.0 wt.%) to 2.47 µm (for x = 0.6 wt.%). The development of the grain size could be attributed to the densification of the sample due to the formation of the liquid phase of Bi_2O_3 at the sintering process. The magnetic hysteresis measurement shows that the saturation magnetization increases from 72.1 (for x= 0.0) to 77.6 emu/g (for x = 0.6 wt.%). However, it is deterioreted at x = 0.8 wt.%, which may be ascribed to the dilution effect. The complex magnetic permeability measurement shows that an enhancement of the initial permeability is clearly observed with the addition of Bi_2O_3 content. It is inferred that a correlation has been found between the grain growth and the magnetic properties of the investigated samples. Fourier transforms infrared absorption reveals that the frequency band appears in the high frequency (539–555 cm^{-1}) range, which can be attributed to the stretching vibrations at the tetrahedral site. The band appearing in the low frequency (359–373 cm^{-1}) range is for the octahedral site, which is due to bending vibration. The elastic constants such as bulk modulus, Young's modulus, rigidity modulus, Poisson's ratio and Pugh's ratio have been calculated for all the studied samples. It is found that all synthesized samples are in ductile nature. The dielectric property of the samples show a dispersive behavior in accordance with the Maxwell-Wagner type of polarization. A partial semicircular arc is seen in the complex impedence spectroscopy using the Cole-Cole plot, which suggests that the grain property plays a major role in the conduction process.

Session-5: Plasma and Astrophysics

Paper ID: ICSHSD-52

Dust-Ion-Acoustic Solitary and Shock Waves in A Multi-Ion Dusty Plasma with Vortex-Like Trapped Electrons

Md. Saifur Rahman* and Obaydur Rahman
Department of Physics, Mawlana Bhashani Science and Technology University, Tangail-1902, Bangladesh
Corresponding author: saifur6438@gmail.com

ABSTRACT
This study presents a theoretical model to investigate the nonlinear behavior of Dust-Ion-Acoustic (DIA) waves in a dusty plasma environment. The plasma is assumed to be collisionless and unmagnetized, composed of mobile oxygen ions of both positive and negative charges, vortex-like distributed cometary electrons, and stationary dust grains carrying arbitrary electric charges. These types of plasma are often found in space, especially near comet tails and around planets, where moving electrons and charged dust play a big role in how waves behave. We studied the evolution of DIA waves using the reductive perturbation technique, which is ideal for weakly nonlinear systems. This method helped us derive two key equations: the K-dV equation for solitary waves and the K-dV Burgers' equation for shock waves with dissipation by simplifying the fundamental fluid equations under small perturbations. The characteristics of these waveforms, including amplitude and width, are governed by the nonlinear, dispersive, and dissipative properties of the plasma, along with wave speed. This work provides meaningful insights into how different physical effects combine to control the behavior of DIA waves in dusty plasmas, offering valuable contributions to our understanding of space plasma environments.

Paper ID: ICSHSD-115

Neutron Yield Optimization From 4.1 Kj Plasma Focus Device Using Lee Code

M I Nayeem*
Physics Discipline, Khulna University, Khulna-9208
Corresponding author: nayeem4.phy@gmail.com

ABSTRACT
In this work, numerical optimization of neutron yield from 4.1 kJ Mather type plasma focus device [1] has been studied and carried out using the Lee Model Code. Simulation was performed using different operational parameters, such as deuterium fill pressure and the anode geometry (introduction of taper), to reveal the configurations which yield maximum neutron production efficiency. Initial experiments with pure D_2 indicate an ideal pressure range of 3.5-4.0 Torr, facilitating a maximum production of 8.6×10^6 Yn per shot. Incorporation of a tapered anode has provided a substantial enhancement in performance with a same range of pressure (3.5-4.0 Torr) and Yn/shot value of 12.3×10^6, which is almost double of the performance obtained in the absence of a taper. Furthermore, the impact of a D–T gas mixture (1:1) was also considered with yields of the order of 10^8 per shot, a thousand times improvement rather than pure D_2. These results indicate that an overall optimization of geometry and operational parameters can significantly improve PF performance relevant to neutron applications.

Paper ID: ICSHSD-313

Tracing Cosmological Signatures with Doppler Lensing

Mubtasim Fuad[1*], Sonia Akter Ema[2], and Md Rasel Hossen[1]
[1]Department of Physics, Jahangirnagar University, Savar, Dhaka 1342, Bangladesh
[2]Department of Mathematical & Physical Sciences, East West University, Aftabnagar, Dhaka 1212, Bangladesh
[*]*Corresponding author: m.fuad.rafi@gmail.com*

ABSTRACT

Doppler lensing, driven by peculiar velocities, provides a valuable probe of large-scale structure (LSS) dynamics at low redshift. Unlike gravitational lensing, which measures integrated matter along the line of sight, Doppler lensing directly traces velocity fields, offering complementary insights into cosmic evolution. This study investigates Doppler lensing in cosmic voids that are vast underdense regions whose coherent outflows make them ideal for testing relativistic effects in structure formation. We employ relativistic *N*-body simulations within the ΛCDM framework using the *Gevolution* code, supplemented with its recent cosmic screening approach for computational efficiency. Voids are identified with the *Revolver* algorithm applied to the halo catalogs generated by *Rockstar* algorithm using the simulation outputs, and Doppler convergence is derived from velocity fields across multiple realizations using our lensing algorithm. To enhance detection, we implement stacking techniques that increase statistical robustness and allow extraction of distinct convergence profiles across a range of void sizes. Preliminary results reveal measurable differences in Doppler convergence profiles with void radius and impact parameter, underscoring this probe's sensitivity to underlying velocity fields. Beyond reporting these trends, our work refines simulation pipelines and methodologies for capturing velocity-induced signatures, ensuring readiness for upcoming surveys such as Euclid and DESI. These developments strengthen the computational and observational prospects of Doppler lensing and establish it as a complementary tool to gravitational lensing in precision cosmology. By advancing velocity-field modeling and void identification strategies, this study contributes to improved cosmological parameter constraints and a deeper understanding of large-scale dynamics in an evolving Universe.

Paper ID: ICSHSD-349

Evolution of Electrical Discharge Plasma Processes at Different Initial Ph Levels by High Voltage Ac Supply

Ruma[1*], Shayla Haque Nazer[2], M. A. Halim[2], M. Mamun Sikder[1], and M.A. Habib[2]
Department of Electrical and Electronic Engineering, Dhaka University of Engineering & Technology, Gazipur, Bangladesh
Department of Mechanical Engineering, City University, Birulia, Savar, Bangladesh
[*]*Corresponding author: ruma_duet@duet.ac.bd*

ABSTRACT

Artificial discharge plasma generated by high-voltage AC (HVAC) supply is considered an effective method for wastewater treatment, including textile dyes and microorganisms. This research focuses on generating water surface discharge plasma (WSDP) in solutions with different pH conditions using a point-to-plane electrode configuration. A high-voltage test transformer (Model: HV 9000, TERCO, 50Hz, 0-140 kV) was used as a high-voltage supply source to generate discharge on the water surface. Experiments were conducted using water solutions with initial pH values of 3.3, 7.5 and 10.5. It was observed that discharge plasma initiated at the sharp tip of the positive electrode in atmospheric air, then crossed the air gap immediately and spread along the water surface for all pH conditions. Experimental results showed that the propagation of discharge plasma channels was faster and their illumination was brighter in the pH 3.3 solution than in the others. However, the pH 10.5 solution changed color after several instances of discharge propagation. The typical conduction current during discharge propagation varied significantly for different pH solutions: 29.8 A, 19.4 A and 26.0 A for 3.3, 7.5 and 10.5 pH solutions, respectively. However, the current is frequently changed depending on the discharge plasma propagation on the water surface. Finally, the variation in discharge characteristics due to initial pH conditions may play an important role in plasma chemical activity as well as in wastewater treatment.

Paper ID: ICSHSD-413

Generalized Dust Acoustic Solitons and Double Layers in Kappa Superthermal Electron Containing Dusty Plasmas

M.Islam[1], M. Ferdousi[2] and F. Deeba[1]
[1] Department of Physics, Dhaka University of Engineering and Technology, Gazipur, Dhaka-1342, Bangladesh.
[2] Nuclear Safety, Security & Safeguard Division, Bangladesh Atomic Energy Regulatory Authority, Dhaka-1207, Bangladesh.
**Corresponding author: mozahid.duet.bd2017@gmail.com*

ABSTRACT

A rigorous theoretical and analytical exploration has been made on planar and nonplanar nonlinear dust acoustic (DA) waves in a multi-ion dusty plasma system containing arbitrarily charged inertial dust, Boltzmann distributed negative-charged heavy ions, positive-charged light ions, and superthermal electrons. A series of reductive perturbation methods like Korteweg-de Vries (K-dV), modified Korteweg-de Vries (mK-dV), and Gardner approaches are employed to analyze the basic features of planar and nonplanar DA solitary waves (SWs) and double layers (DLs) and their dependencies on the systems. It has been found that the characteristic properties such as amplitudes, polarity, and intensity of planar K-dV, mK-dV, and Gardner solitons significantly depend on the plasma parameters like dust, electron, and ions thermal properties, temperatures comparative densities, and so on. It is also found that, for positive (negative) charged dust, the amplitudes of the K-dV, mK-dV, and Gardner solitons decrease (increase) for increased (decrease) values of the ratio of dust electron temperature, the dust light ion temperature and the dust heavy ion temperature. K-dV and mK-dV solitons do not exist near c_2c_2 = 1.5 $c_1^2c_1^2$, and c_3c_3 = 2.5 $c_1^3c_1^3$, respectively, where c_1c_1 is the first order perturbation coefficient as well as characterizing critical value, c_2c_2 is the second order perturbation coefficient and c_3c_3 is the third order perturbation coefficient. However, Gardner solitons are found to be valid around both c_2c_2 = 1.5 $c_1^2c_1^2$, and c_3c_3 = 2.5 $c_1^3c_1^3$. Although the characteristics of the one-dimensional planar Gardner SWs and DLs differ from those of the nonplanar (cylindrical and spherical) ones, they behave similarly to the planar SWs and DLs when the co-efficient of geometry is equal to zero.

Paper ID: ICSHSD-498

Solar Plasma Simulation for Space Weather Prediction and Protection of Earth's Power Grids

Hamim Ibrahim[1], Tamim Hasan Apurbo[2], Sanjeda Alam Chaity[2], Tahosin Iftiak Tonoy[2], Zihad Bin Rahim[2], and Md. Mortuza Ahmmed[3]

[1]Department of Electrical and Electronic Engineering, American International University- Bangladesh, Dhaka, Bangladesh
[2]Department of Computer Science & Engineering, American International University Bangladesh, Dhaka, Bangladesh
3Associate Professor,
[3]Department of Mathematics, American International University Bangladesh, Dhaka, Bangladesh
**Corresponding Author: 22-48533-3@student.aiub.edu*

ABSTRACT

Solar plasma eruptions, such as solar flares and coronal mass ejections (CMEs), can be very dangerous for the energy infrastructure on Earth. These events cause geomagnetic storms that can lead to large scale blackouts. Numerical simulations were used in this study to model how solar plasma moves and interacts with Earth's magnetosphere. The results illustrates how less powerful networks are to geomagnetically induced currents (GICs). To make sure that modern society has a reliable and long lasting supply of energy ideas, the more resilient power grids are put forward. The Sun's magneto hydrodynamic (MHD) processes cause solar activity that creates high energy plasma events called CMEs. These plasma clouds compress the magnetosphere and cause geomagnetic storms when they hit Earth. These kinds of problems cause electric currents to flow through long transmission lines that will damage transformers and make electricity less reliable. Energy systems are the most important part of human life, so it's important to be able to predict and lessen the effects of solar storms in order to keep things going. This study was conducted in two parts: modeling the behavior of solar plasma and evaluating its effects on Earth's power grids. First, simplified magneto hydrodynamic (MHD) equations were used to model how coronal mass ejections (CMEs) move through space. To illustrate both mild and extreme solar events a speed range of 300 km/s to 2000 km/s was chosen with changes in magnetic field strength of up to 200 nT. MATLAB was used to model these plasma conditions so we could see how the intensity changes as the CME gets closer to Earth. The second stage was to use grid impedance and average crustal conductivity values to figure out how geomagnetically induced currents (GICs) would work on long transmission lines. We could figure out how much current levels rise sharply under stronger CMEs by comparing quiet solar conditions with storm driven cases. We were able to link solar plasma dynamics directly to the risks that terrestrial power networks face with this method, even though we didn't have any physical labs. Simulation results revealed that GICs rise sharply during strong solar plasma interactions. At CME speeds more than 1200 km/s, induced currents above the safe operational limits for transformers, indicating significant susceptibility. The graph illustrates the relationship between CME speed and GIC amplitude. These findings support the urgent need for predictive space-weather monitoring and adaptive energy protection systems.

Session-6: Medical and Health Physics

Paper ID: ICSHSD-8

Investigation of the Adsorption of Miglitol Anti-diabetic Drug on the Surface of $X_{12}Y_{12}$ (X= B, Al; Y= N, P) Nanocages: A DFT and COSMO Insights

Samiron Kumar Saha[1*], Maliha Nishat[1], Md. Rayhan Mostofa[1], and Md. Abul Hasnat[2]
[1]Department of Physics, Pabna University of Science and Technology, Pabna-6600, Bangladesh,
[2]Department of Physics, Jahangirnagar University, Pabna-6600, Bangladesh
**Corresponding author: samiron@pust.ac.bd*

ABSTRACT

A DFT investigation has been carried out to understand the adsorption nature of the miglitol (MT) anti-diabetic drug on the surface of $B_{12}N_{12}$, $B_{12}P_{12}$, $Al_{12}N_{12}$, and $Al_{12}P_{12}$ nanocages in the gas and water phase. MT drug is physically adsorbed on the surface of $B_{12}N_{12}$ and $B_{12}P_{12,}$ while chemisorption is observed for $Al_{12}N_{12}$ and $Al_{12}P_{12}$ nanocages. $Al_{12}N_{12}$ shows the highest adsorption energy of -2.08eV in gas and -1.96eV in water media, respectively. The electronic HOMO-LUMO energy gaps were extremely reduced by about 48.21%, 41.67%, 4.02%, and 9.92% in the gas phase after the adsorption of the MT drug onto the surface of the studied nanocages, respectively, which implies an increase in electrical conductivity of these nanocages. Dipole moment and COSMO surface analysis forecasted that $Al_{12}N_{12}$ and $Al_{12}P_{12}$ show more solubility in water media. Therefore, all the studied nanocages are favorable drug carriers, and among them, $Al_{12}N_{12}$ can be used as a promising nano-vehicle for the MT drug.

Paper ID: ICSHSD-28

Exploring the Anti-Cancer Potential of Daidzin in Breast cancer: Integrated Bioinformatics and Computational Insights on Oncogene Inhibition

Md. Nazim Uddin[1], Jie Wang[2], Md. Mamunur Rashid[1], Md. Zia Uddin Al Mamun[1], and Miah Roney[3]
[1]Institute of Food Science and Technology, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmodi, Dhaka 1205, Bangladesh.
[2]The First Affiliated Hospital of Xinjiang Medical University, Urumqi, 830011, China.
[3]Universiti Malaysia Pahang Al-Sultan Abdullah, Pahang, Malaysia.
**Corresponding author: nazimbio@yahoo.com*

ABSTRACT

Breast cancer, the most common cancer in women, has high recurrence rates, indicating the need for novel therapies. This study investigates daidzin, a food isoflavone, as a chemopreventive agent by downregulating oncogenes through interaction with hub oncogenic proteins. We used the GSE85871 dataset to identify differentially expressed genes (DEGs) in breast cancer vs. normal cells. This was followed by pathway enrichment analysis, protein-protein interaction (PPI) network construction, and validation using the TCGA cohort. Molecular docking, dynamics simulations, and MM-GBSA analysis further explored daidzin's interaction with oncogenic proteins. Daidzin treatment resulted in 449 upregulated and 644 downregulated genes. KEGG enrichment revealed suppression of cancer-related pathways like PI3K-Akt signaling and cytokine interactions. Validation confirmed inhibition of KRAS, CCND1, CDH11, and MDM2. Docking and dynamics simulations showed stable interactions, and ELUMO, EHOMO, and MEP analyses highlighted high reactivity of daidzin. Daidzin disrupts oncogenic signaling in breast cancer by downregulating critical oncogenes like KRAS, CCND1, and MDM2, offering promise as a chemopreventive agent.

Paper ID: ICSHSD-437

Thermal and Electrical Properties of Human Tissues: Implications for Medical Device Design in Bangladesh

Shaharia Rahman Tanim[1*], Samin Shahriyar Lorin [1] , and Md. Mortuza Ahmmed[2]
Department of Computer Science, American International University-Bangladesh, Dhaka, Bangladesh
Department of Mathematics, American International University-Bangladesh, Dhaka, Bangladesh,
Corresponding author: 23-54509-3@student.aiub.edu

ABSTRACT

Investigation in thermal and electrical properties of human tissues is now a very important issue for the design of medical devices, especially in Bangladesh where cost effective and safety feature with flexibility and future compatibility are the key issue. Introduction Medical devices including imaging devices, therapeutic instruments and physiological monitoring rely on comprehensive knowledge of interaction between human tissues and electrical and thermal energies. These interactions impact the optimization of dose, safety of dose, quality of image, efficacy of therapy and clinical usage. However, despite global progress, there is a paucity of local studies and this information gap is one of the major barriers to the development of cost effective and safe technologies that the healthcare system of Bangladesh demands. This study uses longitudinal data (1994-2023) to reveal trends in performance and the implications for device innovation. We used a retrospective analysis of 30 years (1994–2023) data including five key parameters: Dosage Optimization (%), Safety Index, Imaging Quality Score, Therapy Effectiveness (%), Adoption Rate (%). The data patterns were subjected to statistical analysis in order to identify relationships and performance fluctuations with time. Descriptive analysis emphasized mean values and comparative evaluations captured changes in therapy efficacy, safety and imaging quality. The clinical usability was highlighted as the relationship between the safety index and the adoption rate. Contextual analysis linked the observed trends of technology to the biomedical design needs of Bangladesh in terms of cost, regulatory compliance and sustainability of medical devices. The results showed that there was a noteworthy deviation among the measured parameters analyzed. Dose control optimization increased over time, reaching almost 100% in (2013), suggesting significant further improvement in delivered energy control. The value of safety index fluctuated intermittently (from 2.34 in 2003 to 9.93 in 2002), indicating the difficulty in keeping stable safety performance. Imaging quality scores (as high as >90) cumulatively illustrated that the quality of imaging is generally great and saw significant peaks in 2011 (99.4) and 2018 (99.98), indicating improvements in noninvasive diagnostics. Effective treatment also increased over time with a rate of more than 90% in (1996, 2003, 2008 and 2017) demonstrating an improved reliability. Adoption rates fluctuated usually around 50% or less until (2008, 2010 and 2013) then passed 75% in (2017). This contradiction demonstrates the potential that existed but also points to the fact that socio-economic barriers prohibited broader acceptance. Our results suggest that device development for Bangladesh can be aimed towards durable safety-conscious, cost-sensitive design that also considers context-specific usability to optimally foster effectiveness and broader clinical uptake.

Paper ID: ICSHSD-488

Eeg Patient Trends in Bangladesh: Demographics, Diagnostics, and the Covid-19 Impact

Farah Deeba [1*], Ibrahim Khalil [1], and Mariya Ferdousi [2]

[1]Dhaka University of Engineering and Technology
[2]Bangladesh Atomic Regulatory Comission
Corresponding author: f.deeba@duet.ac.bd

ABSTRACT

This study investigates the demographic and clinical characteristics of patients undergoing electroencephalography (EEG) in Bangladesh, with a focus on gender distribution, age variation, referral background, and diagnostic outcomes. A retrospective analysis was conducted to assess the male-to-female ratio among EEG patients and the age-specific distribution of cases. The referral patterns were examined to determine the proportion of patients recommended for EEG with and without prior epileptiform activity, as well as the proportion of those who exhibited epileptic discharges upon investigation. In addition, the temporal trend in patient numbers was evaluated to identify the potential impact of the COVID-19 pandemic, particularly the rate of increase in EEG referrals after 2019. The findings provide insight into the diagnostic yield of EEG in a Bangladeshi clinical context and highlight changes in patient trends influenced by the pandemic. This study contributes to understanding the epidemiology of EEG referrals in developing countries and underscores the importance of continuous monitoring for effective neurological care.

Paper ID: ICSHSD-503

Biophysics at the Crossroads of Medicine and Health: Innovations for Sustainable Healthcare.

Tarikul Islam Joy[1*], Ahnaf Hasan[2] ,Md Fatin Hasnat Patwary[3] , And Md. Mortuza Ahmmed[4]
Department of Computer Science, American International University-Bangladesh, Dhaka, Bangladesh.
Department of Mathematics, American International University-Bangladesh, Dhaka, Bangladesh.
**Corresponding author: 23-53237-3@student.aiub.edu*

ABSTRACT

Biophysics is continuously transforming healthcare by integrating physical science with medicine based on disease detection, treatment, and sustainability. In terms of global health, the incidence of chronic diseases like heart disease and cancer, as well as infectious diseases like malaria, tuberculosis, and COVID-19 have increased from 2000 to 2023.The number of patients is increasing, but there are many differences in the treatment patient diseases. This study explores the importance of biophysics in improving healthcare by understanding disease differences between various populations, structuring healthcare, permanently improving healthcare based on treatment outcomes. A longitudinal data set has been created from 2000 to 2023, collecting government statistics. Countries from all continents are included here. The health situation is assessed using statistics such as how many people have died (mortality rate%),how widespread the disease is (rate%),how many doctors and beds are in hospitals for every 1,000 people. The relationship between healthcare and disease symptoms, outcomes, and socioeconomic development has been examined. Data suggests that the development of vaccines has reduced deaths from infectious diseases, but chronic diseases such as cancer and cardiovascular disorders have contributed to an increase in Disability-Adjusted Life Years (DALYs). COVID-19 temporarily increased the global mortality rate to 6.2% in 2020. Countries with better education and healthcare, with more than 5 doctors per 10,000 people, had a recovery rate of over 90%.On the other hand, in low-income countries, many have to bear medical costs exceeding 40% of their per capita income due to poor infrastructure. Advanced imaging, nanomedicine, and personalized medicine have ensured ease of access to healthcare (high access of up to 98%). The average growth rate over the last 20 years was 4.8%, but there were large differences between developed and developing regions. Biophysics plays a key role in disease detection, developing new methods sustainability of healthcare, developing medical imaging that has improved patient outcomes. However, infrastructure deficiencies, limited access, and high costs are becoming major obstacles to global progress. Investment in preventive technologies to strengthen services and reduce chronic diseases in low-income countries.

Paper ID: ICSHSD-530

Advanced Machine Learning Approaches for Dengue Outbreak Prediction in Monsoon-Driven Epidemics

Alvi Ahmed Sarker[*] and Dr. Md. Kamrujjaman [2]
University of Dhaka
**Corresponding email: a.a.sarker09@gmail.com*

ABSTRACT

Dengue fever poses considerable public health challenges in Bangladesh and other tropical areas, characterised by highly variable outbreak patterns and intricate seasonal dependencies. This ongoing research examines sophisticated machine learning techniques for forecasting dengue outbreaks that utilise extensive meteorological and epidemiological data from Bangladesh (2008-2024). The dataset shows an unprecedented amount of variation, with reported cases ranging from 1 to 107,498 per month. This makes it very hard for traditional forecasting methods to work. Our research framework will systematically assess various advanced methodologies, including Long Short-Term Memory networks, Transformer-based foundation models, ensemble methods, and Neural Ordinary Differential Equations (NODEs). Initial analysis indicates that conventional methods encounter difficulties with extreme value distributions typical of epidemic time series. We are creating specialised extreme-value modelling methods that use quantile transformations, peak-weighted loss functions, and latent Neural ODEs to learn about how epidemics work directly from data instead of using mechanistic constraints. Preliminary experiments utilising compartmental SIR-based models suggest possible constraints when epidemiological assumptions are contravened in actual surveillance data. Our intended comprehensive assessment will encompass: (1) a rigorous comparison of discrete-time and continuous-time modelling methodologies, (2) an exploration of attention mechanisms for elucidating long-range seasonal dependencies, (3) the formulation of hybrid architectures that integrate the advantages of various approaches, and (4) the creation of specialised loss functions that prioritise significant outbreak intervals. We anticipate illustrating that log-space modelling with robust scaling is crucial for outbreak prediction, and that domain-specific model design markedly surpasses generic time series methodologies. The study seeks to establish operational frameworks for early warning systems in monsoon-affected areas, with wider ramifications for epidemiological forecasting in climate-sensitive disease contexts.

Session-7: Thin Film and Nano-structural Material-II

Paper ID: ICSHSD-40

Impact of Manganese Doping on the Structural and Optical Properties of Zinc Selenide Thin Films Prepared by Thermal Evaporation Method

M. Mahbubur Rahman[1*], K. M. A Hussain[2], T. Faruqe[2], and A. T. M. K. Jamil[1]
[1]Department of Physics, Dhaka University of Engineering & Technology, Gazipur-1707, Bangladesh
[2]Experimental Physics Division, Atomic Energy Centre, Dhaka-1000, Bangladesh
[*]*Corresponding author: mahbub.physics@gmail.com*

ABSTRACT

Zinc selenide (ZnSe) thin films, both undoped and manganese (Mn)-doped, were synthesized on glass substrates using the thermal evaporation technique under high vacuum conditions (~10^{-5} mbar). The Mn doping concentration was systematically varied between 0.5% and 2.5%. The films were consistently fabricated with a thickness of 500 nm, as monitored by the frequency shift of a quartz crystal oscillator. After deposition, each film was annealed at 300 °C for one hour in the deposition chamber. The crystallographic, structural, morphological, and elemental properties of the films were analyzed using X-ray diffraction (XRD), field-emission scanning electron microscopy, and energy-dispersive X-ray spectroscopy (EDX). XRD analysis confirmed that the films exhibited a face-centered cubic (fcc) zinc-blende structure with a preferred orientation along the (111) plane. UV-visible spectrophotometry was employed to assess the transmittance, reflectance, absorbance, absorption coefficient, energy band gap, Urbach energy, refractive index, extinction coefficient, dielectric constant, and optical conductivity of the films. The UV-visible transmittance results demonstrated that the films were highly transparent, with transmittance values ranging from 60% to 88% in the visible spectrum. The direct optical band gap for both undoped and doped films was found to be between 2.91 and 3.33 eV, with a decrease in the band gap observed as the Mn doping concentration increased. The introduction of Mn into ZnSe thin films enhanced the optical conductivity and shifted the absorption edge to lower energies, resulting in a reduction in the band gap. This modification resulted in optically active Mn-doped ZnSe films, making them promising candidates for optoelectronic device applications.

Paper ID: ICSHSD-62

Deposition of Zinc Bismuth Sulphide Thin Films by Spray Pyrolysis for Photovoltaic Application

Nishat Salsabil[1*], A. T. M. K. Jamil[1], Syed Jamal Ahmed[1], Md Rasadujjaman[2], and Md. Sahab Uddin[1]
[1]Department of Physics, Dhaka University of Engineering & Technology, Gazipur, Bangladesh
[2]SDepartment of Physics, Mawlana Bhasani Science & Technology University, Tangail, Bangladesh
**Corresponding author: nishatsara1998@gmail.com*

ABSTRACT

Zinc Bismuth sulphide ($ZnBi_2S_3$) thin films were deposited on glass substrate at 300 ^oC by low cost spray pyrolysis technique. The concentration of zinc (Zn) was varied from 1 to 4 atomic %. The structural, surface, compositional and optical properties of the fabricated films were observed by X-ray diffraction (XRD), Scanning electron microscope (SEM), Energy dispersive X-ray analysis (EDAX) and a UV-Vis spectrometer. From the XRD analysis, it was found that the deposited films were polycrystalline in nature characterized by three dominant bismuth sulphide (Bi_2S_3) peaks. For lower concentration of Zn only three distinct peaks of Bi_2S_3 were observed. With the increase of Zn concentration along with Bi2S3 peaks additional zinc sulphide (ZnS) peaks were observed. From SEM photograph, it was found that the surface of the films were almost uniform with formation of nanostructure over the entire substrate. From EDAX analysis, it was found that the compositional percentage of Zn was increased with the increase of doping concentration that confirms the doping accuracy. The films were found to be highly absorptive at the ultraviolet region and the absorption was almost uniform at the visible region. The optical band gaps of the fabricated films was found to vary between 3.2 -3.8 eV. The optical properties including absorbance and band gap confirms the suitability of the fabricated films for window layer and top cell of a tandem solar cell. With further improvement of stability our fabricated films might be a potential candidate for high frequency device applications

Paper ID: ICSHSD-76

Fabrication of a Chemically Stable Ksnx$_3$ (Cl, I) Perovskite Film by Spin Coating Process

Syed Habibul Basher*, Yeasir Ahmed, and Md Rasadujjaman
Department of Physics, Mawlana Bhashani Science and Technology University, Tangail, Bangladesh
Corresponding author: ph20018@mbstu.ac.bd

ABSTRACT

The global pursuit of clean energy motivates the search for efficient, stable photovoltaic materials. Lead-based perovskite solar cells (PSCs) have achieved remarkable efficiencies but suffer from toxicity and stability concerns, motivating the search for environmentally friendly alternatives. Potassium tin halide perovskites, $KSnX_3$ (X = Cl, I), offer a promising lead-free, inorganic solution due to their favorable optoelectronic properties and chemical stability. This study investigates perovskite thin films of $KSnCl_3$ and $KSnI_3$ fabricated through spin coating at ambient conditions for solar cell applications, emphasizing stability achieved through solvent engineering. The optical, compositional and electrochemical characteristics were comprehensively investigated using UV-Vis spectroscopy, FTIR and cyclic voltammetry. Optical characterization revealed strong light absorption in the UV and visible range with good absorption coefficients (~10^6 cm^{-1}). Tauc plot analysis revealed a direct bandgap of 2.13 eV for $KSnCl_3$ and 1.86 eV for $KSnI_3$, ideal for PSC. The bandgap increases with increasing Cl^- concentration. Relatively low defect densities, indicated by Urbach energies of 310 meV for $KSnCl_3$ and 550 meV for $KSnI_3$ and FTIR spectroscopy verified the compositional integrity of the inorganic perovskite lattice through characteristic Sn-Cl and Sn-I stretching vibrational modes (400-600 cm^{-1}) for all compositions. CV measurements demonstrated capacitive behavior with $KSnI_3$ achieving the highest specific capacitance of 5.46 mF/g. These findings highlight the potential of ambient-synthesized $KSnX_3$ perovskites as stable, lead-free absorber layers with tunable optoelectronic properties, suitable for solar energy harvesting.

Paper ID: ICSHSD-77

Synthesis of Ru-Doped Zno Nanoparticles by Precipitation Method: Effect of Annealing Temperature

Jannatul Nayem*, Yeasir Ahmed, Md Abdur Razzaq, and Md Rasadujjaman
Department of Physics, Mawlana Bhashani Science and Technology University, Tangail, Bangladesh
**Corresponding author: ph20048@mbstu.ac.bd*

ABSTRACT

This study synthesized ruthenium (Ru)-doped zinc oxide (ZnO) nanoparticles (0.5, 1, and 3 wt% Ru) via a chemical precipitation method and systematically investigated the impact of annealing temperature (250 °C, 400 °C, 500 °C, 600 °C) on their compositional, electrochemical, and magnetic properties for multifunctional applications. Fourier Transform Infrared Spectroscopy (FTIR) confirmed successful Ru incorporation into the ZnO lattice, evidenced by the emergence of Ru-O-Zn (~697-700 cm^{-1}) and Ru-O (770-900 cm^{-1}, ~1040-1065 cm^{-1}) vibrational modes, alongside the characteristic Zn-O stretching band (~666 cm^{-1}). Annealing significantly enhanced structural purity and crystallinity, as indicated by the reduction or disappearance of organic residue peaks (C-H, C-O, C=O, O-H) at higher temperatures (500-600 °C). Vibrating Sample Magnetometry (VSM) revealed room-temperature ferromagnetic behavior influenced by Ru doping and annealing. Electrochemical characterization via Cyclic Voltammetry (CV) in acidic and alkaline media demonstrated that Ru doping and annealing temperature critically affect specific capacitance and redox activity, quantified using the integrated CV curve area. The findings establish that controlled Ru doping and optimized annealing temperature are crucial for tailoring the compositional, magnetic, and electrochemical functionalities of ZnO nanoparticles, highlighting their potential for applications such as sensing and energy storage.

Paper ID: ICSHSD-83

Effect of Ru-Doping and Annealing on Spin-Coated Nio Films

Yeasir Ahmed[1,*] Md Rasadujjaman[1], Md Didarul Islam Bhuyan[1], Md Rezaul Karim[2], Md Sahab Uddin[2], A.T.M.K Jamil[2], Syed Jamal Ahmed[2], Md Ashraf Ali[3], and Md Anwar Hossain[1]
[1]Department of Physics, Mawlana Bhashani Science and Technology University, Tangail, Bangladesh
[2]Department of Physics, Dhaka University of Engineering & Technology, Gazipur, Bangladesh
[3]Department of Physics, Chittagong University of Engineering and Technology, Chattogram, Bangladesh
**Corresponding author: ahmedyeasir1@gmail.com*

ABSTRACT

In this study, pure nickel oxide (NiO) and Ru (1.5 to 3.5 wt%)-doped NiO films were deposited on a cleaned hot glass substrate (50°C) by a homemade, inexpensive spin coating technique. To obtain shiny, uniform and colored films, the films were pre-annealed at 80 ºC for 10 min and annealed at 300 ºC 400 ºC and 500 ºC for 2 hours in air. The thickness of the films for 7 times coatings was 229±5 nm. X-ray diffraction spectra revealed a polycrystalline nature of the NiO film with a cubic structure and a favored growth orientation towards the plane (200). At the doping concentration of 2.5 wt% films showed the formation of a secondary phase of the RuO_2 along with NiO phase at 400 ºC annealing temperature. However, the additional phase of Ru vanished at 500 ºC annealing temperature due to the comparable ionic radii of Ru^{3+} and Ni^{2+} ions, the Ru dopants may well incorporate into the lattice without changing its structural properties at high annealing temperature. Ru doping into NiO films generated defects such as void structures on the surface and showed a uniform distribution of Ru dopant across the films and confirmed the formation of NiO–RuO_2 composite. Pure NiO films were high transparency (>75%), at a 400 °C annealing temperature, but the transparency decreased at 500 °C due to grain separation. Ru doping caused a significant reduction in transparency (30–45%) at all annealing temperatures, which was attributed to increased electron–phonon coupling and defect density. Annealing at 400 °C resulted in structural improvements, as demonstrated by a narrowing of the optical band gap. The addition of Ru created new energy levels, reducing the band gap and increasing carrier density. The estimated resistivity at 400 °C decreased from 76.03 to 10.04 Ω–cm due to Ru doping, indicating an increase in film conductivity. These findings improve our understanding of how Ru doping and annealing affect the optical and structural properties of NiO films. This has implications for their use in optoelectronic applications.

Paper ID: ICSHSD-114

Synthesis of Plasma Polymerized N-Vinyl-2-Pyrrolidone Thin Films: Finding Applications by Analyzing Optical and Electrical Properties

S. M. Kanti Saha[1,2*], S. J. Ahmed[2], and A. T. M. K. Jamil[2]
[1]Department of Electrical and Electrical Engineering, Gono Bishwabidyalay, Savar, Dhaka-1344, Bangladesh
[2]Department of Physics, Dhaka University of Engineering & Technology, Gazipur-1707, Bangladesh
**Corresponding author: smk.saha22@gmail.com*

ABSTRACT

In this study, the monomer N-vinyl-2-pyrrolidone (NVP) has been polymerized onto a glass substrate at room temperature under a pressure of 60 torr by capacitively coupled AC glow discharge plasma. The investigation of the optical and electrical properties of the PPNVP thin films result mainly focused in significant findings applications regarding the impact of film thickness. For these purpose, the findings data of optical and electrical properties of this study to compare with related scientific papers and provide a basis for optimizing their properties for specific applications. Based on the results of the UV-Visible spectroscopy, the optical absorbance of all the PPNVP thin films increased sharply in the UV region and had a high transmittance in the visible region. The direct (3.60-3.30 eV) and indirect (3.21-2.75 eV) band gaps decreased as the film thickness increased, which is characterized by structural variation with film thickness. The refractive index of PPNVP thin films typically ranges from 1.47 to 1.5, depending on the variation of film thicknesses. The current density-voltage (J-V) characteristics of PPNVP thin films were influenced by film thicknesses. The analysis conducted on the current densities showed that the main type of conduction mechanism belongs to the Poole-Frenkel emission type. The above investigation revealed their unique optical and electrical properties make them promising candidates for applications in optoelectronics, sensors and biomedical devices.

Paper ID: ICSHSD-158

Advanced Interface Engineering for High Efficiency Lead Free $Fasni_3$ Perovskite Solar Cells

Abul Monsur Mohammed Musa[1,2*], Syed Farid Uddin Farhad[2], and A. T. M. K. Jamil[1]
[1]Dhaka University of Engineering & Technology, Gazipur-1707
[2]Bangladesh Council of Scientific and Industrial Research, Dhaka-1205
Corresponding author: musamonsur80@gmail.com

ABSTRACT

The development of lead-free perovskite solar cells (PSCs) is critical for sustainable and environmentally friendly photovoltaic technologies. This study proposes advanced interface engineering strategies to enhance the efficiency and stability of lead-free farmamidiniun tin iodide ($FASnI_3$) based PSCs with a novel device architecture FTO/AZO/ZnONR/ZnS/FASnI3/3D Graphene. The proposed structure leverages aluminum doped zinc oxide (AZO) as a transparent conductive layer, zinc oxide nanorods (ZnONR) for improved electron transport, and zinc sulfide (ZnS) as an interfacial layer to minimize recombination losses. The FASnI3 perovskite absorber, known for its favorable bandgap and low toxicity, is paired with a 3D graphene hole transport layer to enhance charge extraction and device durability. This research will focus on optimizing the interfacial properties of the ZnONR/ZnS/$FASnI_3$ heterojunction to reduce trap states and improve charge carrier dynamics. The incorporation of ZnS as a passivation layer is expected to suppress interfacial recombination, while the 3D graphene framework will enhance hole mobility and environmental stability. Advanced deposition techniques, such as atomic layer deposition (ALD) for ZnS and solution processed 3D graphene, will be explored to ensure uniform and defect-free interfaces. Additionally, tailoring the AZO/ZnONR interface through surface modification will aim to improve electron extraction efficiency. Sol-gel-derived absorber layer deposition with carefully selected solutions will provide optimized band alignment and interface energetics to maximize open-circuit voltage (Voc) and fill factor (FF). The proposed research will also investigate the scalability of this device architecture, addressing challenges in large-area uniformity and long term stability under ambient conditions. By integrating non-toxic materials and scalable fabrication methods, this work aims to achieve power conversion efficiencies exceeding 15% while maintaining stability over 1000 hours of operation. These advancements will contribute to the commercialization of lead-free PSCs, offering a sustainable alternative to lead-based counterparts. The findings will provide critical insights into interface engineering for next generation photovoltaic technologies, paving the way for eco-friendly and high-performance solar energy solutions.

Session-8: Magnetic Material-II

Paper ID: ICSHSD-25

Structural and Magnetic Properties of Mg-Cr-Zn Mixed Nano Ferrites

Rizwana Afrin, Kaniz Fatema Laizo, and Muhammad Samir Ullah*
Department of Physics, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
**Corresponding author: samirullah@phy.buet.ac.bd*

ABSTRACT

Recently, nanocrystalline spinel ferrites have garnered attention due to their thermal stability and tunable optical, magnetic, and catalytic properties. Mg–Zn ferrites, in particular, are widely used in electromagnetic devices and show promise in optoelectronic and photocatalytic applications because of their adjustable band gap and chemical durability. Although previous studies have modified their composition to enhance properties, many lack detailed investigations into cation distribution, optical behavior, or frequency-dependent properties, limiting full understanding of their multifunctionality. Chromium (Cr) doping is a promising strategy to tune structural and magnetic properties by altering cation site occupancy and controlling grain growth. However, mismatches in ionic size and valence may introduce lattice strain, defects, or secondary phases. Despite its potential, systematic studies on Cr-doped Mg–Zn ferrites are limited. In this work, the impact of chromium (Cr) incorporation on the structural and magnetic characteristics of Mg-Zn ferrites have systematically studied for different doping levels (x = 0.2, 0.4, 0.6, and 0.8). Analytical-grade $Fe(NO_3)_3 \cdot 9H_2O$, $Mg(NO_3)_2 \cdot 6H_2O$, $Zn(NO_3)_2 \cdot 6H_2O$, $Cr(NO_3)_3 \cdot 6H_2O$, NaOH pellets, ethanol, and deionized water were used without further purification. Mg-Cr-Zn (x = 0.2-0.8) nanoparticles were synthesized via a hydrothermal method. Stoichiometric nitrate solutions were mixed under stirring, and NaOH was added dropwise to achieve an alkaline pH, facilitating hydroxide precursor formation. The mixture was hydrothermally treated, producing ferrite precipitates, which were washed with ethanol and water, dried, finely ground, and calcined to improve crystallinity. X-ray diffraction (XRD) analysis confirms the formation of a pure cubic spinel phase without any detected impurity peak. An increase in Cr content led to a reduction in crystallite size from 18.62 nm to 15.14 nm. Magnetic measurements at room temperature showed superparamagnetic behavior, with a notable drop in remanence from 0.238 to 0.002 emu/g. It is found that the Cr substitution significantly alters the multifunctional properties of Mg-Zn ferrites, making them suitable candidates for use in optoelectronic devices and magnetic hyperthermia applications.

Paper ID: ICSHSD-33

Study of the Structural and Electromagnetic Properties of Sintering Temperature Dependent Synthesized Ni-Mg-Zn-Al Ferrites

Arpon Debnath*, Md Sazzad Hossen, Rajon Saha Auntu, Sujit Kumer Shil*
Department of Physics, Khulna University of Engineering & Technology, Khulna, Bangladesh.
**Corresponding author: debnath2455501@stud.kuet.ac.bd, sujit@phy.kuet.ac.bd*

ABSTRACT

In the present work, Ni-Mg-Zn-Al ferrites have been synthesized using the solid-state reaction method for various sintering temperatures; hence, their structural and electromagnetic properties have been investigated. Polycrystalline $Ni_{0.30}Mg_{0.20}Zn_{0.50}Fe_{1.92}Al_{0.08}O_4$ ferrites have been synthesized using the Solid-State synthesis method at different sintering temperatures: 1200°C, 1300°C, and 1350°C. Different metal oxide powders (99% pure) are used as raw materials. The method involves grinding, pre-sintering, and sintering to obtain the final product. XRD analysis confirms the homogeneity and the formation of a pure single-phase cubic spinel structure**.** All the peaks in the XRD patterns are well arranged with the characteristic reflections of (111), (220), (311), (222), (400), (422), (511), and (440) crystal. The frequency dependent permeability study reveals an increasing trend of μ' with sintering temperature, the optimum sintering temperature is obtained as 1300°C, and then decreases. Moreover, the maximum relative quality factor is achieved at a sintering temperature of 1200°C.

Paper ID: ICSHSD-121

Investigation of Structure, Morphology, and Magnetic Properties of Octadecylalkylammonium Intercalated Montmorillonite Incorporated Calsium Ferrite Nanocomposites

Sha Mohammed Sharfuddin[1], Md. Hedayet Ullah[1,2], Parimal Bala[3], and Mohammad Jellur Rahman[1*]
[1]Department of Physics, Bangladesh university of Engineering and Technology, Dhaka-1000, Bangladesh
[2]Department of Physics, Bangladesh University of Textiles, Dhaka-1208, Bangladesh [3]Department of Physics, Jagannath university, Dhaka-1100, Bangladesh
**Corresponding author: mjrahman@phy.buet.ac.bd*

ABSTRACT
This study investigates the influence of octadecylalkylammonium intercalated montmorillonite (ODA-MMT) on the crystallographic, morphological, magnetic, optical and dielectric characteristics of the Ca ferrite ($CaFe_2O_4$) nanoparticles. $CaFe_2O_4$ samples are synthesized through the sol-gel auto-combustion method with the variation of ODA-MMT contents (0 – 6 wt%). Transmission Electron Microscopy (TEM), X-ray Diffraction (XRD), and Fourier Transform Infrared Spectroscopy (FTIR) techniques have been employed for the morphology and structural analyses of Ca ferrite and ODA-MMT-supported $CaFe_2O_4$. XRD measurement reveals the orthorhombic phase of $CaFe_2O_4$, and a reduction of crystallite size is observed due to the incorporation of ODA-MMT. UV-Vis spectra are observed to investigate absorption, reflectance and band gap of the samples. The values of saturation magnetization are found to be in the range of 24.73 – 28.12 emu/g in ODA-MMT-supported composites, which is much higher than that of pristine Ca ferrite (21.37 emu/g). The dielectric constant is enhanced significantly when ODA-MMT is used as a supporting material for Ca ferrite nanoparticles. 4% ODA-MMT incorporated CaFe2O4 revealed high saturation magnetization, increases crystallinity, and the highest band gap.

Paper ID: ICSHSD-133

The Observation of Morphological, Electrical and Magnetic Properties of Biopolymer and Gd-Doped Mg-Cu-Zn Ferrite

Md. Fahim, Zakia Sultana Tithi , Shadid Ibne Salim, and M Mizanur Rahman
Department of Physics, University of Dhaka, Dhaka-1000, Bangladesh
Corresponding author: s-2018325748@phy.du.ac.bd

ABSTRACT
This work reports the synthesis and characterization of chitosan-coated, Gd-doped Mg-Cu-Zn ferrite for potential biomedical and environmental applications. $Mg_{0.3}Cu_{0.2}Zn_{0.4}Gd_xFe_{2.1-x}O_4$ nanoparticles (x = 0.0, 0.01, 0.015, 0.02) were prepared via the sol gel method and subsequently coated with chitosan biopolymer. Structural analysis of the samples by X-ray diffraction (XRD) confirmed the formation of single-phase spinel ferrite, while Fourier transform infrared spectroscopy (FTIR) verified successful chitosan coating and identified characteristic metal–oxygen vibrations at tetrahedral and octahedral sites. Scanning electron microscopy (SEM) revealed that chitosan coating led to an increase in particle and grain size, whereas Gd doping induced subtle lattice expansion and affected the crystalline structure. UV–Vis absorption studies showed a systematic blue shift with increasing Gd content and further enhancement after chitosan coating, with the optical band gap widening from ~1.64 eV to 2.25 eV. This was accompanied by a decrease in electrical conductivity and an increase in resistivity, consistent with defect suppression and polymer passivation. Magnetic measurements using a vibrating sample magnetometer (VSM) demonstrated soft magnetic behavior, with saturation magnetization and coercivity increasing upon chitosan coating due to surface and size effects. The combined influence of Gd doping, biopolymer coating, and their effects on optical, electrical, and magnetic behavior resulted in nanoparticles with enhanced stability, biocompatibility, and tunable multifunctional properties, highlighting their promise for drug delivery, magnetic hyperthermia, optical coatings and wastewater treatment.

Paper ID: ICSHSD-146

Exploring the Role of Yttrium on Magnetic Properties in Modulating Tetrahedral and Octahedral Sites of Ni-Cu-Zn Ferrites

Piuly. Roy and Md. Alamgir Hossain
Solid State Laboratory, Department of Physics, Khulna University of Engineering & Technology (KUET), Khulna-9203, Bangladesh
*Corresponding author: liton@phy.kuet.ac.bd

ABSTRACT

Ni-Cu-Zn Ferrites is a widely studied materials for its versatile applications. This ferrites still have many limitations including the chemical specimen dependents high sintering temperatures raises the production costs. In the current project, $Ni_{0.35}Cu_{0.15}Zn_{0.5-x}Y_{2x}Fe_{2-x}O_4$ where x=0.10, 0.20, 0.30, and 0.40 will be synthesized by solid state reaction technique and characterize all the properties including microstructural, and magnetic characteristics due the modification of Y^{3+} of both tetrahedral (A) and octahedral (B) sites. The incorporation of Y^{3+} optimized the cation distributions, reduced the saturation magnetization as the Fe^{3+} ions are replaced by Y^{3+} ions. The XRD analysis showed spinel cubic phase structure with secondary phase formation of all the Y^{3+} doped samples. The Gaussian fitting applied to each sample validating the precision of the peak analysis as well as determining the grain structure.Y^{3+} doping significantly influences the structural characteristics of the ferrite system, modifying both lattice parameters and microstructural properties. Magnetic characterization using VSM showed an increase in coercivity from 19.73 to 58.97 Oe, while saturation magnetization decreased from 63.64 to 30.84 emu/g. Overall, although M_s decreases with Y^{3+} substitution, H_c increases sharply, demonstrating that the Ni–Cu–Zn ferrite system gradually transforms from a soft ferrite to a semi-hard ferrite, making it suitable for applications where controlled coercivity is required.

Paper ID: ICSHSD-147

Next-Generation Magneto-Dielectric Materials for High-Performance Microwave Devices

Shohanur Rahman Sagor and Md Alamgir Hossain*
Solid State Physics Laboratory, Department of Physics, Khulna University of Engineering & Technology
Khulna-9203, Bangladesh
**Corresponding author: liton@phy.kuet.ac.bd*

ABSTRACT

This work presents an in-depth analysis of Co-substituted Cr ferrites with the chemical formula $Cr(Fe_{1-x}Co_x)_2O_4$, where x = 0.0, 0.1, 0.5, and 0.9, targeting advanced microwave device applications. To prepare the desired samples, the double sintering technique was followed. The pre-sintering and sintering temperatures were set at 800 °C and 1332 °C. The Reitveld refinement of X-ray diffraction (XRD) patterns confirms a mixed spinel cubic structure with reduced impurity phase. Additionally, the SEM studies show that different Co doping levels result in decreased grain size and porosity. Magnetic hysteresis measurements reveal that Co^{2+} substitution at Fe^{3+} sites enhances magnetic properties, achieving a maximum saturation magnetization (~4.03×10^{-2} μB/F.U) and coercivity (~102.1 Oe) at x=0.5. Enhanced magnetic permeability and controlled dielectric properties are observed with Co doping. Interestingly, impedance matching remains stable with $Z/\eta_0 \approx 0.75$ across a wide frequency range (3 kHz to 7 MHz). Such characteristics are critical for minimizing energy loss and optimizing the performance of microwave components. Moreover, the eco-friendly nature of the Co-substituted Cr ferrites, combined with their superior magneto-dielectric stability and miniaturization potential, makes them promising materials for next-generation microwave devices and circuits.

Paper ID: ICSHSD-220

Enhancing Redox Activity And Surface Reactivity Via A-Moo3 Nanobelt Incorporation into Layered Ws2 Nanosheets for High Performance Supercapacitors

Md. Faysual Kabir[1], Md. Abdullah Zubair[2], Anwar Ul-Hamid[3] and Muhammad Rakibul Islam[1,*]
[1]Department of Physics, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh.
[2]Department of Nanomaterials and Ceramic Engineering, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh
[3]Core Research Facilities, King Fahd University of Petroleum & Minerals, Dhahran 31261, Saudi Arabia
**Corresponding author: rakibul@phy.buet.ac.bd*

ABSTRACT

Nanostructured WS_2 has drawn growing interest for its low cost, non-toxic nature, and electrochemical efficiency, yet it struggles to meet the requirements for practical use, including a broad potential window, excellent rate capability, high energy and power density, and operational stability. This study aimed to develop a redox-active (WS_2/α-MoO_3) nanocomposite electrode, synthesized via a facile hydrothermal method, and evaluate its performance for supercapacitor applications. Also, the influence of varying α-MoO3 content (0, 1, 3, 5, and 7 wt.%) on the surface morphology, structural properties, and electrochemical performance of WS_2 nanosheets was systematically investigated using comprehensive characterization techniques. The hierarchical 2D–1D nanocomposite structure offers multiple electrochemical benefits: (i) enhanced redox activity: contributes to greater charge storage capability by enabling multiple and reversible redox reactions during cycling, (ii) increased surface reactivity: provides more accessible electroactive sites, accelerating ion–electron interactions, and (iii) the presence of oxygen vacancies and interfacial defects: serves as active channels for ion diffusion and charge transfer, reducing internal resistance. The incorporation of α-MoO3 into the WS2 matrix resulted in a notable increase in specific capacitance from 332 F g⁻1 to 715 F g⁻1 at the current density of 0.5 A g⁻1. Additionally, the electrode demonstrated excellent cycling stability, maintaining 85% of its initial capacitance after 6,000 cycles at a high current density of 12 A g⁻1. The WS_2/α-MoO_3 nanostructure, with higher stability and improved specific capacitance, synthesized by a simple, low-cost method, will drive the production of efficient and economical energy storage devices.

Paper ID: ICSHSD-432

Magnetic properties of Mg-Cr-Zn ferrites nanoparticles

Amit Chakroborty[1], Muhammad Samir Ullah [2*], and M. Mizanur Rahman [1]
[1]Department of Physics, University of Dhaka
[2]Department of Physics, Bangladesh University of Engineering and Technology
[*]*Corresponding author: samirullah@phy.buet.ac.bd*

ABSTRACT

Mg-Cr-Zn ferrites nanoparticles were synthesized using a hydrothermal method, followed by sintering at 600 °C for 4 hours. Their structural, vibrational, and magnetic properties were investigated using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), and magnetization measurements (M–H) at 300 K. XRD analysis confirmed the formation of a dominant spinel ferrite phase. The lattice parameter increased from 8.462 Å to 8.497 Å with increasing Zn content, attributed to the larger ionic radius of Zn^{2+}. The crystallite size decreased as x increased. Additional microstructural parameters, including dislocation density, microstrain, and stacking fault probability, were calculated to provide insights into structural evolution. FTIR spectra displayed characteristic absorption bands around 580 cm^{-1} and 470 cm^{-1}, corresponding to tetrahedral and octahedral metal–oxygen vibrations, respectively. The force constant increased from 192 N/m to 288 N/m, indicating stronger metal–oxygen bonds with higher Zn substitution. Magnetic characterization showed a decreasing trend in coercivity (Hc) and remanence (Mr) with increasing Zn content, suggesting the onset of superparamagnetic behavior as the crystallite size approached the nanoscale. The saturation magnetization (Ms) and magnetocrystalline anisotropy constant (K) were also measured and analyzed to understand magnetic softening. Overall, controlled substitution of Zn^{2+} in Mg-based Cr-doped ferrites significantly influenced both structural and magnetic properties. The ability to tune crystallite size, coercivity, and magnetic response through Zn content makes these materials promising for applications in low-coercivity magnetic devices and biomedical fields such as magnetic hyperthermia and drug delivery.

Poster Papers

Paper ID: ICSHSD-065

Investigating the Dynamic Behavior of Human B-Tryptase Via Gaussian Network Model: A Computational Approach Towards Sustainable Therapeutic Development

Tanver Hossain Refat* and Muhammed Yaseen Morshed Adib
Southeast University, Tejgaon I/A, Dhaka, Bangladesh.
**Corresponding email: tanver.refat@seu.edu.bd*

ABSTRACT

The Dynamics of human β-tryptase is important for developing therapeutics for targetting allergic interactions. The fluctuation dynamics of human β-tryptase was studied in this project using the Gaussian Network Model (GNM). The structural property is then reconfirmed using some Python-based computational methods by rematching the protein structure with its previously recorded structure. The data for the three slowest modes (1, 2 & 3), the average of the 1-2 modes, the 1-3 modes, and the 1-10 fastest modes, and the B-factor for all the chains were calculated using self-developed computer programs, the GNM server, and then analyzed. Calculated B-factors for chains A, B, C, and D were compared with the experimental ones. The overall correlation coefficient between the experimental and the theoretical one is 0.72 (72 %) for human β-Tryptase. A small disagreement was found for the experimental and theoretical B-factor for all four chains at the same residue series LYS113-HIS117. This requires further physiological and chemical study to look for any binding sites for therapeutic interaction.

Paper ID: ICSHSD-167

Drug Parameterization for Targeted Drug Delivery into the Pulmonary Surfactant Monolayer

Syed Rashedul Islam Sakil, Khalid Bin Kaysar, and Md. Zohurul Islam*
Department of Mathematics, Jashore University of Science and Technology, Jashore-7408, Bangladesh
**Corresponding author: mz.islam@just.edu.bd*

ABSTRACT

Optimal regulated pulmonary drug delivery systems improve effective lung deposition and delay lung clearance mechanisms to maintain therapeutic concentration of the drug. The corticosteroid drug (budesonide) is widely prescribed medicine for treating inflammatory lung disease. The Martini-3 force field is used in this study to parameterize the drug utilizing a coarse-grained (CG) molecular dynamics (MD) approach. A number of thermodynamic parameters were examined throughout the simulation. The partition coefficient was computed using umbrella sampling simulation with the help of Gibbs free energy gradient method. The drug molecule was then introduced into the alveolar air-water interface of the lung's surfactant monolayer membrane.

Paper ID: ICSHSD-010

Wide Band Gap Double Perovskites for UV Filtering and Thermoelectric Technologies: A Study of $RB_2KSCCL_{6\ a}$nd RB_2NAYCL_6

Md. Borhanul Asfia, Sahadat Jaman, and Mohammad Abdur Rashid*
Quantum Materials Simulation Laboratory, Department of Physics, Jashore University of Science and Technology, Jashore 7408, Bangladesh
**Corresponding Email: rashid@just.edu.bd*

ABSTRACT

Double perovskites are increasingly recognized for their structural robustness, electronic versatility, and multifunctional potential in energy, optoelectronic, and thermoelectric applications. In this work, the properties of Rb_2KScCl_6 and Rb_2NaYCl_6 are explored using first-principles density functional theory within the generalized gradient approximation, employing the full-potential linearized augmented plane wave method implemented in WIEN2k. Structural investigations confirm that both compounds crystallize in the cubic *Fm-3m* phase, exhibiting thermodynamic and dynamic stability as supported by energy minimization and tolerance factor analyses. Electronic structure calculations reveal that Rb_2KScCl_6 possesses an indirect band gap of 4.05 eV, while Rb_2NaYCl_6 shows a direct band gap of 5.01 eV, making them suitable candidates for wide-band-gap optoelectronic devices. The density of states analysis highlights the dominant role of Cl-3p states in the valence band, with Sc-3d states in Rb_2KScCl_6 and Y-3d states in Rb_2NaYCl_6 contributing significantly to the conduction band. Optical results indicate strong ultraviolet absorption combined with high visible transparency, demonstrating potential for ultraviolet filtering and other optoelectronic applications. Thermoelectric evaluations based on Boltzmann transport theory reveal high Seebeck coefficients, favorable electronic transport behavior, and low lattice thermal conductivity, leading to promising figures of merit (ZT) of 0.72 and 0.85 for Rb_2KScCl_6 and Rb_2NaYCl_6, respectively, at room temperature. These values further increase at elevated temperatures, underscoring their potential for efficient thermoelectric energy conversion. Overall, the wide band gaps, strong optical absorption in the ultraviolet region, visible-range transparency, and robust thermoelectric performance establish Rb_2KScCl_6 and Rb_2NaYCl_6 as promising candidates for next-generation multifunctional optoelectronic and thermoelectric devices.

Paper ID: ICSHSD-041

Interlayer Distance Driven Structural, Electronic and Optical Transitions in Bilayer GeS: A First-Principles Investigation

Marjahan Akter, Hasibul Hassan Rizvee*, Budrun Neher, and Farid Ahmed
Department of Physics, Jahangirnagar University, Savar, Dhaka-1342
**Corresponding email: hasibul.stu2017@juniv.edu*

ABSTRACT

Two-dimensional (2D) group-IV monochalcogenides have emerged as promising semiconductors owing to their anisotropic structures, strong piezoelectric responses, and tunable bandgaps, with germanium sulfide (GeS) standing out due to its intrinsically non-centrosymmetric crystal structure that is highly favorable for nonlinear optics and photovoltaic applications. While monolayer GeS has been extensively studied, the impact of interlayer spacing in bilayers on stability, electronic structure and optical response remains largely unexplored, despite the fact that van der Waals separation directly governs orbital overlap, hybridization and charge distribution, offering a non-invasive way to tune material properties without introducing defects or strain. In this work, we perform first-principles calculations based on density functional theory (DFT) using the CASTEP package with GGA-PBE functionals and Vanderbilt-type ultrasoft pseudopotentials to systematically investigate the influence of interlayer distance on bilayer GeS. Our results identify a structural stability window between 3.396 Å and 3.502 Å, with energy minima at 3.426 Å and 3.502 Å, while larger separations (~5.041 Å) yield a gradual decoupling into independent monolayers. Electronic band structure analysis reveals a coupling-induced shift of the direct bandgap from the Z point in the monolayer to the Γ point in bilayers, with the bandgap tunable between 1.128 eV and 1.422 eV, primarily driven by strong S-3p and Ge-4p orbital hybridization as confirmed by projected density of states. Optical property calculations further demonstrate that bilayers at 3.426 Å and 3.502 Å show the strongest near-UV absorption, making them suitable for solar-blind photodetectors and UV sensors, while the maximum refractive index observed at 3.396 Å with prominent peaks in the visible range highlights potential in integrated photonic devices. Although monolayers display slightly higher peak conductivity, bilayers maintain significant visible-range conductivity, underscoring their viability as transparent conductive electrodes, and strong loss function peaks around 20 eV across all stable bilayers indicate robust plasmonic excitations suitable for UV plasmonic applications. These findings establish interlayer distance modulation as an effective strategy for tuning the stability, bandgap, and optical performance of bilayer GeS, positioning it as a versatile platform for visible-

light photodetectors, UV-sensitive devices, integrated photonic circuits, and transparent conductive components, with practical control achievable via mechanical exfoliation, pressure application or substrate engineering.

Paper ID: ICSHSD-050

Assessing the Adsorption Efficiency and Gas Sensing Potential of ScSeTe, TiSeTe, and ZrSeTe Nanosheets for Nitrogen-Based Toxic Gases (NO, NO_2, and NH_3) Through DFT Calculations

Md Mehedi Hasan, S. M. Jayed Hakim, Bivas Kumar Das, and Siraj Ud Daula Shamim*
Department of Physics, Mawlana Bhashani Science and Technology University, Tangail-1902, Bangladesh
Corresponding email: sdshamim@mbstu.ac.bd

ABSTRACT

Nitrogen-based pollutants such as nitric oxide (NO), nitrogen dioxide (NO_2), and ammonia (NH_3) contribute significantly to air pollution, threatening ecosystems and public health, thus requiring precise monitoring and control. Recently, two-dimensional (2D) transition metal dichalcogenides (TMDs), particularly in their Janus form, have emerged as promising materials for gas sensing applications. In this study, we employed density functional theory (DFT) calculations to investigate the adsorption behavior and sensing capabilities of Janus ScSeTe, TiSeTe, and ZrSeTe nanosheets toward NO, NO_2, NH_3 gas molecules. The electrical structure of all the nanosheets is dominated by the d orbitals, which give them all metallic properties. Two distinct adsorption sites (Se site and Te site) were examined to determine their gas-capturing efficiency. For NO, NO_2, and NH_3 gas molecules, the adsorption energy ranges span from -0.147 eV to -0.441 eV for ScSeTe, -0.130 eV to -0.306 eV for TiSeTe, and -0.004 eV to -0.703 eV for ZrSeTe, reflecting material-dependent variations in gas–surface interactions. Our calculated adsorption energies suggest physisorption for all gas–nanosheet interactions. In every nanosheet, NO acts as an electron donor and NO_2 as an electron acceptor, while NH_3 exhibits dual behavior, acting as both a donor and an acceptor. NO and NH_3 preferentially adsorb at the Se site, whereas NO_2 demonstrates stronger interaction with the Te site. All gas–nanosheet interactions exhibited short recovery times, which are advantageous for rapid and reliable gas sensing performance. TiSeTe exhibits weak interactions with all gas molecules, whereas ZrSeTe shows strong adsorption for NO_2 and NH_3, and ScSeTe demonstrates greater responsiveness toward NO.

Paper ID: ICSHSD-051

Exploring the Sensing Properties of Janus Mste (M = Sc, Ti, Zr) Nanosheets for Nitrogen-Based Toxic Gases (NO, NO_2, and NH_3) Via DFT

Md. Jahirul Islam Shawon, S. M. Jayed Hakim[1], Bivash Kumar Das, and Md. Siraj Ud Daula Shamim*
Department of Physics, Mawlana Bhashani Science and Technology University, Tangail-1902, Bangladesh
Corresponding email: sdshamim@mbstu.ac.bd

ABSTRACT

In the current scenario, nitrogen-based gases such as nitric oxide (NO), nitrogen dioxide (NO_2), and ammonia (NH_3) are bringing about serious threats to human health and the ecosystems, even at minimal concentrations, making the purification of these gases vital for environmental safety. In this investigation, Density Functional Theory (DFT) calculations were carried out to examine the gas-sensing properties and adsorption behavior of ScSTe, TiSTe, and ZrSTe nanosheets towards the NO, NO_2, and NH_3 gas molecules. All the nanosheets exhibit metallic behavior, with the dominant contribution arising from the *p* orbitals in ScSTe, and from the *d* orbitals in TiSTe and ZrSTe. To identify the most stable gas adsorption site, two sites (S site and Te site) on the nanosheets were considered. Our adsorption energy calculations indicate weak physisorption across all the nanosheets. The adsorption energy ranges for NO, NO_2, and NH_3 gas molecules are from –0.080 eV to –0.406 eV for ScSTe, –0.144 eV to –0.287 eV for TiSTe, and –0.103 eV to –0.354 eV for ZrSTe. Among all nanosheets, the S site exhibits better adsorption energies with NO and NH_3, and the Te site for NO_2 gas molecules. During the interaction, the gas molecules generally donate charge to the nanosheets, except for NO_2, which tends to withdraw charge due to the presence of two electronegative oxygen atoms. A low recovery time was observed for all gas–nanosheet interactions, which is favorable for gas sensing applications. Among the materials, ScSTe shows stronger interaction with NO and NH_3, while ZrSTe is more responsive to NO_2.

Paper ID: ICSHSD-075

Highly Efficient TCO-Free Perovskite Solar Cell: Scaps-1D Simulation and Optimization

Tanjim Ahmed* and Md Rasadujjaman
Department of Physics, Mawlana Bhashani Science and Technology University, Tangail, Bangladesh
**Corresponding email: rasadphy@mbstu.ac.bd*

ABSTRACT

This study confirms the high-performance potential of an n-type TCO-free inverted perovskite solar cell (Glass/Cu_2O/$MASnI_3$/ZnO/Al) through rigorous SCAPS-1D simulation. The critical solar cell parameters were systematically optimized: inorganic transport layer thicknesses (Cu_2O: 0.04 μm, $MASnI_3$: 1.2 μm, ZnO: 0.20 μm), absorber doping concentration (3×10^{15} cm^{-3}), and bulk defect density (2×10^{15} cm^{-3}). The optimized structure achieves target efficiency of 30.17% (V_{oc} = 1.0867 V, J_{sc} = 33.4942 mA/cm^2, FF = 82.88%), demonstrating exceptional quantum efficiency (99.38%) at 580 nm and optimal band alignment. The important findings include aluminum back-contact selection (4.26 eV work function) to mitigate voltage losses and inorganic transport layers eliminating costly TCO components. Resistance optimization (R_s=1 Ω-cm^2, R_{sh}=10^6 Ω-cm^2) further shows the stable TCO-free structure, while defect engineering suppressed Sn^{2+} oxidation-induced recombination. The TCO-free configuration, enhanced by interface passivation and doping control, delivers a commercially viable pathway for eco-friendly photovoltaics, achieving simultaneous advances in efficiency (>30%), cost reduction, and scalability. Figure 1 shows the optimized PSC device structure and Fig. 2 shows the corresponding energy band alignment of the proposed PSC structure.

Paper ID: ICSHSD-081

Performance Optimization of K_2AgBiI_6-Based Perovskite Solar Cell Using Scaps-1D Simulator

Mahiya Yesmin Tripty* and Md Rasadujjaman
Department of Physics, Mawlana Bhashani Science and Technology University, Tangail, Bangladesh
**Corresponding email: ph20034@mbstu.ac.bd*

ABSTRACT

K_2AgBiI_6-based perovskite solar cells (PSCs) were optimized using the SCAPS-1D simulator. Seven different electron transport layers (ETLs) and seven-hole transport layers (HTLs) were evaluated, with indium gallium zinc oxide (IZGO) identified as the optimal ETL and copper(I) oxide (Cu_2O) as the most efficient HTL. The absorber layer achieved peak performance at a thickness of 900 nm, with an acceptor density of 10^{15} cm^{-3} and a defect density of 10^{13} cm^{-3}. Interface engineering revealed that maintaining interface defect densities at 10^{13} cm^{-3} for both the Cu_2O/K_2AgBiI_6 and IGZO/K_2AgBiI_6 junctions significantly enhances device performance. The optimized device architecture delivered outstanding photovoltaic parameters, including a power conversion efficiency (PCE) of 27.29%, an open-circuit current density (V_{oc}) of 0.956 V, a short –circuit current density (J_{sc}) of 32.78 mA/cm^2 and a high fill factor (FF) of 86.52%. Further analysis indicated that metal electrodes with a work function above 5.1 eV for Au yield optimal performance. Temperature– dependent studies demonstrated excellent thermal stability, with peak efficiency sustained at 300 K. Fig. 1 shows the optimized PSC device structure and Table 1 shows the corresponding SCAPS 1D simulation parameters. This work contributes significantly to the advancement of next-generation solar cell technologies.

Paper ID: ICSHSD-082

Elastic, Optoelectronic and Thermoelectric Properties of MoSI: Insight From DFT Calculations

Yeasir Ahmed*, Md Tahinur Islam, Md Rasadujjaman, and Md Anwar Hossain
Department of Physics, Mawlana Bhashani Science and Technology University, Tangail, Bangladesh
Corresponding email: ahmedyeasir1@gmail.com

ABSTRACT

This study investigates the structural, mechanical, electrical, optical, and thermoelectric properties of MoSI using DFT and Boltzmann transport theory at ambient pressure and 10 GPa to evaluate its potential as an eco-friendly energy harvesting material. The calculated lattice parameters are consistent with prior study, and stability is confirmed using elastic and phonon calculations. Elastic properties revealed that MoSI is ductile and moderately hard at ambient pressure, making it suitable for industrial applications. The electronic band structure indicates an indirect band gap with semiconducting nature. At 0 GPa and 10 GPa, the maximum absorption coefficients in the visible region of light spectra are estimated to be 44.61×10^4 cm^{-1} and 46.13×10^4 cm^{-1}, respectively and the corresponding optical conductivities are 3.85×10^3 $(\Omega\text{-cm})^{-1}$ and 4.25×10^3 $(\Omega\text{-cm})^{-1}$. The predicted absorption is suggesting that the material is a good absorber and suitable for photovoltaic applications. The high Grüneisen value at 0 GPa ($\gamma = 1.57$) implies significant lattice anharmonicity and high phonon scattering, resulting in low lattice thermal conductivity, whereas its reduction at 10 GPa ($\gamma = 1.32$) indicates reduced phonon scattering and a minor rise in lattice thermal conductivity. The calculated lattice thermal conductivity at 900 K is 0.77 W/mK, and 1.45 W/mK for 0 GPa and 10 GPa respectively. The study of pressure effect is not beneficial for thermoelectric transport in MoSI and it is found that power factors decrease with the increase of temperature and pressure. At ambient pressure, the predicted maximum power factor in n–type MoSI at 300 and 900 K are found to be 10.2 and 5.88 mW/mK^2, respectively. Moreover, at ambient pressure the predicted ZT values for n–type MoSI at 300K and 900 K are 0.45 and 0.75, respectively and the corresponding thermal conductivities are 7.25 and 5.38 W/mK. The calculated thermal conductivity is much higher than conventional thermoelectric materials which causes the lower value of ZT. The predicted interesting results will be able to draw the attention of the scientific community for experimental verification and make lead free MoSI as potential in efficient energy harvesting devices.

Paper ID: ICSHSD-194

A Computational Investivation on the Physicochemical Properties of Transition Metal (Gold) Dopped Gallium Phosphide Nanotube Using Density Functional Theory

Nowshin Tabassum Riya[1], Noor Ahammad [3], Bonganur Khan[1], Aoly Ur Rahman[2], Md. Alamgir Kabir[1], and Md. Kabir Uddin Sikder[1, *]
[1]Department of Physics, Jahangirnagar University, Savar, Dhaka, Bangladesh
[2]Department of Physics, Dhaka University of Engineering and Technology, Gazipur, Bangladesh.
[3]Department of Physics, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh
Corresponding email: kabirsikder@juniv.edu

ABSTRACT

Among various types of nanomaterials discovered in the era of modern nanotechnology, nanotubes are versatile nanostructures with exceptional properties, potential for diverse technological and biomedical applications. In this work, the physicochemical properties of gallium phosphide ($Ga_{10}P_{10}$) nanotubes have been investigated before and after doping with transition metal (TM) Gold (Au) by replacing Ga and P alternately. From the analysis of bond length, it has been observed that doping transition metals with pristine $Ga_{10}P_{10}$ causes a significant increase (2.55% for $Ga_{10}P_9Au$ and **1.05% for** $Ga_9P_{10}Au$**)** in the reactivity and a greater surface area, which characterizes them as promising materials for developing nano-sensors and biosensors. Moreover, from the analysis of IR spectroscopy, no molecular vibration is observed in the range of imaginary frequencies for the pristine and Au-doped $Ga_{10}P_{10}$ nanotubes, indicating the formation of the nanotubes at the true energy minima and a high structural stability. All calculations were performed using Density Functional Theory (DFT) with the B3LYP hybrid exchange-correlation functional, including the LanL2DZ basis set. The doping was performed by replacing a Ga or P atom from the optimized nanotube with Au, thus forming two different nanotubes. In both cases, the Au-doped structures have a lower binding energy and a higher average bond length compared to the pristine one, signifying their potential for use in nano-sensors.

Paper ID: ICSHSD-237

First-Principles Insights into the Stability and Physicochemical Properties of Sulfur-Doped Si_8C_{12} Fullerene Using Density Functional Theory

Arnob Das Pritom[1], Noor Ahammad [3], Bonganur Khan[1], Aoly Ur Rahman[2], Md. Alamgir Kabir[1], and Md. Kabir Uddin Sikder[1,*]

[1]*Department of Physics, Jahangirnagar University, Savar, Dhaka, Bangladesh*

[2]*Department of Nanomaterials and Ceramic Engineering, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh.*

[3]Department of Physics, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh

**Corresponding email: kabirsikder@juniv.edu*

ABSTRACT

In the emerging field of nanomaterials, silicon carbide (SiC) fullerenes appear promising cage-like structures with prominent electronic and mechanical properties, prepared for applications in nanoelectronics, photocatalysis, and drug delivery systems. This investigation implements density functional theory (DFT) using the B3LYP hybrid functional with the LanL2DZ basis set to quantify the effects of sulfur doping on the Si_8C_{12} fullerene by replacing a Si or C atom from the optimized fullerene, thus forming two different fullerenes, $Si_7C_{12}S$ and $Si_8C_{11}S$. Structural optimizations highlight extended average bond lengths in doped clusters: 1.903 Å for $Si_7C_{12}S$ (a 4.92% increase) and 1.879 Å for $Si_8C_{11}S$ (a 3.59% increase) relative to the pristine 1.814 Å, signifying increased reactivity and expanded surface area, recommended for nano-sensors and biosensors. Energetic analyses indicate reduced stability in doped systems, with average binding energies of -6.067 eV ($Si_7C_{12}S$) and -5.929 eV ($Si_8C_{11}S$) compared to -6.073 eV for the undoped fullerene, indicating slight instability with sustained viability. Infrared vibrational spectra confirm the structural stability, exhibiting no imaginary frequencies and distinct mode shifts. The pristine Si_8C_{12} displays intense absorptions below 800 cm^{-1}, while sulfur doping introduces prominent high-frequency peaks near 1500 cm^{-1} ($Si_7C_{12}S$) and 1700 cm^{-1} ($Si_8C_{11}S$), highlighting changes in physicochemical characteristics. It provides first-principles evidence that sulfur doping modulates SiC fullerene properties, allowing for the creation of application-specific nanomaterials in advanced optoelectronic and sensing devices.

Paper ID: ICSHSD-279

DFT Insights into the Adsorption Performance of the Anti-Cancer Drug Nitrosourea on the Pristine Graphene and BN Nanosheets and Their Doped Structures

Riya Rani Kundu, Afiya Akter Piya, and Siraj Ud Daula Shamim*

Department of Physics, Mawlana Bhashani Science and Technology University, Tangail-1902, Bangladesh

**Corresponding Author: sdshamim@mbstu.ac.bd*

ABSTRACT

Cancer stands as one of the most crucial global health concerns, causing millions of deaths annually and showing a sharp rise in incidence. The drawbacks of traditional treatments including systemic toxicity, drug resistance, and poor targeting have driven the urgent development of advanced nanotechnology-based drug delivery approaches. In this study, Density Functional Theory (DFT) was utilized to investigate the adsorption strength, electronic characteristics, and chemical interactions between Nitrosourea (NU) and pristine and doped graphene and boron nitride nanosheets (doped with BN, AlN, and GaN) in both air and water media. Our results showed that NU is physically adsorbed on pristine graphene and boron nitride surfaces, with adsorption energies from −0.59 to −0.34 eV and minimal charge transfer about 0.006–0.021e, indicating stable non-covalent interaction. Incorporation of BN, AlN, or GaN dopants significantly exhibited a pronounced enhancement in sensitivity, with adsorption energies up to −1.09 eV in water and −0.61 eV in air, while ensuring the structural integrity of selected complexes. Adsorption of NU, decreased the HOMO–LUMO gap of the nanosheets, such as decreasing from 4.38 to 2.36 eV in BN and from 1.85 to 1.51 eV in GP-doped BN, which reflects increased conductivity and reactivity. Quantum molecular descriptors (QMD) such as chemical potential and electrophilicity showed higher reactivity and preserved stability for drug delivery. After NU adsorption, the increased dipole moments and changes in work function, especially in water media, indicate enhanced polarity, solubility, and could detect the drug electronically. Among all the nanosheets examined, the GP-doped BN nanosheet exhibited the most adsorption behaviour, including strong adsorption energy, structural stability, and enhanced dipole moment, which emphasizes its value as the most promising nanocarrier for NU delivery.

Paper ID: ICSHSD-398

Advanced Drug Sensing of Baricitinib Using C60 Fullerene Nanosheets: A First Principle Study for Rheumatoid Arthritis and Covid-19 Treatment Applications

Md. Raihan Islam[1*], Prianka Mondal[2], and Md. Rezaul Karim[3]
[1*] Department of Physics, Rajshahi University of Engineering and Technology (RUET), Rajshahi 6204, Rajshahi
[2, 3,] Department of Physics, Dhaka University of Engineering and Technology (DUET), Gazipur, Gazipur-1707
[*]*Corresponding email: raihanmahin1997@gmail.com*

ABSTRACT
In this study, DFT simulations using the DMol³ module were employed to investigate the sensitivity and reactivity of C60 fullerene nanosheets as potential drug carriers. Baricitinib, a therapeutic agent previously applied in the treatment of COVID-19 and rheumatoid arthritis, was selected as the model drug. The interaction between C60 nanosheets and Baricitinib was explored through analyses of adsorption behavior, charge transfer, solvation effects, quantum molecular descriptors, and COSMO surfaces. To assess adsorption performance, the drug was positioned in ten distinct configurations (S1–S10) on the nanosheet. The results indicate feasible drug adsorption, with adsorption energies ranging from –49.65 to –65.64 kcal/mol in the gas phase and –50.23 to –62.40 kcal/mol in aqueous environments. Among these, the S1 configuration exhibited superior adsorption properties. Charge transfer calculations revealed significant electron transfer during the adsorption process, with Baricitinib acting as an electron donor. Following adsorption, the nanosheet's energy gap decreased by 4.690%–21.71% in the gas phase, while in aqueous environments the variation was more modest. Additionally, work function and COSMO surface analyses further support that C60 nanosheets could serve as efficient and promising nanocarriers for Baricitinib delivery.

Paper ID: ICSHSD-438

Pressure-Induced Structural and Optoelectronic Modulation of CsBaF3 Perovskite: A DFT-Based Study

Yasmin Akter [*], Prianka Mondal, and Syed Jamal Ahmed
Department of Physics, Dhaka University of Engineering and Technology, Gazipur, Bangladesh
[*]*Corresponding email: yasminuddin885@gmail.com*

ABSTRACT
In this work, the structural and optoelectronic responses of a CsBaF3 perovskite compound were systematically investigated under hydrostatic pressure using density functional theory (DFT) within the CASTEP code of Materials Studio. The applied pressure was varied up to 20 GPa to examine pressure-induced modifications in the lattice and electronic structure. Our results reveal a monotonic decrease in lattice parameters and unit cell volume with increasing pressure, consistent with structural compression. The structure has an indirect band gap of 4.87eV. Concurrently, the band gap shows a significant reduction under stress, suggesting enhanced electronic conductivity. Furthermore, the calculated optical properties indicate strong absorption and dielectric response in the ultraviolet (UV) region, highlighting the potential of this material for pressure-tunable optoelectronic and photonic applications. These insights provide a deeper understanding of the structure–property relationship in perovskites and open prospects for their use in high-performance UV optoelectronic devices under extreme conditions.

Paper ID: ICSHSD-442

Performance Enhancement of Rb_2Ligai_6 Double Perovskite Solar Cell Using ETL And HTL Engineering: Insights From Scaps-1D Modeling and DFT Analysis

Md. Riad Khan, Zihad Hossain, Md. Redwan Alam Hridoy, Sanzida Naznin Mim, Md. Khairul Alam, and Md. Lokman Ali*
Department of Physics, Pabna University of Science and Technology, Pabna-6600, Bangladesh
**Corresponding e-mail: lokman.cu12@gmail.com*

ABSTRACT

The remarkable electrical, optical and transport capabilities of lead-free double perovskite halides have attracted a lot of interest in the optoelectronics field. In this study, a comprehensive theoretical investigation is carried out to optimize the performance of Rb_2LiGaI_6-based perovskite solar cells (PSCs) using SCAPS-1D device modeling. A total of 24 electron transport layer (ETL) materials were examined, including WS_2, Alq_3, BCP, $Cd_{0.5}Zn_{0.5}S$, ICBA, PEIE, $Sn(S_{0.92}Se_{0.08})_2$, SnO_2-MXene, SnS_2, ZnOS, ZnSe, C60, In_2S_3, PCBM, SnO_2 and WO_3 to evaluate their influence on device performance without convergence error. Among them ICBA, SnS_2, BCP and SnO_2-MXene exhibited superior photovoltaic properties, with SnO_2-MXene emerging as the most efficient ETL when paired with the Rb_2LiGaI_6 absorber. Building on the ETL optimization, 36 hole transport layers (HTLs) were investigated, including CFTS, $BaSi_2$, D-PBTTT-14, $SrCu_2O_2$, $CuSbS_2$, CNTS, CBTS, Cu_2Te, Spiro-OMeTAD and P3HT are the best HTLs. Except for CFTS and $BaSi_2$, all optimized HTL/Rb_2LiGaI_6/ETL/FTO configurations have achieved power conversion efficiencies (PCEs) exceeding 25%. The highest simulated efficiency of 25.88% with open circuit voltage (Voc) 0.75 V, short circuit current (Jsc) 41.80 mA/cm^2, fill factor (FF) 82.07% were obtained for the optimized device structure (Cu_2Te/Rb_2LiGaI_6/SnO_2-MXene/FTO) demonstrating enhanced charge extraction and minimal interfacial recombination losses. Furthermore, the electronic structure of Rb_2LiGaI_6 was analyzed using the WIEN2k full-potential linearized augmented plane wave (FP-LAPW) method, based on density functional theory (DFT). Employing the modified Beck-Johnson (mBJ) potential with spin orbit coupling (SOP), the material is identified as an direct bandgap semiconductor with band gap of 1.13 eV, which is highly efficient for photovoltaic applications. In addition, the material exhibits a high thermoelectric figure of merit (ZT), highlighting its potential for thermoelectric energy conversion. These findings provide valuable insights into band structure engineering, ETL/HTL material selection and device optimization, offering promising guidelines for designing cost effective, high efficiency and thermally stable double perovskite solar cells with potential applications in both photovoltaics and thermoelectric application.

Paper ID: ICSHSD-448

First Principles Investigation of the Structural, Electronic, Optical and Mechanical Properties of Ti_3Ac_2 (A = Al, Si, Ge) Max Phases

Md. Hasnat Shahriar Shanto, Md. Riad Khan, Md. Lokman Ali,* and Md. Khairul Alam
Department of Physics, Pabna University of Science and Technology, Pabna-6600, Bangladesh
**Corresponding e-mail: lokman.cu12@gmail.com*

ABSTRACT

The study of MAX phase materials has gained significant attention in recent years due to their unique combination of metallic conductivity and ceramic-like properties. In this study, first-principles calculations based on Density Functional Theory (DFT) were employed to investigate the structural, electronic, optical and mechanical properties of Ti_3AlC_2, Ti_3GeC_2, and Ti_3SiC_2 MAX phase compounds. The calculations were performed within the CASTEP framework, where exchange-correlation interactions were treated using the Generalized Gradient Approximation (GGA) with the PBEsol functional, ensuring reliable prediction of structural and bonding characteristics. The negative formation energy calculation and elastic analysis shows that these materials are thermally and mechanically stable. The electronic band structures and density of states (DOS) analyses confirm that all three compounds exhibit metallic behavior dominated by Ti 3d orbitals, though with distinct variations introduced by A-site substitution. Ti_3AlC_2 displays highly dispersive bands near the fermi level (E_F) that ensures high carrier mobility. Ti_3GeC_2 shows stronger Ti-Ge orbital hybridization, which modifies electronic transport characteristics. In contrast, Ti_3SiC_2 demonstrates enhanced Ti-Si covalent interactions, accounting for its superior oxidation resistance and structural stability. The optical properties derived from the dielectric function, absorption, reflectivity, conductivity, loss function and refractive index reveal that Ti_3SiC_2 exhibits superior optical behavior. Furthermore, mechanical analyses including bulk modulus, shear modulus and Young's modulus indicated that Ti_3SiC_2 exhibited the highest mechanical resilience. The calculated Pugh's ratio ($B/G > 1.75$) and Poisson's ratio ($\nu > 0.26$) indicate that Ti_3SiC_2 exhibits ductile behavior, suggesting that this material is suitable for applications requiring flexibility and resilience under stress. Overall, these findings establish a comprehensive comparison of Ti_3AlC_2, Ti_3GeC_2 and Ti_3SiC_2 where Ti_3SiC_2 shows the most enhanced properties among the three. This study not only advances the fundamental understanding of MAX phase materials but also provides theoretical guidance for their design and optimization in structural engineering, thermal barrier coatings, optoelectronic devices and next-generation functional materials.

Paper ID: ICSHSD-453

An Investigation into the Pressure-Induced Superconducting Properties of Lao For Enhanced High Performance Applications

Md. Mazharul Masud, Md. Riad Khan, Irfan Bin Habibi, Md. Hafijur Rahman, and Md. Lokman Ali*
Department of Physics, Pabna University of Science and Technology, Pabna-6600, Bangladesh
Corresponding email: lokman.cu12@gmail.com

ABSTRACT

Lanthanum oxide (LaO) has gained significant attention as a material because of its distinctive superconducting properties. In this study, we investigated the first-principles approach to investigate the electronic properties, mechanical properties, optical properties and superconducting properties of a LaO under pressure from (0-10GPa). The study utilized generalized gradient approximations (GGA) within the framework of density functional theory (DFT) to explore the material's key physical properties. It appears that a way to estimate transition temperature (Tc) of this material feasible, based on consistent patterns that are appearing across families of superconductors as determined via DFT simulations. Our computational results revealed significant insights into the material's fundamental properties and offered excellent agreement with experimental findings. Our results indicate that the superconducting pairing in LaO corresponds to the usual Bardeen-Cooper-Schrieffer (BCS) type. The phonon dispersion analysis of the material showed positive dispersion curves (0-10GPa) indicating the dynamical stability of the system. Notably, we observed that heavier atoms contribute more significantly to the formation of acoustic modes, while lighter atoms are more influential in the formation of optical modes. The mechanical stability of the material was further assessed through the calculation of elastic constants. The calculated Pugh's ratio ($B/G > 1.75$) and Poisson's ratio ($\nu > 0.26$) indicate that the material exhibits ductile behavior, suggesting it is suitable for applications requiring flexibility and resilience under stress. The high machinability index further establishes its potential for precision machining, as it offers smooth surface qualities, reduced friction and simplicity of processing. Regarding superconducting properties, we computed the transition temperature (Tc) of LaO which was found to be 5 K. The applied (0-10GPa) pressure on LaO modifies its electronic structure, leading to an increased density of states at the Fermi level (E_F). This enhances electron-phonon coupling and consequently raises Tc to 11 K, offering valuable insights into the optimization of superconducting properties for real-world applications. The insights derived from this research may facilitate the advancement of materials with superior superconducting properties, enhancing the efficiency and performance of future superconducting devices and applications.

Paper ID: ICSHSD-524

Y_2CoCrO_6 Double Perovskite Nanoparticles for Photocatalytic Degradation of Antibiotic Pollutants

Susmita Bhattacharjee[1,2*] and M. A. Basith[1]
[1] Nanotechnology Research Laboratory, Department of Physics, Bangladesh University of Engineering and Technology, Dhaka-1000.
[1,2] Department of Physics, Dhaka University of Engineering and Technology, Gazipur, Bangladesh.
Corresponding email: susmita29@duet.ac.bd

ABSTRACT

The escalating release of industrial and pharmaceutical pollutants has heightened concerns over water contamination, emphasizing the urgent need for sustainable treatment technologies. In this work, Yttrium Cobalt Chromium Oxide (Y_2CoCrO_6, YCCO) nanoparticles were synthesized via a sol–gel route and comprehensively characterized to assess their potential as photocatalysts for degrading levofloxacin (LFX), a widely used antibiotic with high environmental persistence. The nanoparticles exhibited an average size of ~80 nm (FESEM), with crystallinity and phase purity confirmed by XRD. Thermal analyses (TGA/DSC) indicated excellent stability, while XPS verified chemical composition and the absence of impurities. Optical studies revealed a narrow bandgap of 1.35 eV and TRPL measurements showed a carrier lifetime of 6.67 ns, suggesting efficient charge separation. Photocatalytic tests under UV–visible irradiation demonstrated 75% degradation efficiency of LFX, highlighting the strong activity of YCCO toward pharmaceutical pollutant removal. Combining structural stability, favorable electronic properties, and high photocatalytic efficiency, YCCO nanoparticles emerge as a promising material for sustainable wastewater remediation.

Paper ID: ICSHSD-032

Effect of Sintering Temperature on the Structural and Electromagnetic Properties of Co-Mn-Zn Ferrites

Md Sazzad Hossen*, Arpon Debnath, Rajon Saha Auntu, and Sujit Kumer Shil*
Department of Physics, Khulna University of Engineering & Technology, Khulna, Bangladesh
**Corresponding email: sazzadmt1358@gmail.com, sujit@phy.kuet.ac.bd*

ABSTRACT

The fast-paced improvement of power electronics has produced a pressing need for a new generation of compact, lightweight, high-performance, and energy-efficient electronic components. Hence, it is important to perform comprehensive research on the development of new materials and to extensively investigate their structural, electrical, and functional properties for advanced technological applications. Mn-Zn ferrites offer low loss factor, high quality factor, high saturation magnetization (M_S), and high initial magnetic permeability (μ_i). Comprehensive studies of the sintering temperature dependent $Co_{0.2}Mn_{0.3}Zn_{0.5}Fe_2O_4$ ferrite have not been reported. Therefore, we will concentrate on the sintering temperature dependent synthesis and exploration of various properties of $Co_{0.2}Mn_{0.3}Zn_{0.5}Fe_2O_4$ ferrites. In this research, we report on the synthesis of Co-Mn-Zn ferrites using the widely recognized solid-state reaction method. The structural properties were investigated using an X-ray diffractometer, while the morphological properties were studied with scanning electron microscopy (SEM). The magnetic, dielectric, and electric properties were examined using an impedance analyzer, and the magnetization was investigated with a vibrating sample magnetometer (VSM). Herein, X-ray diffraction spectra revealed a well-crystallized single-phase cubic spinel structure of the synthesized ferrites. Crystallite sizes using the Williamson-Hall (W-H) method obtained in the range 30-34 nm. The real part of permeability (μ') increases from 1100°C to 1200°C, then decreases at 1300°C. The relative quality factor followed a similar trend. These studies show that phase purity, microstructure, and magnetic characteristics are strongly correlated with T_S.

Paper ID: ICSHSD-074

Surface Morphology and Phase Evolution of ZnO–RuO_2 Composite Films Synthesized by Spray Pyrolysis

Nirmal Chandra Roy[1], Md Rasadujjaman[2], Yeasir Ahmed[2], Md Sahab Uddin[1], Syed Jamal Ahmed[1], and A. T. M. K. Jamil[1*]
[1]Department of Physics, Dhaka University of Engineering & Technology, Gazipur, Bangladesh
[2]Department of Physics, Mawlana Bhashani Science and Technology University, Tangail, Bangladesh
**Corresponding email: atmkjamil@duet.ac.bd*

ABSTRACT

This study investigates the surface morphology and phase evolution along with optical and electrical properties of ZnO–RuO_2 composite films with different Zn/Ru atomic ratios (100/0, 99/1, 96/4, and 92/8). All the films are fabricated onto microscopic glass substrates using a cost–effective spray pyrolysis technique at 300 ± 10 °C. The surface morphology of ZnO evolves from spherical particles with dispersed microfibers to fully covered microfibers, flower–like nanosheets and finally RuO_2–dominated layered nanosheets, demonstrating Ru–dependent nano–structural transformations. The XRD patterns confirm the formation of wurtzite hexagonal ZnO in the pure sample. Moreover, with Zn/Ru atomic ratio of 99/1 showed the similar spectra property of pure ZnO. However, at the ratio of 96/4 and 92/8 the films showed multiphase system with ZnO, RuO_2, $Zn(OH)_2$ and metallic Zn, demonstrating progressive structural evolution with increasing Ru content. Optical studies indicated a red shift in absorption edges and a reduced optical band gap (3.31 eV to 3.09 eV) for RuO_2 films, attributed to increased light absorption and defect–mediated transitions. The electrical resistivity reduced from 2.62×10^{-3} Ω–cm (Zn/Ru = 100/0) to 2.05×10^{-3} Ω–cm (Zn/Ru = 92/8). Fig. 1 shows the summarize synthesis process, optical, surface morphology and structural characteristics of ZnO-RuO_2 composite films. These finding suggests that ZnO–RuO_2 composite films might be used for gas sensing, photocatalysis and optoelectronics.

Paper ID: ICSHSD-095

Nanoporous Yttrium Orthoferrite Electrodes for High-Energy Symmetric Aqueous Supercapacitors

Md. Sobuj Hossain, Mohasin Tarek, and M.A. Basit*
Nanotechnology Research Laboratory, Department of Physics, Bangladesh University of Engineering and Technology, Dhaka, 1000, Bangladesh.
*Corresponding Email: hossainsobuj.phy@gmail.com

ABSTRACT

The global transition toward sustainable energy solutions necessitates the development of next-generation electrochemical energy storage systems that combine high energy density, rapid charge-discharge capability, and long operational life. Among various contenders, supercapacitors (SCs) offer significant advantages over traditional lithium-ion batteries, including enhanced safety, faster energy delivery, and superior cycling stability. However, their broader deployment is constrained by limitations in energy density and long-term electrochemical stability. In this study, we address these challenges by designing symmetric SCs based on nanoporous yttrium orthoferrite ($YFeO_3$, or YFO) electrodes and a neutral aqueous Na_2SO_4 electrolyte. YFO was synthesized via a simple sol–gel method, yielding a nanoporous structure with an average pore size of 54 nm. The structural, morphological, and surface chemical properties of YFO were thoroughly characterized using X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM), X-ray photoelectron spectroscopy (XPS), Raman spectroscopy, and zeta potential measurements. The assembled symmetric SC, operating in 0.5 M Na_2SO_4 ,exhibited a broad stable voltage window of 2.4 V and achieved a notable energy density of 43 Wh kg^{-1} at a power density of 1250 W kg^{-1}. Furthermore, it demonstrated excellent cycling performance, retaining 87% of its initial capacitance and over 90% coulombic efficiency after 10,000 cycles. These results underscore the excellent charge storage performance, electrochemical resilience, and structural robustness of YFO. Overall, this work highlights the potential of nanoporous YFO as a promising electrode material for environmentally friendly, scalable, and high-performance energy storage devices, thereby contributing to the advancement of sustainable energy infrastructure.

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Paper ID: ICSHSD-127

Water-Stable $CsSnCl_3$ – MoS_2 Nanocomposites with Dual Functionality in Photocatalytic Degradation and Electrochemical Energy Storage

Tasnim Jahan and M. A. Basith *
Nanotechnology Research Laboratory, Department of Physics, Bangladesh University of Engineering and Technology, Dhaka-1000
*Corresponding email: mabasith@phy.buet.ac.bd

ABSTRACT

The growing demand for sustainable energy storage and wastewater remediation has intensified interest in multifunctional materials capable of addressing both challenges. Metal halide perovskites, with their tunable optoelectronic properties and solution-processable synthesis, are promising for high-performance supercapacitors as well as photocatalysts. Here, we investigate the dual role of cesium tin chloride ($CsSnCl_3$) and its nanocomposites with molybdenum disulfide (MoS_2). $CsSnCl_3$–MoS_2 (CSC-MS) nanocomposites containing 5 and 10 wt% MoS_2 were synthesized by a hot-injection method. Structural and spectroscopic analyses (XRD, FESEM, UV–Vis, PL, TRPL, FTIR, Raman, Zeta, XPS, and Mott–Schottky) confirmed that the composites preserved the intrinsic features of $CsSnCl_3$ while exhibiting enhanced stability and charge transport. Electrochemical tests in 1 M Na_2SO_4 aqueous electrolyte demonstrated that the pristine $CsSnCl_3$ delivered a specific capacitance of ~355 F g^{-1} at 1 A g^{-1}, whereas CSC-MS (90:10) reached 534 F g^{-1} in a three-electrode setup. In a symmetric two-electrode setup, CSC-MS (90:10) achieved 165 F g^{-1} at 1 A g^{-1} compared to 107 F g^{-1} for $CsSnCl_3$. The composite also retained 92% of its capacitance with 85% Coulombic efficiency after 5000 cycles and provided an energy density of 30.3 Wh kg^{-1} at a power density of 1148 W kg^{-1}, significantly outperforming pristine $CsSnCl_3$. For photocatalysis, $CsSnCl_3$ (n-type) coupled with 5wt% of MoS_2 (p-type) to form a heterojunction. Band edge alignment validated efficient electron–hole separation. Photocatalytic tests showed that the $CsSnCl_3$–MoS_2 (95:5) composite degraded ~99% methylene blue and ~88% levofloxacin under solar irradiation, surpassing pristine $CsSnCl_3$. The improved activity is attributed to MoS_2-induced charge separation, increased surface area, and reduced aggregation. These results establish $CsSnCl_3$–MoS_2 as a multifunctional halide perovskite system, combining a high-performance supercapacitor as energy storage with efficient solar-driven photocatalysis.

Paper ID: ICSHSD-132

Study on Okra Fiber Reinforced Polyester Composite

Md Mahbubur Rahman[1], Md Abdullah Kayser[2], Md Mamun-Or-Rashid[1,3], Md Rezaul Karim[1], Susmita Bhattacharjee[1], and Syed Jamal Ahmed[1*]
[1]Department of Physics, Dhaka University of Engineering & Technology, Gazipur 1707, Bangladesh
[2]Textile Physics Division, Bangladesh Jute Research Institute, Dhaka 1207, Bangladesh
[3]Graduate School of Science & Engineering, Saitama University, Saitama 338-8570 Japan
**Corresponding email: jasyed111@duet.ac.bd*

ABSTRACT
Okra (*Abelmoschusesculentu*) fiber (agriculture waste) reinforcement in polymer matrix attracted attention as biodegradable engineering materials replacing Jute fiber because of the fiber constituents, fineness and brightness of Okra which is very similar to jute. Also Thermal stability and decomposition temperatures of Okra fiber are higher than that of Jute fiber. Natural -Polyester composites required lesser processing time than natural fiber-Epoxy. Sodium hydroxide (NaOH) treated natural fiber produce higher tensile strength composites. Therefore, the motivation of the research is to utilize the hydrophilic nature of Okra plant fiber reinforcement with adhesion to Polyester for the possibility of preparing low cost, light-weight, higher thermally stability, mechanical strength water resistant eco-friendly engineering material. At first the Okra fiber is treated with NaOH (1-8wt%) and then composites of the different concentration (wt%) NaOH treated Okra fibers reinforced with Polyester are prepared using hand layup method. The objectives are to understand the Surface morphology, Bundle strength and Chemical compositions of Okra fiber. Also the water absorption capacity, thermal and mechanical properties of its reinforcement with Polyester composite are carried out. Scanning electron microscopy (SEM) shows that after NaOH treatment, okra fiber diameter is decreased as the hydrogen bonds in the cellulose network structure are broken and surface smoothness is increased. Okra fiber treated with 6wt% NaOH exhibited better Bundle strength, 5.94 lbs/mg. Fourier transform infrared (FTIR) spectroscopy analysis of Okra fiber (untreated and NaOH treated) reveals the presence of the functional groups. The water absorption capacity of NaOH treated Okra fiber-Polyester composite is found lower than the untreated ones. Thermo-gravimetric analyses (TGA) show that NaOH treated Okra fiber reinforced Polyester composite exhibits better thermal stability than that of untreated Okra fiber reinforced polyester composite. Composites fabricated from 6wt% NaOH treated Okra fiber have maximum tensile strength (70.59 MPa) and maximum flexural strength (99.96MPa). Okra fiber may be considered to be used instead of Jute fiber.

Paper ID: ICSHSD-208

Effect on Structural and Optical Properties of Manganese Doped Tin Oxide Thin Films Deposited by Spin Coating Method

***Fatema Tuz Zahra1, Bristy Rani Sarker[1], M. Rasaduzzaman[2], M. S. Uddin1, S. J. Ahmed[1], and A. T. M. K. Jamil[1]**
[1]Department of Physics, Dhaka University of Engineering and Technology, Gazipur, Bangladesh
[2]Department of Physics, Mawlana Bhashani Science and Technology University, Tangail, Bangladesh
**Corresponding email:ftzahra522@gmail.com*

ABSTRACT
Metal oxide (MO) thin films have been given significant attention due to their applications in modern electronic technology. A simple, easy, and low-cost homemade spin coating method was employed for the deposition of the films on glass substrates. A 0.2 M SnO_2 solution with varying Mn concentrations (0–15 at%) was prepared using $SnCl_2 \cdot 2H_2O$ and $MnSO_4 \cdot H_2O$ in ethanol. The precursor was stirred at 60 °C for 4 h and aged for 24 h. Films were deposited in three layers, each dried at 150 °C for 10 min, followed by annealing at 300–500 °C for 2 h. The thicknesses of the films were measured by the Newton ring method, and a decrease in thickness was observed with increasing doping concentration. The structural, optical, elemental, and surface morphologies of the films were characterized by X-ray diffraction (XRD), UV-Vis spectroscopy, Energy Dispersive X-ray Spectroscopy (EDX) and Scanning Electron Microscopy (SEM) measurements. The XRD results revealed that all films were tetragonal crystalline in nature with a preferred orientation along the (110) plane. The optical properties of the synthesized films were analyzed, including absorbance (A), transmittance (T), reflectance (R), absorption coefficient (α), refractive index (n), extinction coefficient (k), band gap energy (Eg), Urbach energy (Eu), the real (ε_1) and imaginary (ε_2) parts of the dielectric constant, loss tangent (tan δ), and optical conductivity (σ_{opt}). Absorbance was found to increase, while transmittance decreased with increasing Mn concentration in SnO_2. Direct band gaps (3.92–3.82 eV) and indirect band gaps (3.69–3.46 eV) were measured using the Tauc method. A decrease in band gap was observed with Mn doping, while Urbach energy was found to increase with doping concentration. SEM images of the pure SnO_2 thin film showed a smooth, uniform surface with minor porosity, indicating homogeneous nucleation and high particle density. Grain size was found to decrease with an increase in Mn concentration. EDX results confirmed the presence of Sn and O in all samples, along with a small amount of Mn in the doped films, indicating compositional homogeneit

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Phase Transformation in Poly (Vinylidene Fluoride) Using Porous Silica Fillers for Improved Dielectric Performance

Mst. Rumana Akter, Mst. Momotaz Begam, and Saika Ahmed*
Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
Corresponding email: saika@du.ac.bd

ABSTRACT

Poly(vinylidene fluoride) (PVDF) has emerged as a prominent material in materials science due to its remarkable flexibility, semi-crystalline structure, chemical resistance, and unique pyroelectric, piezoelectric, and dielectric properties, which arise from its electroactive β-phase. The widespread applicability of the electroactive β-phase has motivated research on enhancing the transformation of other crystalline phases into the β-phase. In this study, SBA-16 and MCM-41 mesoporous silica, were employed as a filler, with variations in their content and surface silanol (Si-OH) group concentration, to investigate their effects on the α- to β-phase transformation and the dielectric properties of PVDF. SBA-16 and MCM-41 were synthesized using a non-ionic and ionic surfactant template respectively. Several characterizations were carried out to determine the properties of these materials. The mesoporous structure of the materials was confirmed by N_2 adsorption-desorption analysis, α- to β-phase transformation by XRD analysis, and particle morphology characterized via SEM. The silanol group concentration was determined using FTIR and TGA. Results showed that composites with higher silanol content exhibited enhanced β-phase formation due to improved interactions between the filler and PVDF chains. While the β-phase fraction was higher at lower silica content, composites with increased silica loading demonstrated superior dielectric properties. These findings offer valuable insights into tailoring filler characteristics to optimize the electroactive and dielectric performance of PVDF for advanced applications.

Paper ID: ICSHSD-354

Annealing Temperature-Dependent Structural and Optical Tuning of Cu_2FeSnS_4 Thin Films for Solar Cell Applications

Sumaia Akter[1*], Md. Mamun-Or-Rashid[1,2], A.T.M. K. Jamil,[1] and Syed Jamal Ahmed[1]
[1]Department of Physics, Dhaka University of Engineering & Technology, Gazipur 1707, Bangladesh
[2]Graduate School of Science & Engineering, Saitama University, Saitama 338-8570 Japan
[*]*Corresponding email: sumaiakh8623@gmail.com*

ABSTRACT

Copper-Iron-Tin-Sulfide (CFTS, Cu_2FeSnS_4) thin films emerge as promising absorber materials for low-cost and non-toxic thin-film solar cells due to their elemental abundance, environmental friendliness, and favorable optical properties. Optimizing the physical and optical characteristics of CFTS films is essential to enhance their photovoltaic performance. Annealing temperature serves as a critical parameter that significantly influences the structural, morphological, and optical properties of these films. Therefore, this study systematically investigates the effect of annealing temperature on spin-coated CFTS thin films. CFTS films are prepared on glass substrates using a spin-coating technique at 120 °C and subsequently annealed at four different temperatures: 300 °C, 320 °C, 340 °C, and 360 °C. X-ray diffraction confirms the formation of a kesterite phase in all samples. Higher annealing temperatures improve crystallinity, increase crystallite size (7.86 nm→8.20 nm), and reduce dislocation density and microstrain, indicating enhanced lattice quality. Scanning Electron Microscopy reveals significant grain growth and smoother surfaces, with average grain size increasing from 18.37 nm to 33.52 nm, suggesting improved grain connectivity beneficial for charge transport. Energy Dispersive X-ray analysis confirms the presence of Cu, Fe, Sn, and S, with slight temperature-dependent variations in Fe and S content. UV–Visible spectroscopy shows increased absorbance, decreased transmittance, and a reduction in optical bandgap (2.11 eV→1.86 eV), consistent with enhanced crystallinity and larger grain size. Optical constants, including the refractive index and absorption coefficient, also exhibit favorable changes with annealing temperature. Finally, the film annealed at 360 °C exhibits the most suitable bandgap and morphology, making it a promising candidate for thin-film solar cell absorber layers.

Paper ID: ICSHSD-361

Fabrication and Characterization of Copper Doped Bismuth Oxide Thin Film by Spray Pyrolysis Technique

M. Parves*, A.T. M. K. Jamil, S.J. Ahmed, and M. S. Uddin
[1]Department of physics, Dhaka University of Engineering & Technology, Gazipur 1707, Bangladesh
**Corresponding email: masumparvesduet@gmail.com*

ABSTRACT

Thin films of undoped and copper (Cu) doped Bismuth Oxide (Bi_2O_3) have been deposited on to glass substrate at 300 ^oC by low cost spray pyrolysis technique at an ambient atmosphere. The concentration of Cu was varied from 1 to 4 at. %. The effect of doping on the structural, surface morphological, elemental, and optical properties of these films have been investigated by X-ray diffraction (XRD), Ultraviolet- visible spectroscopy(UV-Vis),Scanning Electron Microscopy(SEM) and Energy Dispersive Analysis of X-ray (EDAX). The XRD study revealed that the films were polycrystalline characterized by four different peaks. While doping an extra peak of Copper Oxide as minority phase was observed. From the optical studies it is observed that the undoped and Cu doped films are highly transparent. The transmittance decreases slightly when copper doping increased. SEM study clearly shows the formation of crystalline nano-belts entangled for undoped and Cu-doped Bi_2O_3 thin films. The EDAX spectrum shows the presence of bismuth, copper and oxygen in the doped samples and the absence of impurities. It is recommended that with further improvement of electrical property the proposed $CuBi_2O_4$-based structure can be used as a potential for thin film solar cells that are both inexpensive and highly efficient.

Paper ID: ICSHSD-365

Investigation on Structure and Magnetic Properties of $Mn_{0.3}Ni_{0.3}Zn_{0.4}La_xFe_{(2-x)}O_4$ Spinel Ferrites

M. M. I. Khan[1*], M. R. Hasan[2], R. Rashid[2], and A. T. M. K. Jamil[1]
[1]Department of Physics, Dhaka University of Engineering & Technology, Gazipur-1707, Bangladesh
[2]Materials Science Division, Atomic Energy Center, Dhaka-1000, Bangladesh
**Corresponding email: manzu2511@gmail.com*

ABSTRACT

Mn-Zn and Ni–Zn ferrites with a spinel structure are widely used in many electronic devices because they offer very high electrical resistivity, low magnetic coercivity, good mechanical hardness, chemical stability, and are reasonably priced. The structural, magnetic and electrical properties of La^{3+} doped Mn-Ni-Zn ferrites with composition of $Mn_{0.3}Ni_{0.3}Zn_{0.4}La_xFe_{(2-x)}O_4$, where x = 0 to 0.1 in steps of 0.02, are studied. The sample were prepared by the conventional solid state method and sintered at temperature of 1150 °C for 4 h. The structural investigation has been carried out by powder X-ray diffraction technique. The XRD patterns revealed the formation of a simple cubic structure, with a minor contribution from a secondary phase. The lattice parameter for all samples was determined using the Nelson–Riley (N–R) function. Lattice constant of the samples have increased with the increasing La contents which follows Vegard's law. An inverse relationship between X-ray density and bulk density was observed. Similarly, bulk density and porosity showed an anti-correlation with varying La^{3+} content. The microstructure of the samples showed that the grain growth rate was greatly changed by doping contents. The microstructure analyses of the compositions it is clear that the grain size decreases. The transmittance spectra of FTIR were measured to characterize the vibration of crystal lattice. The shifting of the bands with doping can be correlated with the corresponding ionic sizes and structural changes induced due to doping of La^{3+} ions. Doping contents have influenced the dielectric constant within the frequency range of 100 Hz to 120 MHz. This high value at lower frequency region might be caused by the Maxwell-Wagner interfacial type polarization. The loss factor increased at the lower frequency and decreased at the higher frequency range. The loss factor is attributed to domain wall resonance. It is noticed that the quality factor increases with the increasing La-contents. The resistivity of all the samples has been observed to be decreased with increasing frequency and then become almost invariant at high frequency. The conduction mechanism in ferrites can be explained on the basis of hopping of charge carriers. High frequency increases the rate of hopping resulting in an increase in the conduction process and thereby a decrease in the resistivity. The magnetic hysteresis loops had also been observed by Physical Properties Measurement System (PPMS) at room temperature. The coercivity (H_c), saturation magnetization (M_s) and Bohr Magneton were calculated for various La^{3+} content. The saturation magnetization for La^{3+} substitution was found to have maximum value for x = 0.04 content and decreased with the substitution of La^{3+}.

Paper ID: ICSHSD-367

Synthesis and Characterization of Manganese Doped Zinc Selenide Thin Films Deposited by Spin Coating Method

***B. R. Sarker[1], F. T. Zahra[1], M. Rasaduzzaman[2], M. S. Uddin[1], S. J. Ahmed[1], and A. T. M. K. Jamil[1]**
[1]Department of Physics, Dhaka University of Engineering and Technology, Gazipur, Bangladesh
[2]Department of physics, Mawlana Bhashani Science and Technology University, Tangail, Bangladesh
**Corresponding email:bristytuli862@gmail.com*

ABSTRACT

Zinc selenide (ZnSe), an II–VI semiconductor with a wide and direct band gap, is an attractive material for optoelectronic and photovoltaic applications due to its high transparency, excellent luminescence efficiency, and chemical stability. In this study, Mn-doped ZnSe thin films with varying concentrations (0–4 wt%) were successfully synthesized onto glass substrate at room temperature using a cost-effective, easy and homemade spin coating technique. The films were deposited in 3 layers, each dried at 150 ºC for 10 min and then thermally annealed at 400 ºC for 3 h to improve their crystallinity. The thicknesses of the films were measured by the Newton ring method, and a decrease in thickness was observed with increasing of Mn doping concentration. X-ray diffraction (XRD) patterns exposed a wurtzite crystal structure with preferred orientation of (111) plane. Energy-dispersive X-ray spectroscopy (EDX) confirmed that Mn was present in the ZnSe matrix, while scanning electron microscopy (SEM) revealed a homogeneous and smooth surface shape, minor porosity indicating homogeneous nucleation and high particle density. Grain size was found to increase with an increase in Mn concentration. The optical studies of the films were carried out by UV-visible spectrophotometry in the wavelength range 300 to 1100 nm. Various optical constants such as transmittance, reflectance, absorbance, absorption coefficient, energy band gap, Urbach energy, refractive index, extinction coefficient, dielectric constants, loss tangent and optical conductivity of the films have been studied. Transmittance was found to decrease, while absorbance was increased with increasing Mn concentration in ZnSe. Direct band gaps (3.89–3.61 eV) were measured using the Tauc method. A decrease in band gap was observed with Mn doping, while Urbach energy (3.43-3.60) was found to increase with doping concentration. These results are encouraging that the Mn-doped ZnSe thin films may find application in optoelectronics devices.

Paper ID: ICSHSD-420

Investigation of the Thermal and Mechanical Properties of Jute Fiber Reinforced with Nano-Clay Polyester Composite

M. A. Kaysar[1,2*], M. M. Habib[2], N. M. Khan[2], M. O. Rashid[1], A. T. M. K. Jamil[1], and S. J. Ahmed [1]
[1]Department of Physics Dhaka University of Engineering & Technology, Gazipur, Bangladesh
[2]Textile Physics Division, Bangladesh Jute Research Institute, Dhaka, Bangladesh
[*]*Corresponding email: mdkaysar1977@gmail.com*

ABSTRACT

This study investigates the effects of 1–3% nano-clay modified polyester composites reinforced with untreated and NaOH-treated Tossa (*Corchorus olitorius*) and White (*Corchorus capsularis*) jute fibers. NaOH treatment changes the fiber structure by reducing hemicellulose and lignin content, exposing cellulose microfibrils, and increasing fiber roughness and reflecting the higher cellulose content 12.45% in Tossa and 12.58% in White jute in chemical compositions. FTIR analysis confirmed the removal of hemicellulose and lignin, while XRD patterns showed improved crystallinity in the treated fibers. The crystallinity of Tossa jute treated with 5% NaOH increased by 13.33%, and White jute by 15.62 %. These changes enhanced the crystalline structure, with White jute showing a greater improvement due to a higher loss of hemicellulose. The treatment resulted in stronger, more durable fibers suitable for composite materials. Tossa jute fibers, both treated and untreated, had higher tensile strength than White jute, with treated fibers showing notable improvements. White jute tensile strength increased by 72.22%, while Tossa jute increased by 58.61% after 5% NaOH treatment. Additionally, the treated fibers showed improvements in fineness, whiteness, breaking twist, and thermal stability. These structural changes led to stronger, more durable fibers suitable for composite materials. Treated Tossa fibers showed a 21.63% increase in tensile strength, while White fibers improved by 9.50% compared to untreated fibers. The addition of 1% nano-clay further boosted tensile strength, increasing it by 34.91% for Tossa and 28.39% for White fibers. Flexural strength increased by 24.28% for treated Tossa fibers and 19.42% for treated White fibers of 1% addition nano-clay. In impact strength, untreated Tossa composites exhibited 44.01 kJ/m², slightly higher than the 42.04 kJ/m² of untreated White composites. Treated Tossa composites with 1% nano-clay achieved an impressive impact strength of 62.85 kJ/m², while treated White composites showed 57.92 kJ/m². Hardness measurements indicated treated Tossa composites reached 98, while White composites reached 97. Water absorption tests revealed that untreated White jute composites had the highest water absorption rate (9.27%), whereas treated Tossa jute with 3% nano-clay showed the lowest absorption rate at 4.87%. Thermogravimetric analysis (TGA) revealed that Tossa jute-reinforced polyester composites, whether treated or untreated, exhibited superior thermal stability compared to White jute composites.

Paper ID: ICSHSD-512

The Effect of Quantum Confinement on Optical Properties of CdSe Nanocrystals at Different Times and Temperatures

Md. Rezaul Karim[1*], Md. Saidur Rahman[1], Md. Raihan Islam[2], Md. Rasadujjaman[3], Md. Sahab Uddin[1], ATM Kaosar Jamil[1], and Syed Jamal Ahmed [1]

[1]Department of Physics, Dhaka University of Engineering & Technology, Gazipur
[2]Department of Physics, Rajshahi University of Engineering & Technology, Rajshahi
[3]Department of Physics, Mawlana Bhashani Science and Technology University, Tangail
[*]*Corresponding email: mrkarim@duet.ac.bd*

ABSTRACT

We investigated the optical properties of CdSe nanocrystals, which were synthesized at different temperatures and times, to study the effect of these isolated crystalline semiconductors. In this work, the synthesis and optical characterization of colloidal CdSe nanocrystals were performed at various temperatures (1700°C and 1750°C). Additionally, we investigated the effects of injection time and temperature effects on isolated CdSe nanocrystals synthesized at different temperatures. The samples were washed three times with MeOH by centrifugation for 5 min. After cleaning the crude solution, the precipitate was diluted in 3 ml hexane. After synthesizing different temperature CdSe nanocrystals, we investigated the dilution effect on the CdSe samples and compared the optical results and energy efficiency. We compared to optical absorption spectrum under these conditions. The UV-vis results show the temporal evolution of the absorption spectra of samples of collodial CdSe nanocrystals grown at different temperatures. During the whole reaction process, the growth of the particles was clearly evidenced by the shift of absorption spectra to longer wavelengths as a consequence of the quantum confinement effect. With the reaction temperature increase, the growth rate of the CdSe nanocrystals increases. Atomic force microscopy (AFM) allows imaging of description of the size and shape of the particles in solutions. At higher reaction temperature, larger particles were obtained.

CHEMISTRY

Invited Papers

Invited -01

Designing Sustainable Materials via Functionalizing Metallic Bismuth Particles for Catalytic and Antimicrobial Applications

Md. Abdur Rahman[1]*, M. A. Jalil Miah[1], Choudhury M. Zakaria[1] and Hasan Ahmad[1]
[1]Research Laboratory of Polymer Colloids and Nanomaterials, Department of Chemistry, Faculty of Science, University of Rajshahi, Rajshahi-6025, Bangladesh
Corresponding author email: arahaman@ru.ac.bd

ABSTRACT

We aim to design and develop some sustainable biomaterials from metallic-bismuth nanoparticles (MBNPs) and some organic compounds for catalytic and antimicrobial applications. MNPs have high surface-energy and agglomeration tendency. That's why these are often functionalized with various scaffolds. Surface functionalization often improves stability, dispersity, and processability for desire applications. Our facile procedure provides colloidally stable, highly dispersible-MNPs for easy-to-use in targeted fields. We have synthesized and stabilized the bare-surface of MBNPs with functionalized polydopamine, silk fibroin, Gallo tannin[2] and Bombyx mori silk. Functionalized particles were characterized using conventional techniques, which were spherical-shaped, dispersible, mesoporous, possessed negative surface, and highly hemocompatible. In a study, functionalized polydopamine coated MBNPs showed core−shell structure used for gentamicin immobilization that showed significant bactericidal activity. In another research, tannic acid functionalized MBNPs effectively degraded azo compounds. The catalytic degradation efficiencies against methylene blue and Congo red were almost 100% within 40 s. In a recent work, we used non-toxic, abundant Gallo tannin for functionalizing MBNPs. Gallo tannin protected MBNPs from oxidation. Drug-loaded composites showed fine control to inhibit bacterial and a fungus, *Rhizoctonia solani* growths. In another approach, Rajshahi raw silk modified MBNPs were fabricated and applied as a catalyst for degradation of nitro-compounds. These approaches have been introduced economic, nontoxic, easy-to-use, relatively biocompatible bismuth particles as a replacement of precise metals like Pt, Au, Ag, and toxic Pd, Pb for developing sustainable materials. Therefore, functionalized bismuth particles can be applied as a sustainable biomaterial in catalysis, free radical scavenging, antimicrobial agent carrier in nanobiomedicine.

Invited -02

Thin Film-Based Surfaces to Study Different Electrochemical Reactions

Mohammad A. Hasnat [a], *, Md. Fahmidul Islam [a], Mohammad Imran Hossain, Md. Saiful Alam
[a] Electrochemistry & Catalysis Research Laboratory (ECRL), Department of Chemistry, School of Physical Sciences, Shahjalal University of Science and Technology, Sylhet-3100, Bangladesh
*Corresponding author email: mah–che@sust.edu

ABSTRACT

This is the compilation of research works that emphasises on the development of thin film-based electro-catalysts to study electro-oxidation of various species e.g., ethanol, hydrogen peroxide, catechol, and paracetamol. The brief overview of each investigation is separately given below. Pt is widely acknowledged as an excellent catalyst to perform electrochemical oxidation of ethanol. But its activity often decreases over time due to irreversible adsorption of intermediate species, mainly, carbon monoxide (CO). To get rid of CO poisoning, a simple catalyst, IrO_x-Pt (iridium oxide film deposited on platinum electrode), was developed via cycling from 0 V to +1 V vs. Ag/AgCl (sat. KCl) in $Ir_2O_3.xH_2O$ colloidal suspension for 10 incessant cycles at scan rate of 0.1 V s^{-1}. Cyclic voltammetric analysis revealed that the activity of pure Pt catalyst in ethanol oxidation reaction (EtOR) was around 1.3 times higher than that on IrO_x-Pt but the CO-tolerant ability of Pt catalyst was around 3.5 times less than IrO_x-Pt. The stability test of Pt electrode also revealed that the activity of Pt electrode drastically decreased within 3 consecutive cycles. In case of IrO_x-Pt, the stability test revealed that the current density related to EtOR remained almost unchanged upon 500 incessant cycling, whereas almost 50% activity of Pt electrode dropped upon similar experimental condition. Nickel (Ni)-based catalysts are extensively used to perform electro-oxidation of H_2O_2. But Ni particles or glassy carbon electrode modified with Ni (GCE/Ni) loss their activities after a single cyclic voltammetric (CV) run. Consequently, frequent cleaning actions are required to re-activate the electrodes, which causes troubles and sometimes inconsistent results are obtained during the oxidation of H_2O_2. To improve the problem, Nafion polymer was incorporated onto GCE surface prior to electrodeposition of Ni particles. The voltammetric analysis revealed that the performance was improved tremendously due to nafion incorporation. Utilizing the as developed catalyst, the detailed oxidative pathway of H_2O_2 on GCE/Nafion/Ni was probed by analysing mass transfer dependent cyclic voltammograms in static condition and hydrodynamic linear sweep voltammetry. The total number of electrons transferred was found to be two which was calculated by analysing the hydrodynamic voltammograms. The first electron transfer step determines the overall reaction rate with $k° = 2.71 \times 10^{-4}$ cm s^{-1} and $E^o = -0.078$ V

Invited -03

Microplastic Contamination and Ecological Risk in River Water and Sediment: Evidence from the Karnaphuli River, Bangladesh

Md. Shoffikul Islam[1*], Mumtahina Jui[1], Md. Sagor Miah[1], Farzana Ahmed Rumi[1]
Department of Soil Science, University of Chittagong, Chattogram-4331, Bangladesh
[*]Corresponding email: mislam@cu.ac.bd

ABSTRACT

Microplastic (MP) contamination has emerged as a significant ecological issue in aquatic ecosystems, but the studies of this pollutant in the urban rivers of Bangladesh are rare. In this paper, it was aimed to investigate the abundance, characteristics, and ecological risks posed by MPs in the surface water and bottom sediment of the Karnaphuli River, an important type of urban estuary in Chattogram, Bangladesh. Moreover, the spatial-temporal distribution of MPs and its ecological risk along sections of a typical river with different zones and seasons was also explored. Sampling was conducted in 24 sites from both sides of the river (right and left) at the late monsoon, winter, and early summer periods during 2023 and 2024. MPs were separated from the wet peroxide oxidation and density separation, visualized via stereomicroscopy, and chemically characterized via FT-IR spectroscopy. Concentrations of MPs covered in water and sediment were 14.24-26.68 items m^{-3} and 75.63-272.45 items kg^{-1}, respectively, with higher values obtained in the downstream section. MPs concentrations were relatively higher in water in the late monsoon and in sediments in winter. The smallest particles (0.3–0.5 mm) were most frequent, fibers and fragments were the most common shapes, and black and blue were the most prevalent colors. Polymer analysis showed the occurrence of PET, HDPE, ABS, CA, EVA, PS, and PA, indicating different anthropogenic sources such as packaging, textiles, fishing activities, and industrial effluent. A satisfactory correlation between MPs in water and sediment (R^2 = 0.893) was found, indicating the transport and deposition process were in satisfactory agreement. Risk assessment of the ecosystem employing contamination factor (CF) and pollution load index (PLI) categorized the river into Category I, which denotes high ecological risk, but not catastrophic. The results conclude that industrial effluents, urban sewage, and improper disposal of plastic waste sources are the major causes of MP contamination in this river system, with elevated risks of bioaccumulation and transfer through the food web. In summary, the present study reports the moderate levels of MP contamination in the Karnaphuli River and thereby highlights the urgency to better regulate single-use plastic materials, improve the plastic recycling infrastructure, and implement sustainable waste-to-energy practices to manage potential ecological and human health-related hazards associated with MPs in aquatic ecosystems of Bangladesh.

Invited -04

The Looming Challenge of End-of-Life Photovoltaic Waste in Bangladesh: Pathways to Sustainable Management

Abdun Naqib Jimmy[1], Md. Abu Rahath[2,] Rysul Hasan Hredoy[2], Nuzhat Fatima Purnota[3], Asadullah Al Ghalib[4], Md. Mostafizur Rahman[1,3,5]*,
[1]Laboratory of Environmental Health and Ecotoxicology, Department of Environmental Sciences, Jahangirnagar University, Dhaka-1342, Bangladesh
[2]Department of Environmental Science, Bangladesh University of Professionals, Dhaka-1216, Bangladesh
[3]Department of Environmental Science and Management, Independent University Bangladesh, Dhaka-1229, Bangladesh
[4] Department of Law, Dhaka International University, Satarkul, Badda, Dhaka-1212, Bangladesh.
[5] Department of Environmental Sciences, Jahangirnagar University, Dhaka-1342, Bangladesh
*Corresponding author: rahmanmm@juniv.edu

ABSTRACT

The capacity and number of the photovoltaic module have exponentially grown since its first introduction in Bangladesh. Currently, this sector generates over 1265 MW of energy country-wide. However, the useful lifetime of PV materials is about 20 years and the issue has emerged that several photovoltaic modules will be discarded as waste once they cross their operative time. This study quantifies PV waste generation (2025–2050) using Material Flow Analysis (MFA) and evaluates recycling feasibility via cost-benefit analysis (CBA). Forecasting with the machine learning model (RMSE: 55.56 MW, R^2: 0.68), study projected 219,188 tons of cumulative PV waste by 2050, including 162,550 tons of glass, 22,576 tons of aluminum, 7342 tons of silicon and 1,249 tons of copper. Based on this finding, this study puts forward a convincing foundation to the importance of recovering valuable resources to tap into the economic opportunity through Material Flow Accounting perspective. The cost-benefit analysis demonstrates that while PV waste recycling in Bangladesh requires significant initial investment leading to negative net present values in early years (2025-2043), the long-term economic potential is substantial, with benefits surpassing costs from 2044 onward and reaching 9.5 million by 2050 with Benefit Cost Ratio of 1.5. As a result, it will create a Circular Flow for photovoltaic waste, promoting resource decoupling and catapulting the paradigm shift from a linear economy to a circular economy.

Invited -05

Development of Efficient Photocatalysts for Removal of a Dye from Aqueous Solution

Md. Mufazzal Hossain
Department of Chemistry, University of Dhaka, Dhaka 1000
*Corresponding email: mufazzal@du.ac.bd

ABSTRACT

In many countries, like Bangladesh, textile dying and knitting industries contributes major environmental contaminants in the aqueous bodies. The discharge of this dye-contaminated wastewater poses a serious threat to aquatic ecosystems and human health. Photocatalytic degradation has emerged as an efficient and eco-friendly approach for the removal of these dyes from aqueous solutions. Light irradiated degradation involving advanced oxidation process (AOP) is a widely used technique for removal of these pollutants. Researchers in this field have their goals, firstly to use efficient photocatalysts and secondly to enhance their effectiveness under solar light. This study focuses on the development of highly efficient photocatalysts capable of degrading common organic dyes under visible light irradiation. Accordingly, different types of photocatalysts were synthesized through a sol-gel method and characterized using XRD, SEM, UV–Vis spectroscopy, and FTIR to determine their structural, morphological, and optical properties.

Among the semiconductor photocatalysts employed, TiO_2 and ZnO are widely accepted as the most efficient catalysts in the presence of artificial UV light because it has the band gap ~3.2 eV corresponds to 380 nm. However, two main drawbacks of applying this oxide are the need of using UV light as excitation source and the relatively high electron-hole recombination rate. To overcome these problems, various methods have been explored, such as doping of metals and non-metals onto TiO_2, ZnO and coupling of two or more semiconducting oxides. Since the band gap of the oxide falls in the region of UV light, doping of either metal or nonmetal and coupling of two oxides may introduce some extra energy levels for excitation of electrons into these levels by visible light. This may cause the materials to be effective in the presence of most abundant solar light. In this study the photocatalytic performance of some prepared photocatalysts was evaluated by monitoring the degradation of a most common dye, methylene blue under controlled conditions. Results revealed that the optimized catalyst exhibited enhanced light absorption, increased surface area, and improved charge separation efficiency, leading to superior photocatalytic activity compared to conventional TiO_2 or ZnO. This work highlights the potential of nanostructured photocatalysts as a sustainable and cost-effective solution for wastewater treatment and provides insights into designing advanced materials for environmental remediation applications.

Invited -06

Salinity-Induced Controls on Iron and Phosphorus Cycling in Coastal Soils of Bangladesh

Md Abdus Sabur
Department of Chemistry, Jahangirnagar University, Dhaka-1342, Bangladesh
*Corresponding email: sabur@juniv.edu

ABSTRACT

Coastal Bangladesh represents one of the world's most dynamic deltaic environments, where salinity intrusion driven by sea-level rise and changing hydrology is reshaping soil biogeochemistry. Iron (Fe) and phosphorus (P) play pivotal roles in nutrient cycling and soil fertility, yet their interactions under saline conditions remain poorly understood. This study integrates field observations, laboratory experiments, and national soil data to unravel the cycling of Fe and P across coastal agroecosystems. Soils collected from different salinity zones were analyzed for electrical conductivity and pH, alongside phosphate adsorption and extraction experiments. Results indicate that increasing salinity decreases phosphate bioavailability through immobilization with divalent cations, consistent with field observations and data from the Soil Resources Development Institute (SRDI). Complementary soil incubation experiments under anoxic–oxic transitions demonstrate that while elevated salinity enhances the reactivity of Fe minerals, it simultaneously suppresses Fe solubility through complexation and precipitation with saline chemical constituents, in agreement with patterns observed in the SRDI database. Collectively, these findings indicate that saline conditions immobilize both Fe and P, reducing their bioavailability and, consequently, constraining nutrient supply and crop productivity in the coastal agricultural soils of Bangladesh.

Invited -07

Exploring the Potential of Cathode Materials in Aqueous Zinc-Ion Battery Technology

Muhammad Abu Yousuf* and Nusrat Tazeen Tonu
Department of Chemistry, Khulna University of Engineering & Technology, Khulna-9203, Bangladesh
*Corresponding email: yousuf@chem.kuet.ac.bd

ABSTRACT

Aqueous rechargeable zinc-ion batteries (ARZIBs) are emerging as a promising alternative to lithium-ion batteries due to their safety, low cost, and environmental friendliness. Central to the performance of ARZIBs is the cathode material, which plays a crucial role in determining the battery's capacity, cycling stability, and overall efficiency. Recent research has focused on various classes of cathode materials, including transition metal oxides, phosphates, and organic compounds, each offering unique advantages and challenges. Transition metal oxides, such as manganese dioxide and vanadium oxide, demonstrate high capacity but often suffer from structural instability during charge-discharge cycles. In contrast, phosphates provide better cycle life but may have lower energy density. Organic materials, while still in the experimental stage, offer potential for tunable properties and sustainability. Innovative strategies, such as the development of nanostructured materials by tuning the synthesis procedure, are being explored to enhance the electrochemical performance and structural integrity of cathodes. Furthermore, the optimization of cathode materials purity, and uniformity in distribution significantly impacts the overall performance of ARZIBs. In our laboratory, several methods have already been adopted for the development of Mn-based nanomaterials as cathode for ARZIBs. Among them ultrasonic assisted reverse micelle route was adopted for the preparation of bixbyite microdice. As cathode material of ARZIB, it showed 252.10 mAhg-1 specific discharge capacity at 0.3 Ag-1 current density with efficiency 98.44%, and retention 90.35% after 1000 cycles of charging-discharging. This advancement of cathode materials is suitable for the commercialization of ARZIBs, paving the way for more sustainable energy storage solutions.

Invited -08

4th Generation Biomaterials for Enhanced Biomedical Applications

Dr. Samina Ahmed*, Md. Sahadat Hossain, Mashrafi Bin, Mubarak
Institute of Glass & Ceramic Research and Testing (IGCRT), Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka-1205, Bangladesh
*Corresponding email: shanta_samina@yahoo.com

ABSTRACT

Biomaterials like hydroxyapatite (HA), β-tricalcium phosphate (β-TCP), plaster of Paris (calcium sulfate), cellulose, and chitosan can be synthesized for biomedical uses, with HA being a widely used bio-ceramic in orthopedic and dental applications. HA's low mechanical strength for load-bearing applications can be improved by forming composites with polymers, which are then characterized using tests like tensile strength (TS) and bending strength (BS), while Fourier Transform Infrared (FTIR) and Scanning Electron Microscopy (SEM) provide structural insights. HA can also be modified by gamma radiation or metal doping to improve its antimicrobial properties without compromising its biocompatibility. Hydroxyapatite's poor mechanical strength for orthopedic applications was improved by creating composites with thermoset polymers, enhancing properties like tensile strength and bending modulus. The study found that binder addition to these HA composites boosted mechanical properties, while mechanical properties were only slightly affected by due to the variation of temperature. However, the composites showed good resistance to degradation in simulated body fluid (SBF) and at various pH levels. Characterization with FTIR, SEM, and TGA confirmed the structural, morphological, and thermal properties of these improved composites.

Invited -09

Adsorption of PPCPs acid over MOFs and functionalized MOFs

Zubair Hasan[1,*]
[1]Department of Mathematical and Physical Sciences, East West University, Dhaka-1229, Bangladesh
**Corresponding email: zhasan@ewubd.com*

ABSTRACT
The presence of pharmaceuticals and personal care products (PPCPs) in water bodies poses a significant environmental threat. This study demonstrates the superior performance of a chemically engineered metal-organic framework (MOF) for the adsorptive removal of two common PPCPs: naproxen and clofibric acid. The benchmark adsorbent MIL-101 was post-synthetically modified with ethylenediamine (ED) and amino-methanesulfonic acid (AMSA) to introduce basic ($–NH_2$) and acidic ($–SO_3H$) functionalities, respectively. While functionalization reduced material porosity, it critically enhanced adsorption specificity. ED-MIL-101 emerged as the most effective adsorbent, exhibiting adsorption capacities 1.17 and 1.10 times higher than virgin MIL-101 for naproxen and clofibric acid, respectively. Kinetic and isotherm studies confirmed a rapid uptake process, characterized by pseudo-second-order kinetics, which are governed by favorable acid-base interactions. This mechanism was further validated by pH-dependent adsorption, which showed maximal efficiency at pH ~4. Crucially, ED-MIL-101 demonstrated excellent reusability over multiple cycles using a simple ethanol wash, highlighting its potential as a sustainable and high-performance material for real-world water treatment applications.

Invited -10

Green Synthesis of CuO Nanoparticles from Aqueous Extract of *Spondias Mombin* Leaves

Ishrat Jahan[1], Md. Tanvir Hossain[1], Md. Abdus Samad Azad[1], and Muhammed Yusuf Miah[1,*]
[1]Department of Applied Chemistry and Chemical Engineering, Noakhali Science and Technology University, Noakhali-3814, Bangladesh
**Corresponding email: mymacce@nstu.edu.bd*

ABSTRACT
Copper oxide nanoparticles were successfully prepared using Green synthesis route with *Spondias Mombin* leaf extract as an excellent reducing agent. Prepared nanoparticles were characterized followed by FTIR Spectroscopy, UV-Vis Spectroscopy and Scanning electron microscopy. UV absorption peaks were found at 235 nm, and 240 nm respectively for the as synthesized and calcined CuO NPs. The peaks were obtained for as synthesized NPs at 655cm^{-1} and 674cm^{-1} by FTIR spectroscopy and The calcined NPs shows the peaks at 704 cm^{-1}, 682 cm^{-1}, 653 cm^{-1}. SEM images shows irregular spherical shape of CuO NPs and their size ranges between 30-60nm after calcination.

Invited -11

Carbohydrates - the Essential Molecules of Life and in Medicinal Chemistry

S. M. Abe Kawsar[1, *]
[1]Lab of Carbohydrate and Nucleoside Chemistry (LCNC), Department of Chemistry, University of Chittagong, Chittagong-4331, Bangladesh
**Corresponding email: akawsarabe@yahoo.com and akawsar@cu.ac.bd*

ABSTRACT

Carbohydrates are vital molecules for all life forms, serving as a primary energy sources, structural components, and key elements in biological processes. Carbohydrates are naturally broken down in the body to produce energy for various biological activities. Therefore, carbohydrate research has drawn the attention of scientists due to its extensive value in biomedical fields, including fungal, bacterial and viral infections in medicinal chemistry. Carbohydrate derivatives are significant in medicinal chemistry because of their efficacy in the synthesis of biologically active drugs. Here, monosaccharide molecules were treated with a series of acyl halides *via* the direct acylation method. The chemical structures of the newly synthesized compounds were ascertained by analyzing their physicochemical, elemental, and spectroscopic data. *In vitro,* the antimicrobial properties and predicted activity spectra of these substances revealed that these monosaccharide derivatives have promising antifungal functionality compared with their antibacterial activities. The 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay revealed low antiproliferative activity against Ehrlich ascites carcinoma (EAC) cells. The density functional theory (DFT) method was employed, and it was found that all the esters were more thermodynamically stable. Molecular docking was performed to determine the binding affinities and interactions between the monosaccharide derivatives and the targeted proteins. The molecular dynamics simulation validates the molecular docking results. The pharmacokinetic study demonstrated that these monosaccharide derivatives appear to be safer inhibitors, and a combination of in silicoabsorption, distribution, metabolism, excretion, and toxicity (ADMET) prediction and drug-likeness had promising results due to their improved kinetic properties. A structure–activityrelationshipstudy revealed that the few acyl chains in combination with sugar had the greatest potential activity against pathogens. Overall, the results of the present study should be of great help in the development of carbohydrate-based, novel, multiple drug-resistant antimicrobial(s) and therapeutic drugs in medicinal chemistry.

Invited -12

Microplastic Pollution in Coastal Ecosystems and Food Sources of South Asia: Environmental and Human Health Implications

Tasrina Rabia Choudhury[1, *], and M. Belal Hossain[2]

[1]Analytical Chemistry Laboratory, Chemistry Division, Atomic Energy Centre Dhaka, Bangladesh, Atomic Energy Commission, Dhaka-1207, Bangladesh

[2]Department of Fisheries and Marine Science, Noakhali Science and Technology University, Noakhali-3814, Bangladesh

**Corresponding Email: tasrina.rabia@gmail.com*

ABSTRACT

Microplastics (MPs) have emerged as pervasive contaminants in aquatic environments, raising global concerns due to their persistence, ecological impacts, and potential threats to human health. Although extensive studies have documented MPs in coastal regions of developed nations, data from South Asia remain scarce despite the region's vulnerability to environmental pollution. Our recent research provides the first comprehensive assessment of microplastic contamination in estuarine and coastal ecosystems of Bangladesh, as well as in commonly consumed sea salts—an essential dietary commodity. Sediment samples collected from 30 stations along the Karnaphuli River estuary and 24 stations at Kuakata sea beach revealed widespread microplastic pollution. Concentrations ranged from 22.29 to 59.5 items kg^{-1} in the estuarine sediments and 232 to 284 items kg^{-1} in beach sediments. Predominant particle types in the estuary included films, white-colored, and 1–5 mm sized MPs, whereas colored particles dominated the beach samples. Polymer identification using FTIR confirmed the presence of polyethylene terephthalate (PET), polystyrene (PS), polyethylene (PE), cellulose, and nylon. Pollution Load Index (PLI) values greater than one across all sites indicated considerable contamination levels. Sea salt samples from 15 salt pans were also analyzed to trace potential human exposure pathways. Unprocessed salts exhibited higher MP abundance (195 ± 56 items kg^{-1}) than processed salts (157 ± 34 items kg^{-1}), with concentrations exceeding reported values from several other countries by two- to threefold. Fibrous and transparent MPs were dominant, with PET, polypropylene (PP), PE, PS, and nylon identified as the major polymer types. Risk assessment revealed moderate to serious ecological and human health implications associated with this contamination. Overall, our findings highlight that microplastics not only threaten Bangladesh's coastal ecosystems but also enter the human food chain via sea salts, raising pressing concerns for environmental sustainability and food safety. This pioneering research underscores the urgent need for integrated policy frameworks, effective waste management systems, and sustainable production practices to mitigate microplastic pollution across South Asia's coastal environments.

Invited -13

Synthesis of Pyrimidine Derivatives: Biological Study and Molecular Docking

Md. Monarul Islam[1, *], RabeyaAkter[1], and Abhijit Chowdhury[2]

[1]Synthesis Laboratory, Chemical Research Division, BCSIR Dhaka Laboratories, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka-1205, Bangladesh

[2]Industrial Microbiology Section, Institute of Food Science and Technology (IFST), Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka-1205, Bangladesh

**Corresponding email: mmipavel@yahoo.com*

ABSTRACT

The synthesis of heterocyclic compounds is of great significance in organic chemistry due to their broad range of biological activities and crucial role in medicinal chemistry. Among them, pyrimidine derivatives, which are nitrogen-containing heterocycles, exhibit noteworthy pharmacological properties and have inspired extensive synthetic research. A promising approach for synthesizing pyrimidines involves the cyclization of chalcones, a class of α,β-unsaturated carbonyl compounds. Chalcones serve as efficient starting materials, offering a practical route for constructing diverse pyrimidine derivatives. The versatility of this strategy allows for significant structural variation and functional group modification, enabling the development of novel bioactive compounds. The synthesized pyrimidines are thoroughly characterized using analytical techniques such as FTIR, UV-Vis, NMR**,** and mass spectrometry to confirm their structures. Moreover, density functional theory (DFT) calculations are employed to optimize molecular geometry, while molecular docking simulations assess binding interactions, particularly for evaluating antimicrobial potential. These studies also support structure-activity relationship (SAR) analysis, facilitating the rational design of targeted pyrimidine-based therapeutic agents. This study highlights the drug-like potential application of pyrimidine derivatives in the development of innovative pharmaceutical compounds.

Invited -14

Synthesis, Biological Evaluation, in Silico Admet Prediction, Molecular Docking and Dynamics Studies of 4-Phenoxyphenyl-Thiazole-Schiff Base Derivatives

Md. Aminul Haque[1,*], and Mohammad Mostafizur Rahman[1]
[1]Department of Chemistry, Jagannath University, Dhaka-1100, Bangladesh
*****Corresponding author: amin2k12@chem.jnu.ac.bd

ABSTRACT

A series of novel thiazole-Schiff base analogs **(2a-2i)** was synthesized through a multicomponent reaction involving thiosemicarbazide, 4-phenoxybenzaldehyde, and α-haloketone/phenacyl bromide derivatives. IR, ^{1}H NMR, and HRMS spectroscopic techniques were used to characterize the newly synthesized derivatives. These compounds were subsequently employed for their antimicrobial and antioxidant activities using agar disc diffusion and DPPH free radical scavenging methods. The multifaceted activity of compound **2c** was revealed in both *in vitro* experiments. It exhibited the highest potency against *Bacillus subtilis* (26.0 ± 1.0 mm) and *Aspergillus niger* (22.3 ± 0.6 mm), which exceeded the inhibitory value of standard ceftriaxone (20.7 ± 0.6 mm) and amphotericin B (8.7 ± 0.6 mm), respectively. Additionally, **2c** demonstrated a remarkable sevenfold increase in antioxidant capability (IC_{50} = 7.17 ± 2.61 µg/mL) compared to the standard ascorbic acid (IC_{50} = 49.69 ± 19.18 µg/mL). The *in silico* ADMET prediction demonstrated that most synthesized compounds adhered to Lipinski's rule of five and Veber's rule, with **2i** being the exception, with one violation. Molecular docking studies and dynamics simulation were conducted to explore potential binding sites, interactions, and stability of the ligand-protein complexes, providing insights aligned with the *in vitro* results.

Invited -15

Shaping Factors on Catalysis: Bridging Chemistry and Chemical Engineering

Md. Shahajahan Kutubi
Affiliation Chemical Systems Engineering, Graduate School of Engineering, Nagoya University, Japan
*****Corresponding author: *kutubi.shahajahan@material.nagoya-u.ac.jp

ABSTRACT

Materials and chemical synthesis in a sustainable methodology are of great essence in the world, because global developments are based on sustainable materials, which focus on the minimization of the issues of carbon emission, hazardous chemical synthetic processes, industrial waste, economic unsustainability for high production costs, etc. Additionally, catalysis plays a pivotal role in the development of a sustainable chemical synthetic process, and therefore, the catalytic system development is one of the most important types of scientific and engineering research. For the development of different catalytic systems in chemical reaction engineering, the researchers were awarded the Nobel Prize in chemistry in 2021, 2011, 1989, 1963, and 1901 for asymmetric organo-catalysis; metal/Pd-catalysis; catalysis by RNA in biological reactions; catalysis for polymer synthesis; and catalytic principles of equilibria/kinetics. Based on literature, the insights of catalysis explore many factors that influence surface characteristics of catalytic sites, the catalytic activity, product selectivity, mass transfer, diffusion of reactants and products, kinetics and equilibrium poisoning of catalytic systems, deactivation, leaching, sintering, etc. In the conceptual study on bridging chemistry and chemical engineering, the science of chemistry emphasizes the design of catalytic systems in molecular versions based on these factors, while chemical engineering reveals the solutions to scale-up issues: mass transfer, material diffusion, heat diffusion, etc. during industrial implementation. This presentation reveals the process of advanced catalyst design for homogeneous and heterogeneous reactions by inhibition of leaching and sintering, accelerating the rates, and, in the industrial implementation, decreasing industrial waste by 80-85% and making solutions in mass-transfer/diffusion.

Contributed Papers

Organic, Food, Agro and Biochemistry

Paper ID: ICSHSD-57

Nature's Protective Agents: A Comparative Analysis of Antioxidant Activity in Diverse Algae

Rajia Sultana[1,*], and Fariha Farzana[1]
[1]Department of Environmental Science and Technology, Jashore University of Science and Technology-7408, Jashore, Bangladesh
**Corresponding email: f.farzana@just.edu.bd*

ABSTRACT
Algae are a broad category of photosynthetic organisms with substantial ecological and economic significance. Categorized into macroalgae (seaweeds) and microalgae, algae are rich in bioactive substances such as proteins, carbohydrates, total phenolic content, and total flavonoid content, and antioxidants such as DPPH (2,2-diphenyl-1-picrylhydrazyl), reducing power assay, which makes them useful for industrial, medicinal, and nutraceutical uses. Their important ecological functions include producing oxygen and acting as the foundation of aquatic food systems. The study aims to assess the antioxidant capacity of six different species of macro algae (Oedogonium, Cladophora, Chara, Spirogyra, Pithophora, and Rhizoclonium, Spirogyra mix) to identify those with high antioxidant activity and investigate their possible commercial benefits. Utilizing a variety of tests for this study, they are: Total phenolic content (High Phenolic Producers: Pithophora and Oedogonium, Low Phenolic Producers: Chara and Cladophora). Total Flavonoid content (High Flavonoid Producers: Chara, Oedogonium, Spirogyra, and Low Producer: Cladophora). DPPH (High Antioxidant Capacity: Spirogyra and Rhizoclonium, Low Antioxidant Capacity: Cladophora). Reducing Power Assay (High Reducing Power: Chara, Pithophora) and Antimicrobial Activity. The goal of the study is to lay the groundwork for further research on algal antioxidants, even with constraints such as assay variability and environmental effects on antioxidant synthesis.

Paper ID: ICSHSD-100

Evaluation of Heavy Metal Pollution in Nga-Pi, A Common Indigenous Food Ingredient Gathered from Various Sites in Cox's Bazar

Md. YeasinArafat[1], Md. Anisuzzaman[1], and Nahid Sultana[1,*]
[1]Department of Fisheries and Marine Science, Noakhali Science and Technology University, Noakhali-3814, Bangladesh
**Corresponding email: nahid.fims@nstu.edu.bd*

ABSTRACT
Nga-pi is a semi-fermented fish product, with the major ingredient usually being shrimp (around 95%) & trash fish, which is a very familiar foodstuff among the indigenous community. However, because of their toxicity, the possible poisoning of such traditional foods with heavy metals presents major health hazards. This study aimed to assess the level of Lead (Pb), Cadmium (Cd), Chromium (Cr), Manganese (Mn), Mercury (Hg) & Zinc (Zn) in Nga-pi in the Cox's Bazar district. The Chowfaldandi and Moheskhali sites were used to gather samples. Atomic Absorption Spectroscopy (AAS) was used to determine metal concentrations at the Noakhali Science and Technology University (NSTU). The measured levels were contrasted with WHO-permitted limits, where all tested metals except Pb were within safety limits. The concentration of Pb was at 19.56 ± 2.52 mg/kg in the Chowfaldandi and 17.47 ± 4.12mg/kg in the Moheskhali. Other heavy metals: Cd, Cr, Hg, Mn, and Zn were found in tolerable concentrations, such as Cd at 0.081 ± 0.009 mg/kg in Chowfaldandi and 0.0791 ± 0.023 mg/kg in Moheskhali. Pb concentrations were greater in Chowfaldandi than in Moheskhali. Nga-pi's high Pb contents underscore the urgent need for focused actions to lower consumer exposure risks, especially in the Chowfaldandi area. The causes of pollution should be investigated in future studies, and mitigating techniques should be developed. Protecting public health and guaranteeing the long-term safety of traditional fish products in coastal regions will require the implementation of routine heavy metal screening and the enforcement of regulatory norms.

Paper ID: ICSHSD-102

Biocompatible Ionic Liquid-Based Microemulsion for Transdermal Delivery of Celecoxib

Md. Korban Ali[1]

[1]Department of Chemistry, Jashore University of Science and Technology, Jashore-7408, Bangladesh
**Corresponding email: mk.liton@just.edu.bd*

ABSTRACT

Celecoxib (CLX), a cyclooxygenase-2 (COX-2) inhibitor, is a type of nonsteroidal anti-inflammatory drug (NSAID) commonly used to treat severe musculoskeletal and joint-related pain. While effective for such conditions, oral administration of CLX may increase the risk of adverse cardiovascular events, such as myocardial infarction, as well as kidney-related issues, including impaired renal function and reduced blood flow to the kidneys. To develop an ionic liquid surfactant cholinium oleate (IL[Cho][Ole])-assisted non-aqueous microemulsion (ME) formulation for presenting a promising transdermal drug delivery system of cyclooxygenase-2 agents, such as celecoxib (CLX). The CLX contained microemulsion formulation (MEF) was prepared by a mixture of two surfactants, Span-20 and cholinium oleate (IL[Cho][Ole]), IL [C1mim][$(MeO)_2PO_2$], in isopropyl myristate (IPM). A constant weight ratio of 2:1 was used to make the mixture of IL[Cho][Ole] and Span-20. Then 5mg/mL of CLX weighed accurately and was added in ME for the preparation of CLX loaded ME. The particles size and polydispersity index (PDI) of PTX loaded ME was assessed by dynamic light scattering. The skin of pig was utilized to examine CLX permeation using handcrafted Franz diffusion cells where the receiver phase was prepared with 40% v/v ethanol in PBS. Finally, the quantity of CLX was measured by using accepted HPLC method. The droplet shape, size, size distribution, and polydispersity index of ME was investigated and found well-distributed particle size in 10.3 nm, indicating the formation of spherical micelles and the presence of CLX is into the core of micelles. The interactions between the IL([Cho][Ole]) and CLX, have been investigated by ^{1}H NMR techniques. These techniques reveal the presence of H-bonding and cation-π interactions of CLX with IL[Cho][Ole]. The evaluation of CLX's transdermal delivery by the ME carrier was conducted by means of a comparison with the transdermal delivery performances of the control formulation.When comparing the skin penetration capabilities of CLX in various formulations to those in an IL[Cho][Ole]/Span-20 (2:1)-based ME, there was a noticeable increase during the observation period.This might be explained by the fact that ME has a greater drug solubilizing capacity and permeation enhancement due to the presence of IL[Cho][Ole], which forms H-bonding connections between the drug's electron-donating groups and the positively charged cholinium ([Cho+]) group.Moreover, the formulation was stable for up to 4 months.The results demonstrate that the IL[Cho][Ole]-assisted ME is a promising biocompatible nanocarrier for efficient transdermal drug delivery of CLX.

Paper ID: ICSHSD-104

Synthesis, Characterization, and Antimicrobial Evaluation of Schiff Base Metal Complexes Derived from *O*-Aminophenol and Salicylaldehyde

Afzal Hussain*, Abdullah Wasif, Fatema Tuz Zohora, Rafica Yasmin Sumaiya, and Md. Ershad Halim
Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
**Corresponding email: mdafzalhussain262@gmail.com*

ABSTRACT

Schiff bases are versatile ligands in coordination chemistry due to their ability to form stable complexes with transition metals. This research synthesizes a novel Schiff base ligand derived from salicylaldehyde and *o*-aminophenol. The ligand was then used to prepare a series of binary and ternary metal complexes with Ti(IV), V(V), Cr(III), Cd(II), and Hg(II) salts. These complexes were characterized through UV-Vis, FT-IR, ^{1}H-NMR, ^{13}C-NMR spectroscopy, elemental analysis, and molar conductance, revealing that the ligand behaves as a tridentate donor. The results indicated that all complexes were non-electrolytic, and each metal coordinated with the Schiff base in a 1:1 ratio. The antimicrobial activities of the ligand and its complexes were evaluated using the agar well diffusion method against Gram-positive and Gram-negative bacteria. Among the complexes, Cd(II) and Hg(II) complexes exhibited significant antibacterial activity, particularly against *Salmonella typh*i and *Klebsiella pneumoniae*. Furthermore, computational studies, including DFT calculations and molecular docking, were conducted to optimize the geometries and explore interactions between the complexes and bacterial proteins, supporting the experimental antimicrobial findings.

Paper ID: ICSHSD-112

Synthesis and *In-Silico* Study of 4-Methoxy-N'-(3-Oxo-1,3 Diphenylpropyl)Benzohydrazides

Priyanka Mondol[1], Md Mizanur Rahman Badal[1,*], Md Kabidur Rahman[1], Md Maniruzzaman[1], and Mohammad Abu Yousuf[1]
[1]Department of Chemistry, Khulna University of Engineering & Technology, Khulna-9203, Bangladesh
**Corresponding email: mizan@chem.kuet.ac.bd*

ABSTRACT
Hydrazides are a versatile class of compounds known for their significant biological activities, particularly antimicrobial effects. This study reports the synthesis of a novel derivative, 4-methoxy-N'-(3-oxo-1,3-diphenylpropyl)benzohydrazide, via a two-step process involving Claisen–Schmidt condensation to form chalcones, followed by aza-Michael addition with 4-methoxybenzohydrazide. The synthesized compound was characterized using UV-Vis, FTIR, and NMR spectroscopy, along with elemental analysis. To complement the experimental findings, Density Functional Theory (DFT) were performed to evaluate the electronic structure, molecular reactivity, and thermodynamic stability. The compound demonstrated a favorable HOMO-LUMO energy gap and promising global reactivity descriptors, suggesting potential antimicrobial activity.

Paper ID: ICSHSD-113

Synthesis and Computational Study of (Z)-1-(2,4-Dinitrophenyl)-2-(E-1,3-Diphenylallylidene)Hydrazines

Tanni Sikder[1], Md Kabidur Rahman[1], Md Mizanur Rahman Badal[1,*], Md Maniruzzaman[1], and Mohammad Abu Yousuf[1]
[1]Department of Chemistry, Khulna University of Engineering & Technology, Khulna-9203, Bangladesh
**Corresponding email: mizan@chem.kuet.ac.bd*

ABSTRACT
Hydrazides are well-recognized for their broad-spectrum biological activities, especially antimicrobial effects. This study presents the synthesis and characterization of substituted (Z)-1-(2,4-dinitrophenyl)-2-(E-1,3-diphenylallylidene)hydrazines via a two-step protocol: initial chalcone formation followed by Schiff-base condensation with 2,4-dinitrophenylhydrazine. The resulting compounds were characterized using UV-Vis, FTIR, and NMR spectroscopy, complemented by elemental analysis to confirm structural integrity. To further explore molecular properties, Density Functional Theory (DFT) calculations were performed, focusing on electronic structure, reactivity parameters, and thermodynamic stability. The combined experimental and computational approach provides a comprehensive understanding of the synthesized hydrazides, offering valuable insights into their structure–activity relationships.

Paper ID: ICSHSD-129

Assessment of Microbiological Quality of Meat and Meat Products of Dhaka City

Mahbuba Khatun[1,*], A. F. M. Mustafizur Rahman[1*], and Md. Latiful Bari[2]
[1]Department of Applied Chemistry and Chemical Engineering, University of Dhaka, Dhaka-1000, Bangladesh
[2]Food Nutrition and Agriculture Research Division, Center for Advanced Research in Sciences (CARS), University of Dhaka, Dhaka-1000, Bangladesh
**Corresponding email: kmahbuba347@gmail.com*

ABSTRACT
Although meat and meat products are essential sources of nutrition, they are susceptible to contamination by pathogenic microorganisms, posing significant risks to public health. This study aimed to evaluate the microbiological quality and safety of commonly consumed meat and meat products sold in various outlets across the Dhaka city. A total of 81 samples, including raw beef (n=15), raw poultry (n=30), processed beef burger (n=12), processed chicken nugget (n=12), and processed chicken meatball (n=12) were collected aseptically from different shops of Dhaka. Following standard biochemical methods, the samples were analyzed for key microbiological indicators, such as- total viable count, total fungal count and using different pathogenic gram-negative bacteria. The experimental results revealed that the microorganism content of some meat samples exceeded the acceptable limits set by international food safety guidelines (e.g., ICMSF), while some others were within satisfactory level. Furthermore, all these pathogenic microorganisms were found to be resistant to at least 8 to 10 antibiotics (Nalidixic Acid, Gentamycin, Ceftazidime, Amoxicillin, Nitrofurantoin, Meropenem, Colistin, and Cefepime). The high prevalence of pathogenic bacteria indicates lack of proper hygiene practices throughout the meat supply chain, from slaughter to point-of-sale.

Paper ID: ICSHSD-175

Synthesis of Pyridine-based Thiosemicarbazone Schiff Bases: Biological Study and Metal Ion Detection

Taslima Akter[1], and Md. Monarul Islam[1,*]
[1]Synthesis Laboratory, Chemical Research Division, BCSIR Dhaka Laboratories, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka-1205, Bangladesh
**Corresponding email: mmipavel@yahoo.com*

ABSTRACT
Pyridine-based thiosemicarbazone Schiff base ligands were synthesized and fully characterized by ^{1}H and ^{13}C NMR, IR, and mass spectrometry. The synthesized ligands exhibited notable solvatochromic behavior in DMSO and $CHCl_3$ and showed strong affinity toward Cu^{2+} and Ag^{+} ions. UV–Vis and fluorescence titration studies revealed pronounced bathochromic shifts, hypochromic effects, and distinct isosbestic points upon metal coordination. Job's plot and Benesi–Hildebrand analysis confirmed the formation of stable 1:2 (Cu^{2+}) and 1:1 (Ag^{+}) complexes. A remarkable fluorescence "turn-on" effect was observed for Ag^{+}, attributed to the inhibition of photoinduced electron transfer (PET). A ratiometric absorbance-based chemodosimeter assay was successfully developed using the synthesized ligands, enabling rapid and sensitive detection of Cu^{2+} and Ag^{+} in real fruit juice samples. Notably, Ag^{+} exhibited superior sensitivity and stronger complexation than Cu^{2}. Biological investigations revealed that all ligands possess remarkable antioxidant activity, with IC_{50} values ranging from **5.09–5.74 µM**, significantly more potent than ascorbic acid (IC_{50} = 12 µM). The ligands also displayed potent antibacterial activity against both Gram-positive and Gram-negative bacteria and moderate cytotoxicity with LC_{50} values 26-30 µM**.**

Paper ID: ICSHSD-181

An Efficient One-Pot Synthesis of Imidazole Derivatives from Diketones and Aldehydes Using SnO_2/Rgo Catalyst

Md. Sajjad Hossain Saun[1], and Md. Nurnobi Rashed[1,*]
[1]Department of Chemistry, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
**Corresponding email: rashed@chem.buet.ac.bd*

ABSTRACT
Imidazole and its derivatives are an extremely important class of heterocyclic compounds, exhibit diverse biological properties, and are abundantly found in various biological systems such as enzyme- and DNA-based structures and pharmaceuticals. Graphene oxide (rGO)-supported metal oxide catalysts is promising due to their excellent catalytic performance. The focus of this study is the utilization of SnO_2/rGO as an effective heterogeneous solid acid catalyst for the synthesis of imidazole derivatives. Graphene oxide (GO) was prepared according to the modified Hummers' method. The SnO_2/rGO catalyst was prepared via the coprecipitation method using GO and tin chloride ($SnCl_2.5H_2O$) in the presence of urea. Synthesis of imidazole derivatives was carried out in a round-bottom flask in the presence of the SnO_2/rGO catalyst using different aldehydes and ketones. The progress of the reaction was monitored by thin-layer chromatography, and finally column chromatography was utilized to obtain pure products. The surface morphology, structures, phase purity, and chemical characterization of the synthesized SnO_2/rGO catalyst were analyzed by FESEM, XRD, EDX, and FTIR, respectively. The synthesized pure imidazole was characterized by different spectroscopic methods like IR, ^{1}H-NMR, and ^{13}C-NMR. SEM and EDX analysis confirmed that SnO_2 nanoparticles were successfully incorporated into the GO nanosheet, resulting in the formation of the SnO_2/rGO nanocomposite. X-ray diffraction analysis revealed the crystalline structure of SnO_2. After successfully fabricating and characterizing the SnO_2/rGO, its catalytic activity was evaluated for the one-pot synthesis of substituted imidazoles. Optimization of temperature and catalytic amount was carried out, and among several metal oxide catalysts, SnO_2/rGO showed better performance with up to 98% yields of various imidazole derivatives. In summary, a simplified and cost-effective catalyst have been established, and the procedure offers many advantages, such as mild reaction conditions, high purity of products, short reaction times, a clean and straightforward procedure, and the ability to recycle the catalyst. Overall, this approach contributes to the advancement of environmentally friendly synthesis methods and emphasizes the prospects for sustainable chemistry in imidazole synthesis.

Paper ID: ICSHSD-195

Bioinspired MgO Nanoparticles from Annona Muricata as Efficient Catalysts for Isatin-based Chalcone Synthesis with Promising Anticancer Activity

Md. Jahanur Islam Rumon[1], and Md. Nurnobi Rashed[1,*]
[1]Department of Chemistry, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
**Corresponding email: rashed@chem.buet.ac.bd*

ABSTRACT

Plant-mediated synthesis of metal oxide nanoparticles is growing in demand for pharmaceutical applications. Magnesium oxide nanoparticles (MgO NPs), valued for catalytic efficiency and biocompatibility, were bioinspired using Annona muricata extract and applied as green catalysts for isatin-based chalcone synthesis, representing a green route to novel, effective anticancer agents**.** Annona muricata leaf extract was added dropwise to $MgCl_2 \cdot 6H_2O$ solution at reflux conditions under continuous stirring and maintaining pH with NH_4OH. The resulting $Mg(OH)_2$ colloid, indicated by a yellowish-green to brown color change, was centrifuged, washed with water and ethanol, and dried in an air oven to yield MgO NPs powder. Then, the samples were calcinated in a muffle furnace at different temperatures, and finally, white-colored MgO NPs were obtained. The formation of MgO NPs was primarily confirmed by an FTIR analysis wavelength of 588 cm^{-1}. Further testing with UV, XRD, SEM, TEM, and EDX proved the successful production of MgO NPs. Furthermore, the synthesis of chalcone under reflux conditions from isatin andaromatic ketone was achieved by using MgO NPs as a heterogeneous catalyst. Also, Chalcone synthesis confirmed by TLC analysis, UV-vis: 217, 256, 315, and 437 nm, FTIR analysis: 3083 cm^{-1} (C–H stretching vibration), 1705 cm^{-1} (C=O ketone), 1652 cm^{-1} (C=O lactam), 1602 cm^{-1} (secondary N–H stretching vibration), 1456 cm^{-1} (aromatic C=C), 1213 cm^{-1} and 749 cm^{-1} (aromatic C–H bending) and further characterization ^{1}HNMR &^{13}C NMR have been carried out to confirm the successful produced of chalcone. Also, isatin-based chalcone derivatives demonstrated significant cytotoxicity against artificially cultured human cancer cell lines, underscoring their potential as promising anticancer agents. In Conclusion, plant leaf extract can be used as a reducing agent in the synthesis of MgO NPs, and these NPs used as green catalysts for the synthesis of bioactive chalcone derivatives, which are anticancer agents, bridging green chemistry and drug discovery.

Paper ID: ICSHSD-211

Synthesis and Characterization of Reduction-based Vinyl Acetate Modified Poly (Lactic Acid)

Nasima Akter Mukta[1,*], Samina Ahmed[2], Abdullah Mohammad Sarwaruddin Chowdhury[3], and Papia Haque[4]
[1]East West University, Dhaka-1212, Bangladesh
[2]BCSIR Laboratories, Dhaka-1205, Bangladesh
[3]Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh
[4]Applied Chemistry and Chemical Engineering, University of Dhaka, Dhaka-1000, Bangladesh
**Corresponding email: nasima.mukta@ewubd.edu*

ABSTRACT

Poly(lactic acid) (PLA) is a promising thermoplastic polymer derived from renewable resources. It is a bioresorbable, biodegradable, and hydrophobic material that is applicable in several biomedical uses. In biomaterials, the hydrophobic moieties of the polymer induce the interactions between protein and lipid, whereas hydrophilic moieties add antifouling properties. The present work focuses on amending commercial PLA by using lithium tetrahydridoaluminate (LiAlH4) and vinyl acetate (VAc) to lessen the hydrophobicity of PLA. Gel permeation chromatography (GPC) and Nuclear magnetic resonance (NMR) data reveal the presence of the vinyl group on the amended PLA. The presence of C=C and further increase of –C=O groups in the modified materials are revealed from spectroscopic (FTIR and NMR) analyses. A higher Tg value recommends additional crosslinking in the structures of amended PLA. The temperature of melting, crystallinity percentage, and crystallite sizes are also decreased in modifications. Additionally, the lower average water contact angle of modified PLA than that of pristine PLA endorses the increase of the hydrophilic moiety in the modified PLA, which may be due to more available amorphous polar sites.

Paper ID: ICSHSD-266

Solvent Free Synthesis of Chalcones from Aldehydes and Ketones using Heterogenous Niobic Acid Catalyst

Roksana Akter[1], and Md. Nurnobi Rashed[1,*]
[1]Department of chemistry, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
**Corresponding email: rashed@chem.buet.ac.bd*

ABSTRACT

Chalcone, an important organic molecule featuring an *α, β*-unsaturated carbonyl framework, holds significant relevance in both organic synthesis and medicinal chemistry. It acts as a key intermediate in the production of polymers, fine chemicals, agrochemicals, and a range of pharmaceutical compounds due to its notable biological activities, including anti-inflammatory, anticancer, and antimicrobial properties. The synthesis of chalcones from aldehydes and ketones has traditionally relied on methods such as Claisen–Schmidt condensation, Meyer–Schuster rearrangement, Suzuki coupling, and Fries rearrangement. However, these approaches often demand elevated temperatures, prolonged reaction times, and substantial amounts of reagents or additives. To overcome these limitations, we investigated the use of niobic acid ($Nb_2O_5 \cdot nH_2O$) as a sustainable and recyclable catalyst. In this study, various substituted aldehydes and ketones reacted under mild conditions in the presence of niobic acid. The mixture was heated on a hot plate at about 80 °C for one hour while being stirred continuously at 400 rpm under solvent free condition, avoiding additional bases or additives. The progress of the reaction was monitored by TLC, and the crude products were purified by recrystallization and finally confirmed by IR and NMR. Catalyst reusability was assessed through successive reaction cycles without significant loss in activity. The results revealed excellent substrate tolerance, affording chalcones in high yields (up to 98%). The catalyst demonstrated strong water stability and dual activation by Lewis and Brønsted acid sites, enabling efficient C–C bond formation followed by dehydration under eco-friendly conditions. Importantly, niobic acid retained its catalytic efficiency upon reuse, highlighting its potential for sustainable large-scale applications. This study establishes niobic acid as a promising green catalyst for the efficient and recyclable synthesis of chalcones, offering advantages over conventional homogeneous and heterogeneous systems.

Paper ID: ICSHSD-340

Limonoids from the Seeds of Swietenia Macrophylla and Their Pharmacological and in Silico Analysis

Mazharul Islam[1], Md. Sakhaoyat Hossain[1], and Rajia Sultana[1,*]
[1]Department of Chemistry, Chittagong University of Engineering & Technology, Chattogram-4349, Bangladesh
**Corresponding email: rajiasultana@cuet.ac.bd*

ABSTRACT

Despite significant strides in understanding and managing diabetes, the absence of a single effective therapeutic agent to treat and prevent its progression remains a formidable challenge. This underscores the crucial need for comprehensive research and continued exploration of new antidiabetic therapeutics. Our study was designed to address this need by investigating the antidiabetic bioactive ethyl acetate fraction of Swietenia macrophylla at the molecular level. Our focus was on understanding the disease's molecular interactions and ligand-protein binding, with the ultimate goal of contributing to the development of new antidiabetic therapeutics. Known limonoids(1–8) were isolated from the seeds of Swietenia macrophylla. The structure of all compounds was determined through extensive, IR 1D/2D-NMR and mass spectrometric analyses, including swietemacrophin (1), 2-Hydroxy-3-O-isobutyrylproceranolide (2), Swietenine(3), Swietmanin A (4), Swietmanin E (5), Swietmanin F (6), Swietmanin I(7), Swietmanin J(8).All limonoids were tested in vitro for antioxidant activity, α-amylase, and α-glucosidase inhibitory activity; among them, swietenine (3) against α-amylase (11.76 ± 1.29 µg/mL) and α-glucosidase(14.45 ± 1.25 µg/mL) activity was significant. Molecular docking was employed to assess the activity of compounds against α-amylase, pancreatic lipase, and β-glucosidase. Among these compounds, swietenine (3) emerged as a promising candidate, demonstrating robust interaction with the active site residues of these enzymes. It exhibited the highest binding free energy against α-amylase (-9.8 kcal/mol), a significant improvement over the commercial drug acarbose (-5.04 kcal/mol). The stability of the complexes formed between lead molecules and receptors, as indicated by molecular dynamics simulation-derived parameters such as root mean square deviation and radius of gyration, further underscores the potential of swietenine for diabetes management, offering a ray of hope in the field.

Paper ID: ICSHSD-364

Phytochemical Composition and Evaluation of Biological Potential of *Carissa carandas* L. Fruit

Zeba Samiha[1], Md. Nazrul Islam[1], and Mohammad Shoeb[1,*]
[1]Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
**Corresponding email: shoeb71@yahoo.com*

ABSTRACT

The dichloromethane extract of the powdered fruit sample of *Carissa carandas* L. was analyzed by different chromatographic techniques to isolate secondary metabolites and the structures of isolated compounds were elucidated by comparing the data obtained from ^{1}H NMR (600 MHz) and ^{13}C NMR (150 MHz) spectra with reported data for corresponding compounds. Lupeol, β-Sitosterol, 3β-Hydroxyurs-12-ene-28-aldehyde, along with a mixture of Lupeol-3 acetate and α-Amyrin acetate were determined to be of the structures of the compounds. Total phenolic content, total flavonoid content, total antioxidant capacity, and DPPH radical scavenging activity found to be the highest for DCM extract (48.88 ± 0.70 mg GAE/g, 247.44 ± 0.96mg QE/g, and 427.31 ± 2.84mg AAE/g of dry extractives, and IC_{50}=75.98µg/mL respectively) compared to n-hexane and methanolic extracts. All three extracts exhibited significant cytotoxic activity against the human cervical carcinoma cell line (HeLa) and normal cell line (Vero).

Paper ID: ICSHSD-375

Synthesis, Biological Evaluation and Computational Approaches of Uridine Derivatives as Antimicrobial Agents

Toahira Eakin[1], and S. M. Abe Kawsar[1,*]
[1]Lab of Carbohydrate and Nucleoside Chemistry (LCNC), Department of Chemistry, University of Chittagong, Chittagong-4331, Bangladesh
**Corresponding email: akawsarabe@yahoo.com; akawsar@cu.ac.bd*

ABSTRACT

Uridine derivatives are typically used for the treatment of viral, bacterial, and fungal infections. However, relatively few studies have shown that uridine derivatives have antibacterial and antifungal activities. In this study, uridine was modified with various aliphatic chains and aromatic groups to generate new derivatives as antimicrobial agents. All newly synthesized uridine derivatives were analyzed via spectral, elemental, and physicochemical methods. Prediction of activity spectra for substances (PASS) and *in vitro* biological evaluation against bacteria and fungi indicated promising antimicrobial capability of these uridine derivatives. *In vitro* antimicrobial activity revealed that the tested compounds were more effective against fungal phytopathogens than against bacterial strains. Most of the compounds inhibited fungal mycelial growth by >60%. Cytotoxicity testing indicated that the compounds were less toxic. Furthermore, its antiproliferative activity was studied against Ehrlich ascites carcinoma (EAC) cells, and 2′,3′-di-O-cinnamoyl-5′-O-palmitoyluridine (2′,3′-di-*O*-cinnamoyl-5′-*O*-palmitoyluridine) exhibited promising anticancer activity, with an IC_{50} value of 1108.22 µg/mL. In support of this observation, their molecular docking studies were performed against *Escherichia coli* (1RXF) and *Salmonella typhi* (3O00), and significant binding affinities and nonbonding interactions were observed. A 400-ns molecular dynamics (MD) simulation study revealed a stable conformation and binding patterns/energy in a stimulating environment. A structure–activity relationship (SAR) investigation indicated that acyl chains, $CH_3(CH_2)_{10}CO$-, $(C_6H_5)_3C$-, and $C_2H_5C_6H_4CO$-, combined with deoxyribose, were most effective against the tested bacterial and fungal pathogens. Pharmacokinetic predictions were examined to determine their ADMET characteristics, and the in-silico results were intriguing. To rationalize these observations, molecular docking studies, molecular dynamics, pharmacokinetic property studies and SAR studies were performed. Finally, the synthesized uridine derivatives demonstrated increased medicinal activity and high potential for use as future antimicrobial agents.

Paper ID: ICSHSD-376

Design, Synthesis, Antimicrobial Assessment and in Silico Studies of Glucopyranoside Derivatives

Nakibul Islam[1], and S. M. Abe Kawsar[1,*]
[1]Lab of Carbohydrate and Nucleoside Chemistry (LCNC), Department of Chemistry, University of Chittagong, Chittagong-4331, Bangladesh
*Corresponding email: akawsarabe@yahoo.com ; akawsar@cu.ac.bd

ABSTRACT

Carbohydrates play a vital role in the biochemistry of living organisms, serving as key nutrients and primary energy sources. Carbohydrate derivatives are used in biochemical and medicinal research, especially in the fields of chemistry and biochemistry. From this perspective, the present study was designed to explore the synthesis of methyl α-D-glucopyranoside derivatives (**1--8**), focusing on their efficacy against bacterial and fungal inhibition. The structure of the synthesized compounds was ascertained via FTIR, ^{1}H-NMR, ^{13}C-NMR, mass and elemental analyses. Antimicrobial screening revealed strong antifungal properties, with compound **7** exhibiting minimum inhibitory concentrations (MICs) ranging from 16.0–32.0 µg/L and minimum bactericidal concentrations (MBCs) ranging from 64.0–128.0 µg/L. The incorporation of decanoyl acyl groups at C-2 and C-3 of (**7**) significantly improved the efficacy against bacteria and fungi. Structure–activity relationship (SAR) analysis indicated that adding nonanoyl and decanoyl groups to the ribose moiety increased the potency against both bacterial and fungal strains. Computational methods, including molecular docking, DFT, and molecular dynamics simulations, were used to assess the efficacy of these derivatives. Compounds **6** and **7**, which presented nonanoyl and decanoyl substituents, demonstrated greater efficacy. Molecular docking revealed that compound **8**has exceptional binding affinities to bacterial proteins, conferring potent antibacterial and antifungal activities. In addition, a pharmacokinetic study highlighted compounds **1** and **2** as promising bioavailable drugs with minimal toxicity. Molecular dynamics simulations confirmed the stability of the compounds. Future experiments are needed to validate their efficacy for pharmaceutical development. The integration of *in vitro* and in silico methods, including DFT anchoring dynamics and molecular dynamics simulations, provides a solid framework for the development of effective anti-infective drugs.

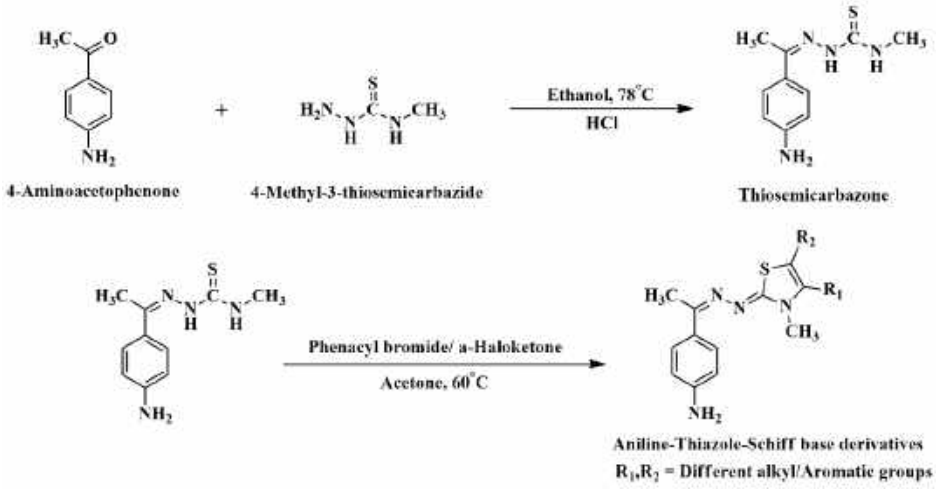
Paper ID: ICSHSD-379

Synthesis of Aniline Containing Thiazole-Schiff Base Derivative: Evaluation of Biological Activity, in Silico Admet Predictions, Molecular Docking, and Dynamics Studies

Setu Karmokar[1], Mohammad Mostafizur Rahman[1], and Md. Aminul Haque[1,*]
[1]Department of Chemistry, Jagannath University, Dhaka-1100, Bangladesh
Corresponding email: amin2k12@chem.jnu.ac.bd

ABSTRACT

Antimicrobial resistance is a global threat to health and development. To address this situation, a novel series of aniline-thiazole–Schiff base analogs **(2a–2p)** was synthesized through a multicomponent reaction involving 4-methyl-3-thiosemicarbazide, 4-aminoacetophenone, and various α-haloketone/phenacyl bromide derivatives. The structural elucidation of the synthesized compounds was achieved using IR, ^{1}H NMR, and HRMS spectral techniques. The antimicrobial and antioxidant activities of these derivatives were subsequently assessed through agar disc diffusion and DPPH free radical scavenging assays, respectively. Most of the compounds exhibited moderate to excellent antimicrobial efficacy against the tested bacterial and fungal strains. Notably, compounds **2j**, **2l**, and **2m** demonstrated significant activity against *Salmonella typhi*, while compound **2m** also showed notable inhibition against *Staphylococcus aureus*. Furthermore, derivatives **2a**, **2b**, **2c**, and **2o** displayed potent antifungal activity across all examined strains. In silico ADMET predictions revealed that the majority of the synthesized analogs complied with Lipinski's rule of five and Veber's rule, indicating favorable pharmacokinetic profiles. Complementary molecular docking and molecular dynamics simulations provided insights into the binding interactions, active sites, and stability of ligand–protein complexes, which were consistent with the in vitro results. Collectively, these findings underscore the potential of aniline-containing thiazole–Schiff base derivatives as promising candidates for antimicrobial and antioxidant drug development.



Scheme: Synthesis of aniline containing thiazole–Schiff base derivatives.

Paper ID: ICSHSD-385

Synthesis, Characterization, Bioactivity Screening and In Silico Studies of Phenyl Thiazole Derivatives

Ranajit Kumar Sutradhar[1], Md. Din Islam[1] and Md. Abu Bakkar Siddiki[1,*]
[1]Department of Chemistry, Chittagong University of Engineering & Technology,
Chattogram-4349, Bangladesh
**Corresponding email: absiddiki005@gmail.com*

ABSTRACT

Antimicrobial agent resistance in microorganisms has become a major global concern in the modern era. Thiazole, a unique heterocycle containing sulfur and nitrogen atoms that plays a significant role in medicinal chemistry including anti-microbial, antioxidant, anti-fungal, anti-cancer, anti-candida and anti-inflammatory agents. Moreover, substances with thiazole structure have been employed as hypnotics, schizophrenia, hypertension, allergies, and HIV infection treatments. On the other hand, a large number of such substances are vital for controlling human metabolism. The main goal of this research work was to develop phenyl thiazole derivatives containing nitro benzaylidine moiety following two step reactions using 3-Nitroacetophenone, Thiosemicarbazide and substituted phenacylbromide. Several spectroscopic techniques (IR, ^{1}H NMR, ^{13}C NMR, HMBC and HSQC) were utilized to confirm the structures of the synthesized compounds. We were able to synthesis three bioactive thiazole derivatives 1b, 2b and 3b.The compounds were screened for antimicrobial and antioxidant assays. *In silico* molecular docking was also performed by DFT method on the basis of B3LYP/6–31+G(d,p). *In silico* studies revealed that all the synthesized analogs bind effectively to putative receptor binding sites.

Paper ID: ICSHSD-393

Bioactive Phytoconstituents from the Aerial Parts of *Spilanthes Calva*

Ranajit Kumar Sutradhar[1], and Muhammead Shahidul Islam[1,*]
[1]Department of Chemistry, Chittagong University of Engineering & Technology,
Chattogram-4349, Bangladesh
**Corresponding email: rksutradhar2002@yahoo.com*

ABSTRACT

Spilanthes calva is one of the indigenous medicinal plants of Bangladesh. It belongs to the family Asteraceae and the genus *Spilanthes*, commonly known as Marhatiga. It is widely distributed in India and Bangladesh. Its flowers are used in folk medicine for the treatment of toothache, throat and gum infections. It has been reported that the plant is used in the treatment of allergy, foot mud sore, hysteria, insanity, stomachache, toothache, traumatic paralysis, rheumatism and scabies. It also stimulates wound healing, protects the individual from colds and flu. Previous phytochemical investigations revealed that *Spilanthes calva* was a rich source of steroids, flavonoids and alkaloids. In our continuous research on medicinal plants, we conducted a study on the aerial parts of *Spilanthes calva* to isolate new bioactive natural products from the aerial parts of *Spilanthes calva*. In this study, we were able to isolate four new natural products from the dichloromethane (DCM) fraction. The structures of all compounds were elucidated by spectroscopic analysis. Compounds were also studied for their antibacterial and antifungal properties. All compounds demonstrated significant antibacterial and antifungal activities.

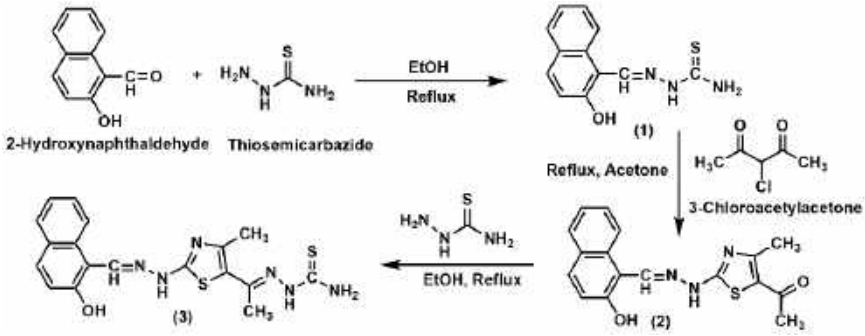
Paper ID: ICSHSD-394

Synthesis, Antimicrobial and Antioxidant Activity of Di-Thiazole-Schiff Base Derivatives Containing Hydroxynapthalene Moiety with their ADMET Prediction, Molecular Docking and Dynamics Study

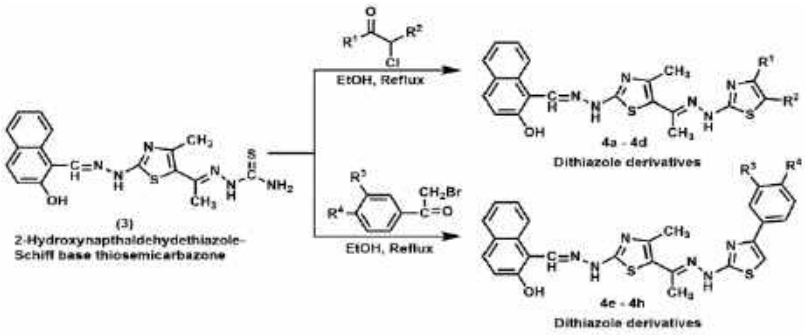
Md. Mizanur Rahman[1,*], Mohammad Mostafizur Rahman[1], and Md. Aminul Haque[1]
[1]Department of Chemistry, Jagannath University, Dhaka-1100, Bangladesh
**Corresponding email: amin2k12@chem.jnu.ac.bd*

ABSTRACT

In the present study, one thiosemicarbazone (**1**), one thiazole-Schiff base (**2**), one thiazole-Schiff base thiosemicarbazone (**3**) (**Scheme1**), and eightdi-thiazole-Schiff base thiosemicarbazones (**4a-4h**) were synthesized (**Scheme 2**) through four successive reaction steps starting from 2-hydroxynapthaldehyde. The structures of the analogues were confirmed by various spectral analysis like infrared (IR), nuclear magnetic resonance (^{1}H NMR), and high resulation mass spectroscopy (HRMS).Among the synthesized entities, 2-hydroxynapthaldehyde di-thiazole **4d** showed significant antibacterial activity against gram-negative bacteria *S. dysentery* (18.3 ± 0.6 mm) compared to standard ceftrioxane. In DPPH free radical scavanging antioxidant assay, the derivative **4a** showed excellent activity (IC_{50}=30.39 ± 3.20µg/mL) compared to standard ascorbic acid (IC_{50} =40.47 ± 1.11 µg/mL). *In silico* studies fortold that the synthesized analogues follow the Lipinski's rule of five and Veber's rule with one exception. They also displayed significant drug-likeness and drug-score properties. The derivaties would be proved effective in future drug discovery.



Scheme 1. Synthetic route of thiazole-Schiff base thiosemicarbazone



Compd.	R^1	R^2
4a	Et	Me
4b	CH_2COOMe	H
4c	Me	COOEt
4d	CH_2COOEt	H

Compd.	R^3	R^4
4e	H	H
4f	NO_2	H
4g	H	NO_2
4h	Cl	Cl

Scheme 2. Synthetic route of di-thiazole-Schiff base derivatives **4a-4h**

Paper ID: ICSHSD-402

Synthesis of Schiff Base and Its Ni(II) Complex for In Vitro and in Silico Evaluation Against Agricultural Pathogen

Md. Eanur Rahman[1], Rummana Islam[2], Md. Shamim Akhter[2], and N. M. Mofiz Uddin Khan[1,*]
[1]Department of Chemistry, Dhaka University of Engineering & Technology, Gazipur, Gazipur-1707, Bangladesh
[2]Plant virology lab, Plant Pathology Division, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh
**Corresponding email: mofizchemdu@duet.ac.bd*

ABSTRACT

Bangladesh's food security and economy heavily rely its agricultural sector, with many people depending on crop and vegetable cultivation. However, significant pre- and post-harvest losses are caused by bacterial and fungal pathogens. To address this issue, Schiff bases and their metal complexes, a promising class of organic compounds, exhibit remarkable antimicrobial properties. These properties enable them to effectively protect crops. To investigate this potential, a Schiff base, 4-((2-hydroxybenzylidene)amino)benzoic acid was synthesized and utilizing the chelating properties Schiff base nickel(II) complex was also synthesized, with yields of 84.19% for the ligand and 49.40% for the complex. Moreover, both compounds were characterized using UV-Vis, FT-IR, and ^{1}H-NMR spectroscopy, revealing UV-Vis absorption bands at 270–300 nm ($\pi \rightarrow \pi^*$ transitions) and 340–390 nm ($n \rightarrow \pi^*$ transitions) for the imine (>C=N–) group, with a bathochromic shift confirming coordination in the Ni(II) complex. Additionally, FT-IR revealed >C=N– stretching at 1676 cm^{-1} for the Schiff base, shifting to 1624 cm^{-1} in the complex, while ^{1}H-NMR showed a singlet at δ = 8.995 ppm for the Schiff base's imine proton, but the Ni(II) complex's ferromagnetic nature prevented NMR analysis. Furthermore, the antimicrobial activities of the synthesized compounds were assessed against two plant pathogens, including *Ralstonia solanacearum* (bacteria) and *Sclerotium rolfsii* (fungus), using in vitro assays. The antimicrobial assays demonstrated that the Ni(II) complex completely inhibited the growth of *Ralstonia solanacearum*, whereas the Schiff base allowed 3-4 colonies within 24 hours, performing comparably to standard commercial drugs. On the other hand, 15 ppm concentration of the Ni(II) complex exhibited better antifungal activity (78%) against *Sclerotium rolfsii* compared to the Schiff base (3 days), achieving inhibition levels nearly equivalent to commercial fungicides and maintaining efficacy for up to seven days. In addition, the synthesized compound was subjected to docking studies with proteins (PDB ID- 2chh & 1hg8) from *Ralstonia solanacearum* and *Sclerotium rolfsii*. The docking results revealed that the Ni(II) complex exhibited higher binding scores (-8.9 kcal/mol and -6.2 kcal/mol) compared to the Schiff base ligand against both proteins and interacting at eight distinct binding sites analyzed for 2D and 3D interactions. These findings, coupled with further development, highlight Schiff base metal complexes as promising solutions for effective crop disease management and improving farmers' livelihoods in Bangladesh

Paper ID: ICSHSD-410

Synthesis, Characterization, Bioactive Screening and Molecular Docking Studies of Thiazole Derivatives Containing Quinoline Moieties

Ranajit Kumar Sutradhar[1], Md. Din Islam[1], and Md. Mohiuddin Emon[1,*]
[1]Department ofChemistry, Chittagong University of Engineering & Technology,
Chattogram-4349, Bangladesh
**Corresponding email: mohiemu6118@gmail.com*

ABSTRACT

A notable challenge facing the world today is the growing resistance of microorganisms to antimicrobial treatments. Hospitals face a significant threat from severe diseases caused by bacteria resistant to common medications, especially those classified as Gram-positive, Gram Negative. Although various drugs can effectively treat these infections, the rapid development of resistance poses a challenge, as some bacterial strains show resistance to all current antibacterial agents. In medicinal chemistry, thiazole a special heterocycle with nitrogen and sulfur atoms plays a key role in the production of antimicrobial, antioxidant, antifungal, anticancer, anti-candida, and anti-inflammatory drugs. The increased focus on thiazole compounds is primarily attributed to their remarkable pharmacological effectiveness. These atoms are crucial for coordinating metals in the active sites of various metal biomolecules. Some of these biomolecules might have therapeutic value or can be helpful models for studying metalloenzymes. Additionally, thiazole containing compounds have been used as hypnotics, therapies for HIV infection, hypertension, schizophrenia, and allergies. The primary objective of this study is to use thiosemicarbazide and substituted phenacyl bromide to create thiazole derivatives with nitro quinoline moiety through two step reactions. The structures of the synthesized compounds were confirmed by spectroscopic methods (IR, ^{1}H NMR, ^{13}C NMR, HMBC and HSQC). Compounds were evaluated for their antimicrobial and antioxidant properties. The molecular docking investigation indicated that all the synthesized compounds effectively bind to the potential receptor sites

Paper ID: ICSHSD-426

Physicochemical Characterization of Oil Extracted from *Delonix Regia* Seeds

Nusrat Jahan Mumu[1], Md. Arif Hossain[1,*], and Zinia Nasreen[1]
[1]Department of Chemistry, Dhaka University of engineering & Technology, Gazipur, Gazipur-1707, Bangladesh
Corresponding email: arif.acce2610@gmail.com

ABSTRACT

Plant-derived oils have been widely utilized since ancient times, serving both nutritional and industrial purposes across cultures. Today, vegetable oils play a vital role in food preparation, pharmaceuticals, cosmetics, and bio-based industries. Their applications are largely governed by the physicochemical properties that define quality, stability, and suitability for different uses. In the present study, seeds of *Delonix regia* (flame tree) were collected from different areas of Gazipur, Bangladesh, to investigate the potential of this underutilized resource as a source of vegetable oil. The oil was extracted using n-hexane as a solvent at 60 °C for 6 hours, and the solvent was subsequently removed with a rotary evaporator to obtain pure oil. The physicochemical properties of the extracted oil were systematically analyzed. The results revealed moisture content of 2.219%, density of 0.86 g/cm^3, and pH of 6.3. Further characterization showed a saponification value of 149.6 mg KOH/g oil, an acid value of 22.44 mg KOH/g oil, and an iodine value of 114.3 g I_2/100 g oil. These findings were compared with standard values for edible and industrial oils to assess suitability. The relatively high iodine value suggests a notable degree of unsaturation, indicating potential for use in soap making, cosmetics, and as a drying oil in surface coatings. Thermogravimetric analysis (TGA) demonstrated that the oil possesses good thermal stability, with decomposition initiating gradually and a final residue observed at 475 °C, confirming its robustness under heat exposure. Gas chromatography (GC) analysis identified the major fatty acid components as palmitic acid (C16:0), stearic acid (C18:0), cis-9-oleic acid (C18:1), and linoleic acid (C18:2). The presence of both saturated and unsaturated fatty acids suggests versatility in potential applications. Overall, this study highlights that *Delonix regia* seed oil exhibits promising physicochemical and thermal characteristics, supporting its potential use in food processing, cosmetics, and industrial formulations. The findings provide baseline data for further exploration into large-scale extraction and value-added applications of this unconventional seed oil.

Paper ID: ICSHSD-429

Preparation and Physicochemical Properties of Silver-Modified Viscose Rayon from Jute Fiber

Sharmin Akter[1], Md. Arif Hossain[1,*], and Zinia Nasreen[1]
[1]Department of Chemistry, Dhaka University of engineering & Technology, Gazipur, Gazipur-1707, Bangladesh
Corresponding email: arif.acce2610@gmail.com

ABSTRACT

Viscose rayon, also known as artificial silk, is a semi-synthetic fiber widely used in textiles, packaging, and industrial applications. Recent advancements have focused on modifying viscose rayon with inorganic and organic substances to enhance its performance and broaden its utility. Among these, metal-modified viscose rayon has gained considerable attention due to its improved functional properties, particularly for applications in antimicrobial textiles, filtration, and biomedical materials. In this research, viscose rayon was synthesized from locally available jute fiber and subsequently modified with silver to study its physicochemical properties. The preparation process began with pretreatment of jute using 2% sodium hydroxide, followed by bleaching with 1.7% sodium chlorite ($NaClO_2$) in an acetic buffer solution to yield purified cellulose. This cellulose was then converted into viscose rayon through treatment with carbon disulfide and 17.5% sodium hydroxide, producing a viscous solution which was regenerated in diluted sodium hydroxide. To obtain silver-modified viscose rayon, the fiber was subjected to a chemical modification process involving silver incorporation. The properties of both unmodified viscose rayon and silver-modified viscose rayon were characterized using various analytical techniques. Physical studies revealed differences in moisture content and water uptake capacity between the two samples, indicating the influence of silver modification on hydrophilicity and structural integrity. Scanning electron microscopy (SEM) analysis provided insights into the surface morphology. Thermal stability was assessed through thermogravimetric analysis (TGA), which demonstrated enhanced resistance to degradation in the modified sample compared to the pristine viscose rayon. Additionally, Fourier transform infrared spectroscopy (FTIR) confirmed the presence of functional groups and provided evidence of chemical interactions between silver and the viscose rayon matrix. Overall, the study highlights the successful preparation of silver-modified viscose rayon from jute fiber and establishes its enhanced physicochemical properties compared to conventional viscose rayon.

Paper ID: ICSHSD-436

Organic Fertilizers and Their Effects on Soil Biochemistry and Crop Yield in Bangladesh

Shaharia Rahman Tanim[1,*], Samin Shahriyar Lorin[1] and Md. Mortuza Ahmmed[2]
[1]Department of Computer Science, American International University-Bangladesh, Dhaka-1229, Bangladesh
[1]Department of Computer Science, American International University-Bangladesh, Dhaka-1229, Bangladesh
[2]Department of Mathematics, American International University-Bangladesh, Dhaka-1229, Bangladesh
Corresponding email: 23-54509-3@student.aiub.edu

ABSTRACT

Bangladesh being an agricultural country depends on soil fertility management for increasing agricultural production and food security. Overuse of chemical fertilizers damaged soil quality, increased impurities and lowered crop yields. Organically prepared fertilizers are being advocated as an environmentally friendly and sustainable alternative. The addition of organic amendments in soil improves soil biochemistry and affects antioxidant capacity, nutritional quality and safety of crops. Nevertheless, long-term effect of organic fertilizers on crop yield and soil health is poorly understood in Bangladesh. The effects of organic fertilation through agricultural practices on soil biochemical parameters, nutritional indices and crop yield patterns for a period approaching three decades (1994–2023) were examined in the present study.
The 30-year dataset (1994–2023) consisted of annual values of biochemical and agronomic variables (total concentration of secondary metabolites (mg/g), antioxidant activity (%), contaminant levels (ppm), nutritional value index and safety index). Trend analysis dealt with temporal changes and comparisons were made related to the responses of soil and crops to fertilizer application. We studied the years with highest variations on concentration of compounds, bioactive levels and safety indexes to understand changes. The study concentrated on periods where the nutritional value was high and the contamination relatively low and showed that organic fertilizing practices were effective. The results revealed that soil and crop parameter varies with time frame of the study. Compound concentration fluctuated. However, it was highest in 1995 (93.47 mg/g), 2007 (90.22 mg/g) and 2016 (79.58 mg/g), which would suggest a better availability of nutrients in those years under organic management. Antioxidant activity increased in 1995 (92.84%), 2012 (97.86%) and again in 2023 (92.38%), indicating enhancement of plant defense and possible health effects. The contents of contaminants ranged from low (10.96 ppm in 2002) to high (94.08 ppm in 2003), indicative of poor fertilizer quality or external contamination. Nutritional value index reached maximum value in 2016 (95.35) and 2001 (90.94), indicating an influence of organic amendments towards improving quality of crops. The safety index ranged from a high of 97.99 in 2010 and 92.09 in 2001 and implied the great safety of food production in these years, respectively. Organic fertilizers are found to enhance soil and crop health, although their efficacy is found to be inconsistent given different practices and environmental factors. Overall, there are long-terms gains in both nutrition and safety and the use of organic fertilizers may be promoted in agricultural policymaking in Bangladesh.

Paper ID: ICSHSD-440

Synthesis, Characterization and Computational Study of Novel Azo-Schiff Bases as Anti-Breast Cancer Agents

Md. Mehedi Hasan[1], Md. Eanur Rahman[1], Mamiya Chowdhury[2], and N. M. Mofiz Uddin Khan[1,*]
[1]Department of Chemistry, Dhaka University of Engineering & Technology, Gazipur 1707, Bangladesh
[2]Chemistry Department, Tennessee Tech University, Cookeville, USA
**Corresponding email: mofizchemdu@duet.ac.bd*

ABSTRACT

Schiff bases containing azo functionalities represent an important class of organic molecules due to their versatile structural features, stability, and biological applications. This interest is primarily driven by the incorporation of both the azo (–N=N–) and imine (–C=N–) groups within a single molecular scaffold, which enhances their interaction potential with biological targets and makes them promising candidates for pharmaceutical research. In particular, considerable attention has recently been given to these compounds for their antimicrobial, antioxidant, and anticancer properties. To explore therapeutic potential, this study aimed to synthesize the azo compound 4-((4-bromophenyl)diazenyl)-2-hydroxybenzaldehyde via diazotization and coupling reactions, which was subsequently employed as a precursor for two novel Schiff bases: L1 (4-((4-((4-bromophenyl)diazenyl)-2-hydroxybenzylidene)amino)benzoic acid) and L2 (5-((4-bromophenyl) diazenyl)-2-(((4-hydroxyphenyl)imino)methyl)phenol). The compounds were obtained in good yields (L1: 73.88%, L2: 75.20%).Their structures were confirmed by UV-Vis, FTIR, and ^{1}H NMR spectroscopy. The UV-Vis spectra showed characteristic π–π* (240–260 nm) and n–π* (320–370 nm) transitions while FTIR confirmed hydroxyl (O–H, ~3450 cm^{-1}) and imine (>C=N, 1620–1637 cm^{-1}) functionalities. In the ^{1}H NMR spectra, L1 exhibited aromatic protons (δ 6.80–8.20 ppm) and singlets for imine (>CH=N), hydroxyl (-OH), and carboxylic (-COOH) protons, while L2 displayed aromatic protons (δ 5.80–8.20 ppm) and hydroxyl protons (δ 10.30 & 11.60 ppm), influenced by diazenyl (-N=N-) and hydroxyl groups. To investigate their potential anticancer activity, molecular docking studies were performed using AutoDock Vina against breast cancer-associated proteins 3nup and 4oar (PDB ID). The docking results revealed that L2 exhibited strong binding affinity with 3nup (–7.0 kcal/mol), while L1 showed even higher affinity with 4oar (–8.9 kcal/mol). Detailed interaction analyses indicated the presence of hydrogen bonding, hydrophobic interactions, and π–π stacking with key amino acid residues at the binding sites, suggesting stable ligand–protein interactions. Furthermore, the drug-likeness and pharmacokinetic properties of the synthesized Schiff bases were evaluated using SwissADME. Both L1 and L2 satisfied Lipinski's Rule of Five with no significant violations. Also, they complied with Veber and Muegge filters, suggesting good oral bioavailability and promising physicochemical profiles for potential therapeutic agents.Additionally, the boiled-egg model predicted high gastrointestinal absorption and low brain penetration, supporting their suitability as oral drugs. These findings underscore their potential as promising candidates for further development and biological evaluation in the treatment of breast cancer.

Paper ID: ICSHSD-452

Bioactive Steroidal Glycoside from the Seeds of *Mucuna pruriens*

Md Sakhaoyat Hossain[1], and Ranajit K Sutradhar[1,*]
[1]Department of Chemistry, Chittagong University of Engineering & Technology, Chattogram-4349, Bangladesh
**Corresponding email: rksutradhar2002@yahoo.com*

ABSTRACT

Mucuna pruriens, an indigenous medicinal plant native to Bangladesh, is the subject of our research. Belonging to the family Fabaceae and the genus *Mucuna*, commonly known as Alkushi, this plant is widely distributed in India and Bangladesh. Its seeds have been used in folk medicine for the treatment of various ailments. In our continuous research on medicinal plants, we conducted a thorough study on the seeds of *M. pruriens* to discover new bioactive natural products. We successfully isolated a new steroidal glycoside, along with three other new phytoconstituents, from the isopropyl alcohol (IPA) fraction. The structures of all compounds were elucidated by spectroscopic methods. The compounds were also comprehensively assessed for their antibacterial and antifungal properties. All compounds showed significant antifungal activities against *Aspergillus niger* and *Trichoderma harzianum.* Molecular docking was conducted to validate the antimicrobial activity, as we selected the bacterial and fungal receptor proteins to dock with the isolated compounds. The docking results showed promising binding affinity towards all selected protein receptors.

Paper ID: ICSHSD-456

Development and Nutritional Evaluation of Calcium-Fortified Biscuits Using Bone Powder from Indigenous Bangladeshi Fish Species

Rahadul Islam Auvi[1], Nowshin Tarannum Orin[1], Md. Ashikur Rahman[2], and Farzana Rahman [1,*]
[1]Department of Nutrition and Food Engineering. Daffodil International University, Dhaka-1216, Bangladesh
[2]Institute of Food and Radiation Biology, Bangladesh Atomic Energy Commission, Dhaka-1207, Bangladesh
Corresponding email: frahman.nfe@diu.edu.bd

ABSTRACT

Calcium deficiency is a major health concern, especially in developing regions, where it leads to bone-related disorders. Fish bones, a nutrient-rich byproduct of the seafood industry, are typically discarded despite being high in calcium and minerals. This study investigates the use of fish bone powder (FBP) from local Kalibaush fish to fortify biscuits, aiming to create affordable, nutritious, and sustainable food products. Biscuits were prepared with different FBP levels (0%, 2%, 4%, 6%) and assessed for nutritional, sensory, microbial, and shelf-life qualities. The results revealed significant increases in protein (7.8% to 9.6%), ash (1.2% to 3.8%), fiber (0.6% to 1.0%) with higher levels of FBP. Functional analysis showed that FBP was compatible with biscuit formulations, causing no adverse effects on dough handling or baking. At 2% FBP, the pH was 6.8 and solubility was 14.2%, confirming its suitability for incorporation. Mineral content also improved, with calcium rising from 18.5 mg/100g to 158.3 mg/100g and phosphorus from 22.1 mg/100g to 180.2 mg/100g. Microbial analysis confirmed all samples remained safe for up to 30 days, with total plate counts increasing from 1.0×10^2 to 3.5×10^2 CFU/g—well below the 10^3 limit. Throughout storage, the biscuits maintained stable moisture levels (4.8%–5.3%) along with their freshness, color, texture. Sensory evaluation revealed that biscuits fortified with 2% FBP received the highest ratings across key attributes such as taste, texture, and overall acceptability**,** making them the most appealing formulation to consumers. In contrast, biscuits with higher fortification levels (4% and 6%) were still acceptable but showed slight drawbacks; aroma scores declined and the **t**exture became somewhat gritty**,** reducing crispness and smoothness compared to the control. Statistical analysis further strengthened these observations. ANOVA results indicated that the differences in appearance (highest score at 2% FBP) and taste among the biscuit formulations were statistically significant ($p < 0.05$), confirming that fortification levels had a measurable effect on these attributes. Tukey's post hoc test revealed that biscuits with 2% and 4% FBP outperformed the control group, particularly in appearance and taste, whereas 6% fortification did not provide additional benefits. This clearly demonstrates that moderate levels of FBP fortification improve consumer perception**,** while excessive fortification may negatively impact certain sensory properties. Overall, the study concludes that fortification of biscuits with **2**% fish bone powder enhances nutritional value without compromising consumer acceptability**.** This innovation represents **a** low-cost, sustainable, and community-benefiting approach to addressing calcium deficiency while effectively utilizing fish bone powder.

Inorganic, Material Science and Nano-Technology

Paper ID: ICSHSD-36

Investigation of Iodine Stability in Salt During Different Processing Techniques and Specific Time Intervals

Sharmin Yesmin Shanta[1,*], Mohammad Shaokat Ali[2], and Mohammad Mozibul Haque[3]
[1]Department of Applied Food Science and Nutrition, CVASU
[2]Department of Applied Chemistry and Chemical Technology, Faculty of Food Science and Technology, CVASU
[3]Department of Applied Food Science and Nutrition, CVASU
**Corresponding email: shantaaus25@gmail.com*

ABSTRACT
Iodine is essential for metabolic regulation, and its deficiency can cause severe health issues. This study assessed iodine availability and stability in five branded iodized salts using titrimetric and UV-spectrophotometric methods. Samples were stored under normal conditions and boiled at specific intervals. Results showed iodine losses of 7.15–18.04% in normal conditions and 12.95–24.54% during boiling after one week, with boiling causing the greatest loss. Brand F showed highest stability, while Brand N had the lowest. Findings highlight the need for public awareness and government initiatives to minimize iodine loss during storage and cooking.

Paper ID: ICSHSD-64

Synthesis and Characterization of Metal-Doped Chitosan/Hydroxyapatite Composites to Develop Biomaterials with Antimicrobial and Drug-Delivery Properties

Bipul Mondal Sagar[1,2], Sudipro Chakraborty[3], Samina Ahmed[1,*], and Md. Sahadat Hossain[1,*]
[1]Institute of Glass and Ceramic Research and Testing, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka-1205, Bangladesh
[2]Department of Applied Chemistry and Chemical Engineering, Gopalganj Science and Technology University, Gopalganj-8100, Bangladesh
[3]Department of Applied Chemistry and Chemical Engineering, University of Dhaka, Dhaka-1000, Bangladesh
[*]*Corresponding email: shanta_samina@yahoo.com; saz8455@gamil.com*

ABSTRACT
The purpose of the study was to evaluate the potential of metal-doped chitosan-hydroxyapatite (CS/HAp) composite as a biomaterial. Different metallic dopants (Cu, Ag, Zn) were incorporated in HAp's crystal, replacing small amounts of Ca^{2+} ions, and then chitosan was introduced to form the composite. The resultant metal-doped CS/HAp composite was characterized by XRD, FTIR, FESEM, TGA, and EDX analysis. XRD analysis was conducted to verify the HAp formation in the composite. FTIR analysis was employed to analyze functional groups. FESEM and EDX were performed to study morphology and elemental composition, respectively.The thermal stability of the synthesized samples was characterized by TGA. The metal-doped composite displayed superior antibacterial performance against *S.aureus*. Furthermore, this enhanced antibacterial action did not affect the hemocompatibility of the composites, confirmed by the hemolysis test. Finally, the doped composites were evaluated as a drug carrier in which amoxicillin was used as a model drug. These findings highlight that incorporating dopants into CS/HAp composites at low concentrations is a viable strategy for developing advanced biomaterials.

Paper ID: ICSHSD-89

Sustainable Synthesis of Metal-Organic Frameworks from Waste Materials for Electrochemical Sensing of Heavy Metal Ions in Aqueous Media

Sumaya Tabassum[1], Sumaiya Akter[2], Md. Farid Ahmed[1], Dipa Islam[3], Samina Ahmed[1], and Md. Sahadat Hossain[1,*]

[1]Institute of Glass & Ceramic Research and Testing, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka-1205, Bangladesh

[2]Department of Applied Chemistry and Chemical Engineering, Noakhali Science and Technology University, Noakhali-3814, Bangladesh

[3]Biomedical and Toxicology Research Institute, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka-1205, Bangladesh

*****Corresponding email: saz8455@gmail.com*

ABSTRACT

This research highlights the sustainable and eco-friendly synthesis of metal–organic framework (Ca-MOF) employing non-biodegradable waste plastic bottles as the precursor for terephthalic acid and a calcium source. The exploration not only provides an innovative method of plastic recycling but also integrates the development of functional materials for environmental sensing, particularly the detection of toxic heavy metal (Pb^{2+}) ions.Several sophisticated instruments, including an X-ray diffractometer (XRD), a Fourier Transform Infrared (FTIR) Spectrophotometer, a Field Emission Scanning Electron Microscope (FESEM), a thermogravimetric analyzer (TGA), and a Differential Scanning Calorimeter (DSC), were utilized to characterize the synthesized sample. The XRD data confirmed the formation of terephthalic acid and Ca-MOF. The FTIR spectrum assured the presence of aryl (aromatic) groups and the -COOH group for terephthalic acid, whereas O-H, O-C-O, and Ca-O for Ca-MOF. The TG analysis of Ca-MOF revealed the five stages of mass change as a function of temperature. The FESEM analysis revealed a layered, sheet-like structure of Ca-MOF. The sensitivity of the working electrode (fabricated Ca-MOF) was examined using potassium ferrocyanide. An electrochemical technique (LSASV-Linear sweep anodic stripping voltammetry) was applied to detect the heavy metal (Pb^{2+}) with a concentration range of 10-0.0001 ppm, using the fabricated electrode, along with the surface area of the bare and working electrode being calculated. The efficacy of the Ca-MOF fabricated electrode was also explored utilizing the Laviron and Randles-Sevcik equations.

Paper ID: ICSHSD-99

Crystallographic Facet Engineering of Zno Nanoparticles for Photocatalytic Organic Pollutant Degradation and Antibacterial Activity

Priya Paul[1,2], Fataha Nur Robel[2], Newaz Mohammed Bahadur[3], SumayaTabassum[1], SubarnaSandhaniDey[4], Muhammad Shahriar Bashar[5], Nazmul Islam Tanvir[6], Samina Ahmed[1], and Md Sahadat Hossain[1*]

[1]Institute of Glass & Ceramic Research and Testing, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka-1205, Bangladesh
[2]Department of Applied Chemistry and Chemical Engineering, Noakhali Science and Technology University, Noakhali-3814, Bangladesh
[3]Department of Chemistry, Noakhali Science and Technology University, Noakhali-3814, Bangladesh
[4]Institute of Food Science and Technology (IFST), Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka-1205, Bangladesh
[5]Institute of Energy Research & Development, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka-1205, Bangladesh
[6]Industrial Physics Division, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka-1205, Bangladesh
Corresponding email: saz8455@gmail.com

ABSTRACT

Dual-functional zinc oxide nanoparticles (ZnO-NPs) are demonstrated to possess exceptional antibacterial and photocatalytic capabilities through the use of crystallographic engineering. This work investigates the crystallographic facet engineering of ZnO nanoparticles to enhance their antimicrobial and photocatalytic performance, aiming to overcome conventional limitations. The facet-tuned NPs were produced using four different synthesis techniques: conventional hydrothermal (Z3), oleic acid-modified hydrothermal (Z2), PEG-assisted co-precipitation (Z1), and *Canna indica*-mediated green synthesis (Z4). By attaining 34 mm inhibitory zones against Staphylococcus aureus and 50% Congo red degradation under visible light, they outperform conventional ZnO (20–40% degradation, <25 mm zones). In the (101)/(103) and (112)/(110) planes, Z1/Z3 (crystallite size: 34.40–36.69 nm, microstrain: 0.1334–0.1394) and Z2/Z4 (84.51–97.20 nm, microstrain: 0.0611–0.0816) developed preferentially, according to XRD examination. According to FESEM, the shape of the nanodiscs (Z1), cubic rods (Z2), plate-needle hybrids (Z3), and nanorods (Z4) affected how well they performed. EDX confirmed high Zn purity (>86%); however, FTIR detected residual C=O/C-O groups affecting surface interactions. The efficiency of photocatalysis depends on defect-mediated charge separation, which was confirmed by Raman spectroscopy of defect-rich E2 (high) phonon modes (439 cm^{-1}). Antibacterial studies employing nanorod-driven membrane penetration and Zn^{2+} release showed that Z2/Z4 was effective (34–26 mm against *S. aureus* and 18–10 mm against *E. coli*). A paradigm for ZnO-NPs of the future in the battle against water pollution and healthcare illnesses is created by the dual function of the (112) plane, which links the suppression of bacteria with the generation of ROS.

Paper ID: ICSHSD-135

Design and Synthesis of Catalysts for the Lignin Valorization for the Application as Chemical Feedstocks in the Paints and Textile Industries

Habibur Rahman[1], and Nur Uddin Ahamad[1,*]
[1]Department of Chemistry, Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh
**Corresponding email: nur-che@sust.edu*

ABSTRACT

Lignin is the second most abundant naturally occurring complex organic material, considered a low-value waste product. The lignin was extracted from rice straw by alkaline pretreatment and was characterized by Ultraviolet-visible (UV-Vis) extinction spectra and Fourier-Transform Infrared Spectroscopy (FTIR) tests. This research work is dedicated to design and synthesis of metal and metal-oxide nanostructures with different morphologies (nano rod & cube, core-shell) and compositions (as TiO_2) that would carry out the depolymerization process of lignocellulosic organic aromatic polymers. The nanorods & cubes were synthesized via polyol method and primarily characterized by UV-Vis extinction spectra. The deposition of the TiO_2 phase on the surface of both catalysts was achieved through a solvothermal method. The structural modification of metal Ag and Ag NR (Ag Nanorods) to metal-oxide ($Ag@TiO_2$ and $Ag\ NR@TiO_2$) was initially investigated with UV-Vis extinction spectra analysis, and their morphologies were investigated by analyzing the scanning electron microscopy (SEM) images and transmission electron microscopy (TEM) images after the fabrication of necklace-like coatings and core-shell. The energy dispersive spectroscopy (EDS) technique was used for elemental investigation. Tailoring shell thickness for both $Ag@TiO_2$ and $Ag\ NR@TiO_2$ nano-catalysts was accomplished by the acid-etching method, and the deterioration of the shells was traced by monitoring the extinction spectra of both colloidal and solid-supported nanoparticles (NPs). The synthesized metal and metal-oxide nanostructured catalysts were used to depolymerize lignocellulosic organic aromatic polymer targeting β-O-4 linkages. The polymerization process was monitored by UV-Vis Extinction Spectra analysis, and extracted organic depolymerized products are primarily characterized by FTIR analysis. The Gas Chromatography–Mass Spectrometry (GC-MS) test would be carried out for further investigation to identify volatile organic compounds that form during the depolymerization process. The investigation results reveal the effective plasmonic photocatalysts design to offer a protocol for the valorization of lignin. Further work will be directed towards the effective filtration and separation of Ag NRs from polymorphs, along with the optimization of the shell thickness by controlled impregnation to enhance catalytic activity for the valorization of lignin, which can be used as chemical feed stocks in the paint and textile industry.

Paper ID: ICSHSD-141

Moringa Oleifera Mediated Green Synthesis and Characterization of Silver (Ag) and Nitrogen (N) Reinforced TiO_2 Nanoparticles: A Multifunctional Approach to Visible-Light Photocatalysis, Antimicrobial Applications, and Kinetic Study

Sanjida Khanam[1,*], and Md. Kamrul Hossain[1,*]
Department of Chemistry, University of Chittagong, Chittagong-4331, Bangladesh
*Corresponding email: nafisa26sanjida@gmail.com; kamrulch@cu.ac.bd

ABSTRACT

The long-term steady growth of civilization is currently susceptible owing to global environmental degradation and an energy scarcity. It has become crucial for researchers to devise protocols that are both energy-efficient as well as favorable for the environment. Industrial debris, particularly those involving textiles, leather, paper, and pharmaceuticals, discharges toxic dyes that accumulate in the water, undermine ecosystems, and threaten human health endangered. Nanotechnology, especially semiconductor nanomaterials, has unique amenities as their properties can be modulated. TiO_2 nanoparticles stand out among them considering they are inexpensive, stable, have a strong oxidation potential, and may be applied as sensors, photocatalysis, and antimicrobial activity. However, since they have a substantial band gap (3.2 eV), they are limited to absorbing UV light, and the fast recombination of electrons and holes hinders their efficiency. Doping with metals and nonmetals has become a way to improve visible-light activity. Notably, Green synthesis utilizing Moringa oleifera extracts, which are high in flavonoids and polyphenols, additionally makes TiO_2 perform even better through stabilizing oxygen vacancies, decreasing the band gap, and increasing its photocatalytic and antibacterial efficacy. Implementation of Moringa oleifera leaf extract to synthesize and characterize multifunctional silver (Ag) and nitrogen (N) co-doped titanium dioxide (TiO_2) nanoparticles via green plant mediated route. Improve the absorption of visible light by lowering the band gap of pure TiO_2. Characterize by UV-Vis spectroscopy, FTIR, XRD, SEM and TEM, EDX. Asses their organic dye degradation and antimicrobial property and showing that they could be useful in biomedical and environmental applications. The synthesis is undertaken in one pot green synthesis approach, incorporating Moringa oleifera extract functioning as both a stabilizer and a doping agent. Precursors $TiCl_4$, $AgNO_3$, and NH_4OH is applied with optimal concentrations. The nanoparticles is collected, rinsed out and dried, then calcined to yield crystalline forms. Characterization is carried out using XRD, FTIR, SEM, and EDX. Photocatalytic activity is assessed through the degradation of Rhodamine blue dye under visible light irradiation, with degradation rates evaluated using UV–Vis spectroscopy. Antimicrobial activity is reviewed through broth dilution method against typical bacterial strains. The synergistic effects of Ag and N doping lowers the band gap of TiO_2, making it better at absorbing visible light, improve charge carrier separation and reactive oxygen species (ROS) generation, and make the nanoparticles better at breaking down organic pollutants and showing significant antimicrobial activity against both Gram-positive and Gram-negative bacteria. Conclusion and Future prospects: This study seeks to fabricate multifunctional Ag–N co-doped TiO_2 nanoparticles using a green synthesis approach utilizing Moringa oleifera by merging photocatalytic and antimicrobial applications at once. The synthesized TiO_2 nanoparticles exhibit prospective for scalable applications in wastewater treatment, antimicrobial coatings, water filters, packaging materials, energy storage, photocatalytic hydrogen production, sensor technologies and solar-driven environmental restoration. Moringa oleifera extract emphasizes the prospect of building plant-based nano factories, involving other medicinal plants might be used offering a pathway toward multifunctional and sustainable nanotechnology.

Paper ID: ICSHSD-152

Nitrogen Doping in Carbohydrate-Derived Carbon Dots for Fluorescence-Based Sensingand Bioactivity Applications

Sumaiya Hasan Suma[1], and Md. Abu Bin Hasan Susan[1, 2,*]
[1]Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
[2]Dhaka University Nanotechnology Center (DUNC), University of Dhaka, Dhaka-1000, Bangladesh
**Corresponding email: susan@du.ac.bd*

ABSTRACT

Carbon dots (CDs) are biocompatible, economical, and environmentally benign nanoparticles with intriguing applications in biomedicine and biophotonics. Owing to their unique optical properties, such as strong photoluminescence and tunable emission, they have garnered significant attention as alternatives to conventional fluorescent probes. In this work, highly fluorescent CDs were synthesized from glucose, fructose, sucrose, raffinose, starch, and cellulose through a hydrothermal process, with fructose-derived CDs (CD-Fr) exhibiting the highest fluorescence. To further enhance their photoluminescence, nitrogen doping was carried out using aqueous ammonia and urea as nitrogen sources, resulting in nitrogen-doped carbon dots (NCDs) with significantly improved fluorescence performance. The hydrothermal synthesis of CD-Fr was optimized at 180 °C after evaluating a temperature range of 100–180 °C in 10 °C increments, which enhanced both yield and photoluminescence of the CDs. Additionally, adjusting the solvent volume (20, 30, and 40 mL) demonstrated that smaller volumes favored the production of CDs with stronger fluorescent emission. Particle size and morphology analyses using dynamic light scattering (DLS)and transmission electron microscopy (TEM) revealed uniform, quasi-spherical particles (0.5-8 nm). UV-visible and attenuated total reflectance-Fourier transform infrared (ATR-FTIR) spectroscopy indicated the presence of -OH, C=O, C=C groups in CDs and additional presence of -NH_2, C-N, C=N groups in NCDs. Elemental analysis using a CHNS analyzer and photoluminescence enhancement observed by a fluorescence spectrophotometer confirmed the nitrogen doping in CDs. The relative quantum yield of CD-Fr increased substantially from 0.095% to 0.480% and 0.866% following nitrogen doping with urea and aqueous ammonia, respectively. The synthesized CDs and NCDs exhibited excellent thermal stability (up to 60 °C) and maintained a particle size below 10 nm even after one month of storage. Antimicrobial activities tested on E. *coli* and *B. subtilis* bacterial culture showed no inhibition of growth, inferring negligible antimicrobial property of CDs and NCDs. Cytotoxicity analysis via cell viability assay revealed that CDs and NCDs were highly toxic at the prepared concentration but exhibited reduced toxicity at lower concentrations. Ultimately, the synthesized NCDs were employed for bilirubin detection in real samples, confirming their effectiveness for practical biomedical use.

Paper ID: ICSHSD-163

Magnetically Responsive Synthetic Polymer-Modified Bio-Composite Particles for the Separation of Dyes from Wastewater

Ruhul Amin[1,*], Md. Harun Al Rashid[1], and Mostafa Kaiyum Sharafat[1]
[1] Department of Chemistry, Begum Rokeya University, Rangpur, Rangpur-5400, Bangladesh
*****Corresponding email: ruhul0178297@gmail.com*

ABSTRACT:
Magnetic particles are increasingly studied for dye removal from wastewater, as an external magnetic field can easily separate them. The efficiency of magnetic particles can be significantly increased by modifying and functionalizing them with synthetic polymers. In this work, microcrystalline cellulose was prepared from raw jute cellulose called Microcrystalline Jute Cellulose (MCJC) through a series of processing including bleaching, delignification, and hydrolysis. Using MCJC, composite particles of MCJC/Fe_3O_4 were prepared by the co-precipitation of Fe^{2+} and Fe^{3+}. These bio-composites were then modified with copolymers of Glycidyl Methacrylate (GMA) and Methacrylic Acid (MAA) through free radical polymerization utilizing V-50 as the initiator in an aqueous medium. The final composite particles, named MCJC/Fe_3O_4/P(MAA-GMA), were characterized using Scanning Electron Microscope (SEM), Energy Dispersive X-ray Spectroscopy (EDX), Fourier Transform Infrared Spectroscopy (FTIR), Tharmogravimetric Analysis (TGA) and, Vibrating Sample Magnetometer (VSM) to confirm their shape and morphology. These synthesized particles were applied for the separation of Methylene Blue (MB) dye from wastewater. They demonstrated optimal performance at slightly basic pH of approximately 8. The obtained data showed that the adsorption process followed Langmuir isotherm, with maximum adsorption capacity (Q_{max}) of 195.61 mg g^{-1}. Additionally, the adsorption process best fitted with pseudo pseudo-first-order kinetics model. These particles showed a great reusable property, allowing for efficient cleaning with alcohol for subsequent use. This finding highlights their potential for suitable applications in dye adsorption process from wastewater.

Paper ID: ICSHSD-164

Controlled Deposition of Bioactive Nanomaterial inNanocellulose Matrix for Engineering Hygienic Textiles

Fariha Sanjida[1], and Nur Uddin Ahamad[1,*]
[1]Graduate Research Student, Department of Chemistry, Shahjalal University of Science and Technology, Sylhet 3114, Bangladesh
[1]Professor, Department of Chemistry, Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh
*****Corresponding email: nur-che@sust.edu*

ABSTRACT
In this research work, we aimed to prepare silver nanoparticles deposited nano-cellulose composite for potential application in hygienic textiles. The deposition of silver nanoparticle on nanocellulose was performed in a controlled fashion. Prior to deposition, cellulose was extracted from rice straw, the most available, inexpensive, and biocompatible raw material of our country, by pretreating it with alkaline and acid solutions successively. The formation of silver nanoparticles was primarily confirmed by monitoring extinction spectra of deposited silver on cellulose matrix. Morphology of the extracted cellulose was studied by Scanning Electron Microscope (SEM) image analysis. The morphology and distribution of silver nanoparticles on nano cellulose will be carried out by recording Scanning Electron Microscope (SEM) and Transmission Electron Microscopy (TEM) image respectively. Antibacterial Activity of Cellulose-Silver Nanocomposites was studied against Multidrug-Resistant *E. coli.*

Paper ID: ICSHSD-179

Crystallographic Modification of Metal Oxides for the Electrochemical Detection of Heavy Metal in Water

Md. Sahadat Hossain[1,*], and Samina Ahmed[1]
[1]Institute of Glass and Ceramic Research and Testing (IGCRT), Bangladesh Council of Scientific and Industrial Research (BCSIR), Dr. Qudrat-i-Khuda Road, Dhanmondi, Dhaka-1205, Bangladesh
**Corresponding email: saz8455@gmail.com*

ABSTRACT

The crystallographic facet modification is one of the advanced and effective ways of tuning the properties of nano-materials. In this research, we used tetraethyl ortho titanate as a starting material to synthesize {001}-facet nano TiO_2 using stearic acid as an organic modifier. The synthesized sample was characterized using X-ray diffractometer (XRD), Thermogravimetric analyzer (TGA), differential scanning calorimetry (DSC), X-ray photoelectron spectroscopy (XPS), Field emission scanning electron microscopy (FESEM), Fourier transformed infra-red (FTIR) and UV-visible Spectrophotometer. Crystallographic parameters and the facet formation were evaluated using XRD data. The working electrode was fabricated using {001}-facet nano TiO_2 for selective and sensitive detection of heavy metal, Cadmium (Cd), using an electrochemical technique. The sensitivity of the TiO_2-modified glassy carbon electrode was evaluated using the potassium ferrocyanide. Qualitative and quantitative analyses were performed using different electrochemical techniques along with the estimation of the surface area of the working electrode. Different equations such as Randles–Sevcik, and Laviron equations were also utilized to characterize the efficacy of the {001}-facet TiO_2-modified glassy carbon working electrode for the Cd-ions detection. Highly sensitive working electrode exerted very good results where the limit of detection (LOD) was 2.8×10^{-4} ppb, the limit of quantification (LOQ) was 8.7×10^{-4} ppb, the sensitivity was 0.1276 µA/ppb, and the linear range was 0.1-100 ppb.

Paper ID: ICSHSD-188

Fabrication of Ag Doped ZnO Nano Photocatalyst for Efficient Removal of Acid Orange 10 from Wastewater

Farhad Mahmud Fahim[1], and Md. Nurnobi Rashed[1,*]
[1]Department of Chemistry, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
**Corresponding email: rashed@chem.buet.ac.bd*

ABSTRACT

The increasing discharge of synthetic dyes, such as Acid Orange 10 (AO10), into aquatic environments presents a serious environmental challenge due to their toxicity, persistence, and resistance to conventional wastewater treatment methods. Among advanced oxidation processes, semiconductor photocatalysis has emerged as an effective, sustainable solution for the degradation of such pollutants. Zinc oxide (ZnO), a wide-band-gap semiconductor with a bandgap of 3.2 eV, has gained significant attention for its photocatalytic potential under UV light, owing to its low cost, environmental friendliness, and high photocatalytic activity. However, the photocatalytic efficiency of pristine ZnO is hindered by the rapid recombination of photo-generated electron-hole pairs. To overcome this limitation, doping ZnO with noble metals, particularly silver (Ag), has shown promising results. Silver doping enhances visible light absorption through surface plasmon resonance, improves charge carrier separation, and consequently boosts the overall photocatalytic performance. In this study, Ag-doped ZnO (Ag–ZnO) nanostructures were synthesized and characterized to evaluate their photocatalytic efficiency in degrading AO10 under UV irradiation. ZnO nanoparticles were synthesized via a coprecipitation method, followed by calcination to obtain the final product. To synthesize Ag-doped ZnO, silver nitrate ($AgNO_3$) was co-dissolved with zinc acetate $Zn(C_2H_3O_2)_2$ to achieve varying doping concentrations (6%, 12%, 18%, and 24%) before undergoing similar precipitation, washing, and calcination steps. The synthesized ZnO and Ag–ZnO nanoparticles were characterized using UV–vis spectroscopy, X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR) and scanning electron microscopy (SEM). The photocatalytic degradation of AO10 under UV light was assessed, revealing that Ag–ZnO exhibited a significant improvement in degradation efficiency compared to pure ZnO. At 60 minutes of UV irradiation, Ag–ZnO with 12% silver doping removed 91% of AO10, while the pure ZnO achieved only 62% degradation, with adsorption contributing only 27% in both cases. The maximum absorbance for pure ZnO occurred at 544 nm, indicating the effective utilization of UV light.The results highlight that Ag-doped ZnO nanostructures offer superior photocatalytic degradation of Acid Orange 10, exhibiting enhanced efficiency, stability, and environmental compatibility. This study suggests that Ag-doped ZnO could provide an efficient and eco-friendly solution for dye-laden wastewater treatment, paving the way for more sustainable industrial wastewater management and clean water technologies

Paper ID: ICSHSD-191

Synthesis of Polyaniline Nanoparticles with Tunable Size Using W/O Microemulsion as a Nanoreactor

Mehnaj Tahnoon Pronomee[1], and Md. Abu Bin Hasan Susan[1,2,*]
[1]Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
[2]Dhaka University Nanotechnology Center (DUNC), University of Dhaka, Dhaka-1000, Bangladesh
**Corresponding email: susan@du.ac.bd*

ABSTRACT

Polyaniline (PAni) is highly useful electrically conductive polymer known for its remarkable applications in sensors, batteries, corrosion protection, and electrochemical devices. Owing to intrinsic conductive property of PAni, it has captured significant attention as electromagnetic shielding material in smart textile. In this work, PAni was synthesized using a non-ionic surfactant i.e., Triton X-100 based w/o microemulsion of different compositions having different core sizes. The core size was controlled by adjusting the molar ratio of water-to-surfactant. Polymerization of aniline was confined to a nanoreactor named 'water pool' surrounded by surfactant molecules in the non-polar dispersion medium. The characteristic absorption peaks of PAni due to π-π* transition of benzenoid ring and n-π* transition of quinonoid moiety is visible in UV-visible absorption spectra. Formation of PAni was confirmed through Fourier transform infrared (FTIR) spectral analysis and CHNS analysis. The two most important characteristics bands due to quinonoid as well as benzenoid ring stretching vibrations became visible in the FTIR spectra which confirmed the formation of PAni. The thermal property of synthesized PAni showed its high stability up to 500 °C. The morphology of aggregates accompanied by aggregation behavior of synthesized PAni particles were characterized by field emission scanning electron microscopy (FESEM) and dynamic light scattering (DLS). The size of the PAni particles increases from 9 nm to 456 nm with the increase of water-to-surfactant molar ratio of microemulsion. During precipitation process, aggregates may form which also have increment in size with the increase of water pool size. Results analyzed from UV-visible absorption spectra are compatible with that obtained from FESEM. With proper adjustment of core size of microemulsions, size of PAni can be tuned. Finally, a strategy to tune size of PAni nanoparticles from W/O microemulsions has been developed.

Paper ID: ICSHSD-196

Evaluation and DFT Analysis of Green Biocomposites Derived from Polyacrylic Acid and Oxidized Water Hyacinth in an Acidic Medium

Taslima Akter[1, 2], and Shahin Sultana[3,*]
[1]Department of Theoretical and Computational Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
[2]Department of Chemistry, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
[3]Fiber and Polymer Research Division, BCSIR Dhaka Laboratories, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka-1205, Bangladesh
**Corresponding email: Shahin Sultana, shasultana@gmail.com*

ABSTRACT

This study investigates sustainable green biocomposites derived from polyacrylic acid (PAA) and water hyacinth (WH) biopolymer powder in an alkaline medium. WH, an invasive aquatic plant, was chemically oxidized using hydrogen peroxide to produce dialdehyde cellulose, enhancing –CHO groups for covalent interactions with PAA. Biocomposites were prepared at varying PAA: WH ratios (85:15, 80:20, 75:25, 70:30) using both raw WH (RWH) and oxidized WH (OWH), processed via compression molding. The 75:25 PAA:OWH composites exhibited optimal mechanical and thermal performance. ATR-FTIR confirmed oxidation, while SEM, TGA, and water absorption tests demonstrated superior structural, thermal, and water-resistant properties for OWH-based composites. DFT calculations (B3LYP/6-311+G(d,p)) revealed stronger PAA–OWH interactions, higher binding energies, and reduced HOMO–LUMO gaps, supporting experimental results. These findings highlight a low-toxicity, sustainable approach to valorize WH into high-performance biocomposites suitable for packaging, biomedical, and soil-conditioning applications.

Paper ID: ICSHSD-197

Enhanced Adsorption Performance of CeO_2–SnO_2 Nanocomposite for Methyl Orange Removal

Khijir Abdullah Mehdi[1], and Md Nurnobi Rashed[1,*]
[1]Department of Chemistry, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
**Corresponding email: rashed@chem.buet.ac.bd*

ABSTRACT

The discharge of synthetic dyes such as methyl orange (MO) into aquatic systems has become a significant environmental concern due to their toxicity, persistence, and resistance to biodegradation, creating risks to both ecosystems and human health and highlighting the limitations of conventional treatment methods. As a result, researchers have increasingly focused on nanostructured metal oxides, which are known for their tunable surface chemistry, high stability, and strong adsorption properties, but individual oxides often suffer from restricted surface area and slower adsorption kinetics. To address these gaps, the present study was designed with the objective of synthesizing and evaluating the adsorption performance of pure CeO_2 and a CeO_2–SnO_2 composite for the removal of MO dye from aqueous solution, with the goal of improving efficiency and accelerating the dye removal process. The materials were prepared using a hydrothermal method in which cerium nitrate and tin chloride precursors were dissolved in water, the pH was adjusted, and the solution was subjected to hydrothermal treatment at 180 °C for 12 hours, after which the precipitates were washed, dried, and calcined to produce stable crystalline powders. Batch adsorption experiments were carried out under dark conditions with a 10 ppm MO solution to eliminate photocatalytic effects, and samples were collected at regular intervals to measure absorbance changes using UV–Vis spectrophotometry and calculate the percentage of dye removed. The experimental results demonstrated that pure CeO_2 removed approximately 73% of MO after 80 minutes, whereas the CeO_2–SnO_2 composite achieved nearly 80% removal within only 20 minutes, thereby confirming a substantial enhancement in adsorption efficiency. The improved performance of the composite is attributed to synergistic interactions between CeO_2 and SnO_2, which provide a larger number of active surface sites, increase surface reactivity, and promote more efficient dye–surface interactions, leading to faster kinetics and higher overall dye removal capacity compared to the single oxide. In conclusion, this study establishes that the CeO_2–SnO_2 composite is a highly effective and scalable adsorbent material for wastewater treatment, outperforming pure CeO_2 by demonstrating both higher adsorption capacity and significantly faster removal rates. The findings highlight the importance of composite engineering in the design of advanced environmental nanomaterials and suggest that coupling adsorption with photocatalytic degradation under UV and solar irradiation could offer a sustainable and integrated solution for the remediation of dye-polluted water in future applications.

Paper ID: ICSHSD-203

Fabrication and Performance Analysis of Functionalized Polyethersulfone Membranes for Water Treatment

Mithun Rani Nath[1,2], Abu Bin Imran[1,*], and Al -Nakib Chowdhury[1,*]
[1]Department of Chemistry, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
[2]Department of Applied Chemistry and Chemical Engineering, Noakhali Science and Technology University, Noakhali-3814, Bangladesh
**Corresponding email email: abimran@chem.buet.ac.bd; nakib@chem.buet.ac.bd*

ABSTRACT

Growing populations and wastewater from residential, commercial, and agricultural sources create a water scarcity problem, demanding membrane technology for collecting and recycling water from diverse sources. Polyethersulfone (PES) membranes are durable and stable in water purification, although they are often hindered by insufficient hydrophilicity and poor fouling resistance. Integrating polyvinyl pyrrolidone (PVP) and polyethyleneimine (PEI) as modifying agents into the PES matrix enhances the membrane's hydrophilicity, thereby improving water permeability and reducing fouling resistance. This modification technique typically involves phase inversion, resulting in a bi-continuous structure with a large surface area and associated pores. The study focuses on how integrating PVP and PEI at the requisite concentration in the casting solution affects membrane pore growth by evaluating the performance and properties of the membranes that develop. The efficiency of the membrane was assessed by employing various heavy metal ions to determine water flux, permeability, and membrane adsorption capacity.

Paper ID: ICSHSD-215

Synthesis, Biological Evaluation, and I*n Silico* Insights of Thiosemicarbazide-Derived Schiff Bases and Their Ni (II) Cu (II) Complexes

Md. Tariqul Islam[1], Md. Ashraful Islam[1], Md. Saddam Hossein[2], Md. Ali Ashraf[1], Md. Faruk Hossen[1], and Md. Kudrat-E-Zahan[1,*]
[1]Department of Chemistry, Rajshahi University, Rajshahi-6205, Bangladesh
[2]Department of Chemistry, Begum Rokeya University, Rangpur-5404, Bangladesh
**Corresponding email: kudrat.chem@ru.ac.bd*

ABSTRACT

The design and development of Schiff bases derived from thiosemicarbazide and their transition metal complexes have gained considerable attention due to their diverse pharmacological potential. The Ni(II) and Cu(II) complexes were synthesized from the Schiff base ligand, where the ligands were derived from the condensation reaction of thiosemicarbazide with 4-methylbenzaldehyde. The synthesized compounds were characterized using elemental analysis, spectral analysis (FTIR, Raman, UV-vis, MS, ^{1}H NMR, XRD), magnetic measurement, and thermal analysis. Schiff bases exhibited bidentate behavior via azomethane nitrogen and thiolate sulfur in the complexes. The Ni(II) complexes showed octahedral geometry, while Cu(II) complexes demonstrated tetrahedral geometry. The complexes are ascribed more stability than the Schiff bases. The nanosized particles of the Schiff base and its complexes were examined using X-ray diffraction (XRD), which revealed enhanced surface reactivity and bioavailability. The antimicrobial and cytotoxic activities were evaluated by the agar disc diffusion method and the brine shrimp lethality assay, revealing that all the compounds were biologically active. The biological activity was systematically evaluated, exhibiting improved antimicrobial efficacy compared to the free ligands, which is attributed to increased lipophilicity and cell permeability via chelation. The synthesized compounds were investigated using Computational techniques, including molecular docking (PDB IDs: 1JIJ, 1Q8I, 5V8E, and 6P8U for S. aureus, E. coli, B. cereus, and P. aeruginosa, respectively), ADMET prediction, Density Function Theory (DFT), and drug-likeness studies. These studies provided insights into the interaction of the ligands and complexes with biological target proteins, supporting the observed experimental activity and indicating favorable binding affinities of the synthesized compounds. The previously mentioned results suggested that the ligands and their metal complexes have potential as active medicinal agents. *In vivo* investigations and clinical trials are essential for enhanced clarity.

Paper ID: ICSHSD-238

Promising Antioxidant, and Photocatalytic Activies of Phytosynthesized TiO_2 Nanoparticles using *Borassus flabellifer* Seed Extract

Mahjabin Taskin[1,*], Bithi Paul[1], and Farzana Sabeth[1]
[1]Department of Physics, Faculty of Science and Technology, American International University-Bangladesh, Dhaka-1229, Bangladesh
**Corresponding email: mtaskin@aiub.edu*

ABSTRACT

Nanotechnology is rapidly progressing as nanoscale materials show distinct properties compared to their bulk forms. Titanium dioxide nanoparticles (TiO_2 NPs) are valued for stability, biocompatibility, and light-activated activity, with applications in medicine, environment, and industry. Conventional synthesis often requires hazardous chemicals and high energy. This study presents a green, eco-friendly synthesis using *Borassus flabellifer* seed peel extract (PSPE) as a natural reducing and stabilizing agent, offering a sustainable, safe, and cost-effective alternative. Fresh Palmyra palm seed peels were collected, washed, shade-dried, ground into fine powder, and extracted with deionized water to prepare PSPE. For TiO_2 NP synthesis, 10 mL of PSPE was added dropwise to TTIP solution, stirred for 3 hours, and centrifuged to isolate NPs. The precipitates were repeatedly washed, dried at 80°C, and collected as light-brown TiO_2 NP powder, which was later preserved for characterization and further experimental analysis. In this study, XRD analysis confirmed that the synthesized TiO_2 NPs exhibited the anatase tetragonal phase with an average crystallite size of 4.3 nm. TEM observations showed nearly spherical particles ranging from 10–30 nm. Narrow optical band gap was calculated from UV–Vis absorption. Phytochemicals were observed in FTIR spectra. FESEM and TEM revealed uniform morphology with minimal aggregation. Photocatalytic efficiency was assessed using methylene blue (MB) dye under UV irradiation, where ~86.1% degradation was achieved within 120 minutes. Antioxidant activity was evaluated using the DPPH assay, and the TiO_2 NPs exhibited strong radical scavenging which is closely comparable to the standard. Their antioxidant performance is attributed to the small size, high surface energy, anatase structure, and phytochemical capping. Overall, PSPE-mediated TiO_2 NPs demonstrate excellent antioxidant and photocatalytic activities, underscoring their potential applications in biomedical therapy, food packaging, and environmental remediation, while supporting sustainable nanotechnology through agricultural waste valorization.

Paper ID: ICSHSD-268

Photodegradation of *p*-Chlorophenol (PCP) and *p*-Nitrophenol (PNP) Mediated by Titanium Dioxide (TiO_2) and Doped TiO_2Photocatalysts

Md. Kamrul Hossain[1,*], Md. Mufazzal Hossain[2], and Shamim Akhtar[1]
[1]Nanotechnology, Renewable Energy and Catalysis Laboratory (NRCL), Department of Chemistry, University of Chittagong, Chattogram-4331, Bangladesh
[2]Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
**Corresponding email: kamrulch@cu.ac.bd*

ABSTRACT

TiO_2, Ag-, and Cr-doped TiO_2 nanoparticles (NPs) are synthesized by the sol-gel method using Titanium isopropoxide as a precursor. The prepared NPs are characterized by using the techniques of Scanning Electron Microscope (SEM), X-ray Diffraction (XRD), Energy Dispersive Spectroscopy (EDS), and X-ray Photoelectron Spectroscopy [XPS]. SEM imaging visualizes the spherical morphology of all NP samples. EDS spectra assigned the peaks for Ti and O in TiO_2, Ag, Ti, and O in Ag-doped TiO_2, and Cr, Ti, and O in Cr-doped TiO_2, all leading to confirm the purity of NP samples. XRD spectra reveal that all of the NPs exist as anatase phases with tetragonal structures. The crystalline sizes of NPs are calculated by following Debye–Scherrer equation and their lattice parameters for the peaks at (200) and (101) by the Williamson–Hall (W–H) plot method. The XPS study demonstrates the chemical states and valance states of several species in all the NPs. Furthermore, the prepared NPs are used to degrade *p*-chlorophenol (PCP) and *p*-nitrophenol (PNP) photocatalytically, under various conditions, including changes in the catalyst dosages, initial concentrations of pollutants, solution pH, irradiation time, and impact due to a cation. The effect of catalyst doses has revealed that the highest % degradation of PCP and PNP occurs at 2.0 g/L dose for all of the TiO_2, Ag-TiO_2, and Cr-TiO_2 as photocatalysts. Under 90 minutes irradiation at $[PCP]_0 = 1.0 \times 10^{-4}$ M, and catalyst dose = 2.0 g/L the % degradations are 50.06%, 76.96%, and 66.56% for TiO_2, Ag-TiO_2, and Cr-TiO_2, respectively. Whereas, under similar conditions for PNP the values are 76.49 %, 99.71 %, and 82.21 % for using TiO_2, Ag-TiO_2, and Cr-TiO_2, respectively. Using TiO_2 and Ag-doped TiO_2 NPs as catalysts, the effect of pH on the % degradation of PCP and PNP is also observed. In order to illustrate the kinetics of photocatalytic degradation of PCP and PNP under various experimental conditions, both the linear and nonlinear equations are used. The estimated pseudo-first-order rate constants k are also found to be higher for the Ag- and Cr-doped TiO_2 NPs compared to that of pure TiO_2. All the results lead to suggest that, other than very high % degradation, the reaction rates are also faster with the doped TiO_2 samples. Therefore, to degrade PCP and PNP both of the Ag- and Cr-doped NPs are found to be efficient as photocatalysts and they can be employed to degrade organic pollutants of similar types as well.

Paper ID: ICSHSD-275

Surface Propensity of Hydrophilic and Hydrophobic Surface-active Ionic Liquid-based Microemulsions and Their Application in Micellar Catalysis

Israt Jahan Heme[1] and Md. Abu Bin Hasan Susan[1,2,*]
[1]Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
[2]Dhaka University Nanotechnology Center (DUNC), University of Dhaka, Dhaka-1000, Bangladesh
Corresponding email: susan@du.ac.bd

ABSTRACT

Microemulsions are widely recognized supramolecular systems, used in nanotechnology, oil and gas industries, agrochemicals, cosmetics, and pharmaceuticals. Ionic liquid (IL) based microemulsions have garnered much attention owing to their ultralow interfacial tension, large interfacial area, and great solubilizing ability, making them a promising medium for micellar catalysis as a potential nanoreactor. In this work, the surface behavior of surface-active IL (SAIL) based microemulsions has been studied using different ILs of varying chain length. Here, two different types of microemulsion systems have been prepared, where one system contains ILs as the hydrophobic phase in combination of water and a conventional surfactant, while the other system contains long-chain SAILs as the surfactant instead of conventional surfactants, and their physicochemical properties and surface behavior have been observed to investigate the effect of the chain length of ionic liquids in SAIL-based microemulsions. IL-based microemulsion systems containing conventional surfactants have been prepared using Tween-20, water, and IL (1-butyl-3-methylimidazolium hexafluorophosphate $[C_4mim]PF_6$, 1-dodecyl-3-methylimidazolium hexafluorophosphate $[C_{12}mim]PF_6$), where the IL acted as the non-polar phase due to the hydrophobic nature in combination with the surfactant and water for different compositions of microemulsions. SAIL-based microemulsion systems have been prepared using ethylene glycol as the hydrophilic phase, SAILs (1-octyl-3-methylimidazolium chloride $[C_8mim]Cl$, 1-dodecyl-3-methylimidazolium chloride $[C_{12}mim]Cl$, and 1-tetradecyl-3-methylimidazolium chloride $[C_{14}mim]Cl$) as surfactant, octanol as co-surfactant, and another IL (1-butyl-3-methylimidazolium bis(trifluoromethanesulfonyl)imide $[C_2mim]Tf_2N$) as the hydrophobic phase. Surface tensions of the microemulsions were measured using 'Du Noüy ring method' with a solid platinum ring, and the observations help to correlate with the structure of the ILs, hydrophobicity, and compositions of the prepared microemulsions. The physicochemical properties have been correlated to investigate the molecular environment and interaction in the microemulsion systems. Density, dynamic viscosity, refractive index, and conductivity of different compositions of microemulsions have been studied at room temperature. Dynamic light scattering measurements were carried out to observe the aggregation behavior of clusters formed in the IL-based microemulsions. The surface property of these systems was found to be indirectly influenced by their nature in the bulk. Attempts have been made to gain an insight into the surface activity and correlate it with the physicochemical properties of SAIL-based microemulsions, and the observations revealed that the prepared microemulsion systems can act as a promising medium for suitable micellar catalysis.

Paper ID: ICSHSD-278

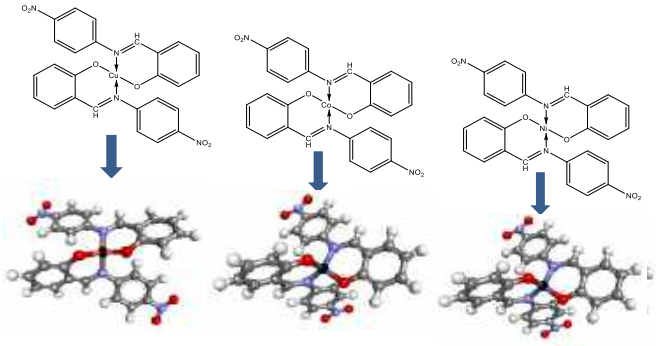
Structural, Biological, and Computational Evaluation of Schiff Base Metal Complexes with *(E)-2-*(((*4*-Nitrophenyl)imino)methyl)phenol: Antibacterial and Antioxidant Activities with DFT and ADMET Analysis

Md. Ashraful Islam[1], Md. Toukir Biswas[2], Faria Tasnim[3], Md. Sajib Hossain[1], Md. Robiul Islam[1], Md. Ali Asraf[1], Md. Faruk Hossen[1], and Md. Kudrat-E-Zahan[1,*]

[1]Department of Chemistry, University of Rajshahi, Rajshahi-6205, Bangladesh
[2]Department of Applied Chemistry and Chemical Engineering, University of Rajshahi, Rajshahi-6205, Bangladesh
[3]Department of Genetic Engineering and Biotechnology, University of Rajshahi, Rajshahi-6205, Bangladesh
**Corresponding email: kudrat.chem@ru.ac.bd*

ABSTRACT

The increasing incidence of antibiotic-resistant bacteria and diseases related to oxidative stress has highlighted an urgent demand for new therapeutic agents having multifunctional activities. In the present study, we prepared a Schiff base *(E)-2-*(((*4*-nitrophenyl)imino)methyl)phenol and its complexes with Copper(II), Nickel(II), and Cobalt(II) ions. The preparation and stability of the metal complexes so formed were established using a range of spectroscopic and analytical methods. The antibacterial activity was evaluated using the disc diffusion technique. Among all the compounds, the Cu(II) metal complex exhibited the highest antibacterial activity. In contrast, the other compounds showed moderate activity and displayed substantial sensitivity towards *S. aureus, B. subtilis, E. coli, and S. flexneri.* Antioxidant activity of the complexes was evaluated by DPPH radical scavenging of the Cu(II) complex, having the best effect with an IC50 value of 187.81 ± 1.42 µg/mL. Molecular docking studies with DNA Gyrase (PDB ID: 7P2M) as a target showed a good binding interaction for the Cu(II) complex (-10.1 kcal/mol) and proved its potential therapeutic application value. Density functional theory calculations, when applied to geometries of the Schiff base ligand and its metal complexes, showed stable molecular geometries for them; but, reducing the HOMO-LUMO energy gap in the metal complexes indicated an increase in reactivity and biological activity. The study addressed potential centres for nucleophilic attack of the complexes, providing additional evidence for the therapeutic potential of these metal complexes in the treatment of bacterial infections and those diseases associated with oxidative stress.



Surface Engineered Nanoparticles as Efficient Catalyst and Bioactive Agent: Reduction of Nitroaromatics, Radical Scavenging and Cytotoxic Activities

Most. Sabiha Islam[1], Rakibul Islam[1], Hasan Ahmad[1], and Md. Abdur Rahman[1,*]
[1]Department of Chemistry, University of Rajshahi, Rajshahi-6025, Bangladesh
Corresponding email: arahaman@ru.ac.bd

ABSTRACT
This research reports hydrothermal synthesis and characterization of hybrid nanomaterial composed of organic and inorganic components for catalytic and antimicrobial applications. The structural and morphological features of synthesized nanoparticles were characterized using various methods. The synthesized nanoparticles exhibited a uniform morphology and amorphous structure, as confirmed by SEM, TEM and XRD analyses. FTIR result confirmed the surface modification. EDX showed the presence of C, O and Co. In dry state the average size of particles is 113 nm. The zeta potential value is -23 mV at pH 12, which indicates the synthesized particles were moderately stable. TGA study revealed that the nanoparticles contained 36.54% organic matter and 62.91% was inorganic. The value of saturation magnetization was 30.11 emu g^{-1}. Specific surface area of TA-CoNPs was 37.947 m^2/g. They showed excellent catalytic efficiency in reducing aromatic nitro compounds, achieved 100 % conversion within 60 s. The color of the DPPH radical is dark purple and vivid, which was neutralized and became colourless. At a dosage of only 40 µg/mL, the TA-Co NPs consumed 97% of the radicals shown in Figure 1. Thus, it possesses potential antioxidant properties. According to results, at 3.45 mg/ mL, TA-CoNPs exhibited moderate cytotoxicity (50%). The value of LC50 was 3557. These results indicating the multifunctional nature, a promising candidate for both environmental and biomedical applications.

Paper ID: ICSHSD-330

Removal of Methyl Violet 2b & Antibacterial Activity of Co_3O_4 Nanoparticles Synthesized from Prussian Blue Analogues

Md. Rockshat[1], Faisal Islam Chowdhury[1,*], and Md. Kamrul Hossain[1,*]
[1]Department of Chemistry, University of Chittagong, Chattogram-4331, Bangladesh
Corresponding email: faisal@cu.ac.bd; kamrulch@cu.ac.bd

ABSTRACT
In this work, spherical shaped Co_3O_4 NPs were employed to remove a cationic dye Methyl Violet 2B (MV2B) and inhibit the different microorganism's growth in liquid medium. Co_3O_4 NPs were synthesized from Prussian Blue Analogue by co-precipitation method using Cobalt (II) Nitrate Hexahydrate as precursor &Polyvinylpyrrolidone (PVP) as stabilizing agent. The unique properties and nanosized spherical shape of Co_3O_4 was confirmed by using characterization techniques including Fourier transform infrared spectroscopy (FT-IR), X-ray diffraction (XRD), Scanning electron microscopy (SEM), Zeta potential, Energy-dispersive X-ray spectroscopy (EDX), Transmission electron microscopy (TEM). The adsorption process showed an effective removal of MV2B dye about 97% just within 90 minutes. The different isotherm and kinetics model were also studied to understand the adsorption mechanism. In antibacterial studies, Co_3O_4 NPs has exhibited highest inhibition rate at 250 µgmL^{-1} against gram-positive B. cereus & S. aureus, and gram-negative E. coli & S. typhi bacteria, and a fungus called Candida. These findings highlight the Co_3O_4 NPs has the potential to be used in environmental remediation, particularly in wastewater treatment process that remove organic contaminants and antibacterial activities.

Paper ID: ICSHSD-334

Boosting Self-Healing of Conventional Hydrogels with the Combinations of FunctionalizedGraphene Oxide Nano Sheet

Md. Mahamudul Hasan Rumon[1], Foysal Ahmed[1], Nahida Akter Shila[1], and Chanchal Kumar Roy [1*]
[1]Department of Chemistry, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
Corresponding email: ckroy@chem.buet.ac.bd

ABSTRACT
Graphene oxide based crosslinker (GOBC), obtained by surface activation of carboxyl groups in graphene oxide and further introduction of acrylate group, were used as dual-function crosslinker to strengthen poly(acrylic acid) (PAA) hydrogels and conduct self-healing. Compared with conventional covalently cross-linked PAA, GOBC cross-linked hydrogels showed higher mechanical properties and moderate intrinsic healing, achieving healing efficiencies of 56% (stress), 23% (strain), and 13% (work). Adding a small amount of ferric ions (0.7 mol% relative to the acrylic acid monomer) to the GOBC network dramatically increased these values to 92%, 85%, and 74%, respectively. This enhancement comes from the cooperative action of dynamic covalent bonds, non-covalent interactions, and reversible Fe^{3+}–carboxylate coordination within the matrix. Together, GOBC and metal-ion crosslinking provide a simple, flexible strategy to build strong, self-healing hydrogels suited for biomedical and soft-materials application.

Paper ID: ICSHSD-366

Nano-Engineered Antibacterial Coatings on Cotton Fabrics Using Zinc Oxide (ZnO) Nanoparticles: A Review of Recent Advances

Abhijit Dhali[1]
[1]Department of Textile Engineering, National Institute of Textile Engineering and Research (NITER), University of Dhaka, Saver, Dhaka-1350, Bangladesh.
**Corresponding email: abhijitdhali1377@gmail.com*

ABSTRACT

Cotton is among the most widely utilized natural fibers in the textile industry due to its comfort, breathability and biodegradability. However, its high moisture absorbency creates a favorable environment for microbial growth, raising concerns in applications such as medical textiles, hygiene products and sportswear. Enhancing the antibacterial functionality of cotton fabrics has become a significant research focus in recent years, particularly through the incorporation of zinc oxide (ZnO) nanoparticles. ZnO nanoparticles are known for their broad-spectrum antibacterial properties, low cytotoxicity, UV- blocking capability and chemical stability. As a result, they are increasingly being used in textile finishing processes to impart long-lasting antimicrobial effects. This review paper critically examines recent advancements in the development of ZnO nanoparticle-coated cotton textiles. It outlines the various methods employed for nanoparticle synthesis such as sol-gel, hydrothermal and green approaches with compares their suitability for textile applications. The paper also surveys a range of coating and finishing techniques, including dip-coating, pad-dry-cure, and spray coating and layer-by-layer deposition, with an emphasis on their practicality, durability and antibacterial performance. Furthermore, the antibacterial mechanisms of ZnO nanoparticles are discussed in detail, focusing on reactive oxygen species (ROS) generation, disruption of bacterial membranes and zinc ion release. A comparative analysis of selected studies is provided to highlight variations in nanoparticle size, concentration, coating technique and bacterial inhibition effectiveness. While ZnO-based antibacterial coatings on cotton fabrics demonstrate a significant promise, challenges such as nanoparticle leaching, wash durability and environmental impact remain areas of concern. This review concludes by identifying research gaps and proposing future directions, including the integration of ZnO with other functional materials, development of eco-friendly synthesis and coating techniques and evaluation of long-term safety and biodegradability. Overall, this paper aims to support ongoing innovation in the field of smart and hygienic textiles and provide a foundation for further academic and industrial research in nano-engineered textile materials.

Paper ID: ICSHSD-445

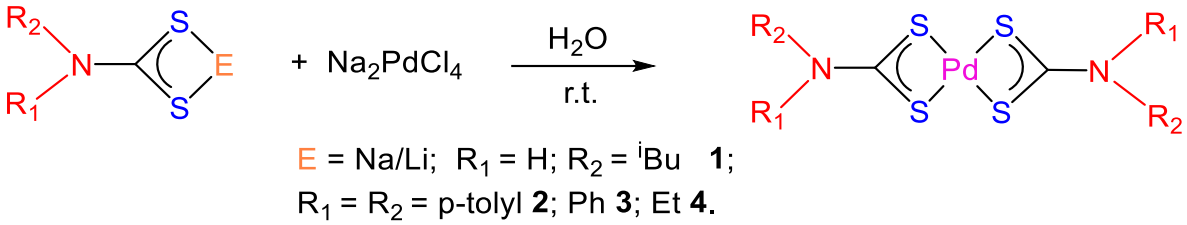
Novel Palladium Dithiocarbamates: Synthesis, Characterisation, DFT Studies, Microbial Activity and Use as Single Source Precursors of Palladium Sulfide

Md. Atikul Islam[1], Md. Nayem Hossen[1], Tannith-Jade Cole[2], David Pugh[2], Md. Aminul Haque[1], Graeme Hogarth[2], Jagodish C. Sarker[1,*]

[1]Department of Chemistry, Jagannath University, Dhaka-1100, Bangladesh
[2]Department of Chemistry, King's College London, Britannia House, 7 Trinity Street, London SE1 1DB, UK
**Corresponding email: jagodish@chem.jnu.ac.bd*

ABSTRACT

Palladium dithiocarbamate (DTC) complexes, $[Pd(S_2CNH^iBu)_2]$ (**1**), $[Pd\{S_2CN(p\text{-tolyl})\}_2]$ (**2**), $[Pd(S_2CNPh_2)_2]$ (**3**), and $[Pd(S_2CNEt_2)_2]$ (**4**), were synthesized from the reaction of MS_2CNR_2 (E = Na/Li) with Na_2PdCl_4 in water/ethanol at room temperature, with moderate yields. Comprehensive characterization was carried out using spectroscopic methods and single crystal X-ray diffraction analysis. FTIR spectra confirmed the bidentate coordination of the DTC ligands through characteristic ν(C–N) and ν(C=S) stretching bands, while ^{1}H and ^{13}C NMR spectroscopy supported the ligand framework around the Pd(II) center. Single-crystal X-ray diffraction showed triclinic crystal system. Density Functional Theory (DFT) calculations were performed to probe the electronic structure, frontier molecular orbitals, and energy band gap. Electrochemical studies showed quasi-reversible redox processes at room temperature. Apart from molecular chemistry, the anti-microbial activity assays revealed moderate to significant inhibition against selected Gram-positive and Gram-negative bacterial strains. Furthermore, we decomposed the Pd-DTCs single source precursors in oleyl amine to produce nanoscale palladium sulfide (PdS), which is the maiden example as controlled solvothermal decomposition of Pd DTCs to PdS nanoparticles.



E = Na/Li; R_1 = H; R_2 = ^{i}Bu **1**;
R_1 = R_2 = p-tolyl **2**; Ph **3**; Et **4**.

Scheme 1. Synthesis of route of palladium dithiocarbamate complexes.

Paper ID: ICSHSD-462

Ru-Sn and Ru-Os Low-Valent Mixed-Metal Clusters Bearing Heterocyclic Thiolate Ligand(S): Synthesis, Crystal and Electronic Structures

Md. Monir Hossain[1], Vladimir N. Nesterov[2], Graeme Hogarth[3], German E. Pieslingerd,[4,*], Shariff E. Kabir[1,*] Shishir Ghosh[1,*]

[1]Department of Chemistry, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh
[2]Department of Chemistry, University of North Texas,1155 Union Circle, Box305070, Denton, TX76203, USA
[3]Department of Chemistry, King's College London, Britannia House, 7 Trinity Street, London SE11DB,UK
[4]CONICET-UniversidaddeBuenos Aires, Institutode QuímicayFisicoquímicaBiol´ogicas(IQUIFIB),Buenos Aires C1113AAD, Argentina
**Corresponding email:skabir_ju@yahoo.com; shishir.ghosh@juniv.edu*

ABSTRACT

The synthesis of clusters $[Ru_2(CO)_4(SnMe_3)_2(\mu\text{-}L)_2]$ (**1-2**) (**1** L = pySH = pyridine-2- thiol, **2** L = pymSH = pyrimidine-2-thiol) and their reactions with $[M_3(CO)_{10-n}(NCMe)_n]$ (M = Ru, Os; n =0, 2) are described. Ru_2Sn_2 clusters areprepared in moderate yields from theone-pot reaction of $[Ru_3(CO)_{12}]$, Me_3SnCl and pySH in the presence of KOH, and each contains two $[Ru(CO)_2(SnPh_3)]$ units bridged by a pair of heterocyclic thiolate ligands. Treatment of **1-2** with $[Ru_3(CO)_{12}]$ in boilingbenzeneaffords pentaruthenium clusters $[Ru_5(CO)_{16}(\mu_3\text{-}L)(\mu_4\text{-}SnMe)]$ (**3- 4**) containing a raft-like metallic core consisting of five ruthenium and one tin atom. In contrast, reactions of **1-2** with $[Os_3(CO)_{10}(NCMe)_2]$ yield tetranuclear clusters $[RuOs_3(CO)_{12}(\eta^1\text{-}Me)(\mu_3\text{-}L)]$ (**5**, L = pyS; **7**, L = pymS) as the major products, in which the four metal atoms adopt a butterfly geometry, with the ruthenium occupying a wingtip position. Further products including $[RuOs_3(CO)_{12}(\mu_3\text{-}pyS)(\mu\text{-}H)]$ (**6**) and $[Os_4(CO)_{12}(\mu_3\text{-}pymS)(\eta^1\text{-}Me)]$ (**8**) are also isolated from these reactions. Clusters **6** and **8** possess an M_4 butterfly skeleton, with ruthenium in a hinge position in mixed-metal cluster **6**, but at a wingtip site in **5** and **7**. The molecular structure of each product has been established by single crystal X-ray diffraction analysis.

Paper ID: ICSHSD-483

Synthesis, Characterization, and Multifunctional Applications of Rhenium (IV) Dithiocarbamate Complexes and Used Them as Single-source Precursors for ReS_2 Nanomaterials

Md. Al-Imran[1], Md. Nayem Hossen[1], Md. Aminul Haque[1], Graeme Hogarth[2], and Jagodish C. Sarker[1,*]
[1]Department of Chemistry, Jagannath University, Dhaka-1100, Bangladesh
[2]Department of Chemistry, King's College London, Britannia House, 7 Trinity Street, London SE1 1DB, UK
**Corresponding email: jagodish@chem.jnu.ac.bd*

ABSTRACT
Rhenium dithiocarbamate (DTC) complexes exhibit promising applications in catalysis, medicinal chemistry, and material science due to their versatile coordination and redox properties. Dinuclear Rhenium (IV) dithiocarbamate complexes, $[Re_2(\mu\text{-}S)_2(S_2CNR_2)_4]$ (where R= Me, Et, p-tolyl), have been prepared from the reaction of $[Et_4N][ReS_4]$ and tetraalkyl/aryl thiuram disulfide in acetonitrile at room temperature with moderate yields. Their formation was confirmed by a combination of IR, ^1H, and ^{13}C NMR spectroscopic analysis. These complexes exhibit promising multifunctional properties, making them attractive candidates for advanced materials and medicinal applications. The in vitro antimicrobial activities of the synthesised complexes against two gram-positive (Bacillus cereus and Bacillus subtilis), two gram-negative (Escherichia coli and Salmonella typhi) bacteria, and two fungal strains (Trichoderma harzianum and Aspergillus niger) were evaluated by the disk diffusion technique. Rhenium dithiocarbamate complex, $[Re_2(\mu\text{-}S)_2\{(S_2CN(Me)_2\}_4]$, produced a prominently high zone of inhibition with 29.7±1.5 mm and 28.6±1.5 mm against Trichoderma harzianum and Aspergillus niger, respectively, compared to standard Amphotericin B (9.3±0.6 mm & 16.7±0.6 mm). The bulk and monolayer ReS_2 with a band gap of 1.35 eV and 1.43 eV, respectively, are mostly applied in electronics and optoelectronics devices, energy storage devices, logic circuits, photodetectors, catalytic hydrogen production, etc. To develop this ReS_2, we used Re-DTC as a single-source precursor. Thermogravimetric analysis (TGA) revealed distinct decomposition profiles, supporting their role as single-source precursors for rhenium disulfide (ReS_2) nanomaterials. The conversion to nanoscale ReS_2 was achieved by solvothermal decomposition of Re-DTC in oleylamine under controlled conditions, providing an efficient route for fabricating nanostructures for photovoltaic/energy storage devices.

Paper ID: ICSHSD-485

Efficient Scalable Synthesis of Mn_3O_4 with Controlled Polymorphs and Morphologies for Enhanced Battery Cathodes

Habiba Jahan[1], Nusrat Tazeen Tonu[1], Ahammad Musa[1], Md. Sadiqul Islam Sheikh[1], Parbhej Ahamed[1], and Muhammad Abu Yousuf[1,*]
[1]Department of Chemistry, Khulna University of Engineering & Technology, Khulna-9203, Bangladesh
**Corresponding email: yousuf@chem.kuet.ac.bd*

ABSTRACT
In this work, Mn_3O_4 nanoparticle was synthesized through a facile calcination process employing polyethylene glycol (PEG) as a soft template. The structural, morphological, and compositional features of the prepared material was investigated by FTIR, FESEM, EDX, XRD, Solid State UV-Vis and Raman spectroscopic techniques. FTIR and Raman spectroscopic analysis validated the Mn–O stretching mode specifically associated with manganese ions in tetrahedral coordination. Elemental analysis verified the presence of manganese and oxygen in proportions consistent with Mn_3O_4 composition. XRD analysis revealed that the sample had a crystallinity of 83% and an average grain size of approximately 15 nm. Wettability assessment revealed a hydrophilic character in Mn_3O_4, which facilitated enhanced electrochemical performance. Solid-state UV-vis spectroscopy confirmed an optical band gap of 3.27 eV, indicating the semiconducting behavior of Mn_3O_4. The nanoparticle was further employed as cathode material in CR-2032 coin cell of Aqueous Rechargeable Zinc-Ion Battery (ARZIB). Electrochemical studies revealed a reversible cyclic voltammetry response with efficient Zn^{2+} storage. Low cell resistance was confirmed by electrochemical impedance spectroscopy. The assembled coin cell exhibited a high specific discharge capacity of 363.98 mAh g^{-1} at 100 mAg^{-1} with a coulombic efficiency of 96.07%. It unveiled exceptional capacity retention, preserving 88.88% of its initial capacity after 100 charge–discharge cycles and maintaining 60.70% even after 500 cycles. Moreover, varying the PEG content demonstrated its critical role in modifying the surface morphology of Mn_3O_4. Overall, this innovative strategy offers an eco-friendly and lucrative route to synthesize Mn_3O_4 nanoparticles, showcasing promising potential for their application in ARZIB.

Paper ID: ICSHSD-507

Amine Functionalization ZnO-CeO_2 Nanocomposites: Synergistic Enhancement in Photodegradation, Antibiotic Decomposition, and Antibacterial Applications

Md Swapon Hossain[1], Mohammad Awlad Hossain[1], and Md Elias[1,*]
[1]Department of Chemistry, Jagannath University, Dhaka-1100, Bangladesh
**Corresponding email: elias_chesust@yahoo.com*

ABSTRACT

The rising challenges of environmental contamination and antibiotic resistance underscore the importance of designing next-generation multifunctional nanomaterials. The present study reports the fabrication and evaluation of amine-functionalized ZnO-CeO_2 nanocomposites, which exhibit improved photocatalytic, antibacterial, and antibiotic degradation performance. A facile solvothermal method was used to modify the amine-functionalized graphene oxide (NH_2-GO) supported heterojunction ternary nanocomposites. Structural, morphological, and optical characterization were performed using UV–Vis spectroscopy, Fourier-transform infrared spectroscopy (FT-IR), photoluminescence (PL), X-ray diffraction (XRD), scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX), and elemental mapping, confirming successful amine modification and homogeneous distribution of these elements. Photocatalytic efficiency was evaluated under UV, visible, and sunlight irradiation, where the amine-functionalized composites consistently exhibited higher degradation rates than bare systems. Key operational factors, including pH, catalyst loading, and light source, were systematically optimized, with the best performance obtained in mildly alkaline media at balanced dosages. Reusability tests further confirmed the robustness of the photocatalysts, which maintained excellent activity across multiple cycles. Beyond photocatalysis, the nanocomposites display strong antimicrobial and antibiotic degradation. Experiments confirmed potent activity, highlighting the synergistic effects of surface functionalization and ROS generation. This work highlights the promising potential of amine-functionalized ZnO–CeO_2 nanocomposites as efficient, stable, and versatile materials for environmental remediation, antibacterial activity, and antibiotic resistance mitigation. The findings provide new insights into the rational design of multifunctional nanocomposites for advanced photocatalytic and biomedical applications.

Physical and Computational Chemistry

Theoretical Insights into Enhanced Electrocatalytic Arsenic Oxidation on Au-Decorated Pt Surfaces in Neutral Medium

Mohebul Ahsan[1,2], Md Asaduzzaman[3], and Mohammad A. Hasnat[1,*]
[1]Department of Chemistry, Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh
[2]Division of Chemistry, Department of Science and Humanities, Military Institute of Science and Technology, Mirpur Cantonment, Dhaka-1216, Bangladesh
[3]Division of Physics, Department of Science and Humanities, Military Institute of Science and Technology, Mirpur Cantonment-1216, Dhaka, Bangladesh
**Corresponding email: mah–che@sust.edu*

ABSTRACT
In this study, we present a comprehensive theoretical and experimental investigation of the electrocatalytic oxidation of arsenite on Au nanoparticle-immobilized Pt surfaces in a neutral medium. Density functional theory (DFT) calculations revealed that the Au-Pt bimetallic system exhibits superior adsorption energy (E_{ads} = −2.045 eV) compared to bare Au (−0.611 eV) and Pt (−0.769 eV) surfaces, indicating enhanced arsenite affinity and catalytic activity. Experimental characterizations, including SEM, PXRD, EIS, and CV, confirmed the formation of noble catalytic sites on Au and synergistic effects between Au and Pt, facilitating efficient As(III) oxidation. The reaction followed first-order kinetics with a diffusion-controlled mechanism, as evidenced by a diffusion coefficient of 3.20×10^{-7} cm^2s^{-1}. Tafel analysis further elucidated the reaction kinetics, revealing a reduced Tafel slope (277 $mVdec^{-1}$) for the Au-Pt electrode, indicative of improved charge transfer. Activation polarization analysis demonstrated lower overpotential ($|\eta_a|$ = 1.28 V) for the Au-Pt system compared to bare Pt (1.56 V), highlighting its enhanced catalytic efficiency and internal synergy after Au deposition. The findings align with theoretical predictions, underscoring the potential of Au-Pt bimetallic surfaces for arsenic sensing and remediation applications.

Paper ID: ICSHSD-68

Wearable Triboelectric Nanogenerators (TENGs) Based Sensors for Human Cardiovascular Monitoring: Progress and Perspectives

Mashrufa Akther[1], Md. Mahmud Alam[1,*], and Mohammed Jasim Uddin[2]
[1]Department of Chemical Engineering, Z. H. Sikder University of Science and Technology (ZHSUST), Shariatpur-8024, Bangladesh
[2]Department of Civil and Mechanical Engineering, SUNY Polytechnic Institute, Utica, NY 13502 USA
**Corresponding email: alam-mahmud@hotmail.com*

ABSTRACT
Cardiovascular conditions (CVDs) remain the leading cause of death worldwide, driving a critical need for non-invasive, continuous, and dependable health monitoring results. Triboelectric nanogenerators (TENGs) have surfaced as a groundbreaking technology enabling self-powered wearable sensor that convert natural biomechanical energy such as heartbeat, pulse wave, body motion into electrical signals. The paper reviews the recent progress and development in TENG- based wearable sensor for cardiovascular monitoring, pressing their eventuality to monitoring particular and clinical healthcare. The working principles, advanced accoutrements, structural designs, and integration with wireless data transmission, machine literacy, and bio-signal processing technologies are explored by this article. Operations including heart rate shadowing, pulse rate analysis, blood pressure estimation, and ECG monitoring are critically anatomized, along with their biocompatibility, safety, and long-term stability. Additionally, we bandy current challenges similar as environmental continuity, signal reliability, and energy operation, and propose unborn directions emphasizing sustainable materials, AI-supported estimation, and cold-blooded energy systems. The convergence of TENG technology with smart, wearable platforms represents a transformative step toward real-time, substantiated cardiovascular health monitoring, with far-reaching counteraccusations for telemedicine, preventative care, and implantable medical device.

Paper ID: ICSHSD-72

Theoretical Study of Anodic Chlorine Evolution Reaction on Platinum-Tetraphenyl Porphyrin Electrocatalyst

Jewel Hossen[1,*], Naoki Nakatani [2], and Md. Mosfiqur Rahman Maruf[1]
[1]Department of Chemistry, Rajshahi University of Engineering & Technology, Rajshahi-6204, Bangladesh
[2]Department of Chemistry, Graduate School of Science, Tokyo Metropolitan University, Hachioji, Tokyo 192-0397, Japan
Corresponding email: jhossen@chem.ruet.ac.bd

ABSTRACT
Chlorine, a vital industrial chemical, is predominantly produced via the chlor-alkali process, where dimensionally stable anodes (DSAs; RuO_2, IrO_2, TiO_2) are commonly employed. However, their reliance on scarce metals, limited selectivity, and environmental concerns necessitate alternative catalysts for the chlorine evolution reaction (CER). Carbon nanomaterials (CNMs) have recently emerged as promising supports owing to their high conductivity, tunable surfaces, and stability. In this work, we theoretically explored the CER activity of platinum-tetraphenyl porphyrin (PTPP), as a Pt-doped graphene analogue, using density functional theory (DFT) along with B3LYP functional and Stuttgart/Dresden triple-ζ basis set with effective core potentials for Pt and the 6-311++G(d,p) for others in Gaussian 16. The calculated adsorption energy (ΔE) of Cl onto PTPP substrate was –0.073 eV, indicating spontaneous yet weak adsorption, enabling facile desorption of chlorine in the next step according to the Volmer–Heyrovsky pathway. The Gibbs free energy (ΔG) of adsorbed chlorine (Cl*) was 0.128 eV at 1.36 V, corresponding to a thermodynamic overpotential (η_{CER}) of 128 mV, consistent with literature benchmarks. Electronic structures analyses (FMO, NBO, MEP, spin density) confirmed favorable electronic features for CER. Importantly, PTPP also displayed strong selectivity toward CER over the competing oxygen evolution reaction (OER). The ΔE/ΔG of OER intermediates (HO*, O*, and HOO*) were calculated as 2.33/2.28 eV, 4.94/4.58 eV, and 4.82/4.37 eV, respectively, all significantly higher than those of Cl*. Moreover, CER proceeds via the Cl* intermediate (ΔG: 0.128 eV) rather than the ClO* pathway (ΔG: 3.150 eV), further ensuring selective chlorine production. These results establish PTPP as a selective, efficient, and cost-effective CNM mimic for chlorine generation.

Paper ID: ICSHSD-130

Phase Separation of Triton X-100 with Tetracaine Hydrochloride: Investigating the Influence of Potassium Electrolytes on Physicochemical Properties and Interaction Forces

Israt Jahan[1,*], Shampa Saha[1], and Md. Anamul Hoque[2]
[1]Department of Chemistry, Jashore University of Science and Technology, Jashore-7408, Bangladesh
[2]Department of Chemistry, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh
Corresponding email: i.jahan@just.edu.bd

ABSTRACT
This study investigates the cloudy phase formation in a mixture of the local anesthetic tetracaine hydrochloride (TCH) and the non-ionic surfactant Triton X-100 (TX-100), with the aid of the cloud point (CP) approach. The effect of various potassium-based electrolytes (KCl, KBr, K_2SO_4, and K_2HPO_4) on the cloud point behavior was examined. The results showed that CP values were dependent on both the type and concentration of the potassium electrolytes. At a given TCH and TX-100 concentration, the CP values of the TX-100 + TCH mixture showed the following pattern in the concentration effect of K-electrolytes: CPaq.KCl > CPaq.KBr > CPaq.K_2SO_4 > CPaq.K_2HPO_4. During the mixture's phase transition, positive values of the Gibbs free energy change (ΔG_c^0) were observed, suggesting that the phase transformation process was non-spontaneous. However, increasing the electrolyte concentration resulted in lower ΔG_c^0 values, suggesting enhanced favorability of phase separation. Enthalpy (ΔH_c^0) and entropy (ΔS_c^0) changes were found to be negative with rising electrolyte concentration, pointing to exothermic and more ordered phase transformations. These thermodynamic parameters imply the involvement of electrostatic interactions (such as hydrogen bonding and dipole-dipole interactions), hydrophobic effects, and π–π interactions among the components. The data gathered from the current study will most likely be very helpful for pharmaceutical formulations and medication delivery systems.

Paper ID: ICSHSD-140

Exploration of the Clouding Behavior and Thermodynamic Properties of Triton X-100 and Chlorpheniramine Maleate Drug Mixture Influenced by the Variable Concentrations of Potassium Salts

Most. Sammi Akter[1], Md. Rehan Alam[1], Md. Rafikul Islam[1,*], Ummey Rayhan[1], and Md. Anamul Hoque[2]
[1]Department of Chemistry, Dhaka University of Engineering & Technology, Gazipur, Gazipur-1707, Bangladesh
[2]Department of Chemistry, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh
**Corresponding email: rafikchemduet@duet.ac.bd*

ABSTRACT

A lot of interest has been shown in the phase partitioning study of triton X-100 (TX-100) and chlorpheniramine maleate (CPM) drug mixture in aqueous potassium salts (K-salts). CPM drug has garnered a lot of attention because of its broad pharmaceutical uses. CPM drugs are used in the treatment of cold and allergic diseases. The phase separation behavior of TX-100 + CPM mixture was investigated by cloud point technique in aqueous solutions of K-salts (potassium chloride (KCl), potassium bi-sulfate ($KHSO_4$), potassium carbonate (K_2CO_3), and potassium sulphate (K_2SO_4)). The 70.7 mmol kg^{-1} of TX-100 and 3 mmol kg^{-1} of CPM drug concentrations were kept constant in the whole experiment. The CP values of the TX-100 + CPM mixture were observed to be declined with upsurging the K-salts contents. As the concentration of K-salts increases, the CP values showed a declining tendency in the following order: $CP_{aq.\ K_2SO_4} < CP_{aq.\ K_2CO_3} < CP_{aq.\ KHSO_4} < CP_{aq.\ KCl}$.The Gibbs free energy change (ΔG_c^o) values were found to be positive stating the nonspontaneity of phase separation. The nonspontaneity was reduced with the increase of K-salts content. The negative and positive values of free enthalpy change (ΔH_c^o) and free entropy change (ΔS_c^o) recomended the presence of probable interaction forces like electrostatic (H-bonding) and hydrophobic between TX-100 and CPM drug. Additionally, entropy-enthalpy compensation parameters were calculated and explained. The concept of this research would be more beneficial in noble drug design and development of drug formulation in pharmaceutical industry.

Paper ID: ICSHSD-160

Modulation of Water Structure by Imidazolium-based Ionic Liquids: Effects of Temperature, Concentration, and Alkyl Chain Length

Kawsar Ahmmed[1], and Md. Abu Bin Hasan Susan[1,2*]
[1]Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
[2]Dhaka University Nanotechnology Center (DUNC), University of Dhaka, Dhaka-1000, Bangladesh
**Corresponding email: susan@du.ac.bd*

ABSTRACT

The molecular-level interactions of ionic liquids (ILs) in aqueous medium are crucial for understanding how they alter the structure of water. By carefully selecting ILs and controlling their concentration, it is possible to influence reaction pathways, leading to higher product yields or the formation of alternative products. In this work, the modification of water structure by ILs having different chain lengths on imidazolium ions is investigated. The effect of additive concentrations at different temperatures has been studied using spectroscopic, volumetric, and viscometric methods. When water and solutes interact, different types of clusters are formed, and the strength and number of the hydrogen bonds in these clusters vary with the concentration of solutes. Using dynamic light scattering (DLS), the hydrodynamic diameter is measured to examine the degree of aggregation. The DLS analysis demonstrates that with increasing concentration, large networks of adjacent water layers form. These networks become unstable at higher temperatures and tend to split into smaller fragments. These tiny particles move in a Brownian motion and appear to either form larger aggregates through collisions or further split to form even smaller fragments. To understand molecular-level interactions, intermolecular close-packing, and the extent of solute-solute and solute-solvent interactions, apparent molar volume (Φ_v), Hepler's constant, Jones-Dole constants, hydration numbers, changes in free energy (ΔG), changes in entropy (ΔS), and changes in enthalpy (ΔH) of activation for viscous flow have been investigated. Viscometric and volumetric analyses reveal that ILs having smaller chain lengths (up to 8 carbon) tend to function as structure-makers, while larger chain lengths function as structure-breakers. The density of the IL-water system increases with concentration for shorter alkyl chains, whereas an opposite trend is observed for longer chains. Solutions with higher concentrations exhibit greater temperature sensitivity, and a distinct dichotomous behavior appears beyond 50 °C for all the IL solutions. This work enhances understanding of IL-water interactions and supports the design of greener and eco-friendly solvents, separation media, or industrial fluids to replace volatile organic solvents.

Paper ID: ICSHSD-240

Dual Stimuli Responsive Molecular Switching of Azobenzene in Surfactant-Based Media

Sabikun Naher Sumi[1], Md. Akib Hasan[1], and Md. Abu Bin Hasan Susan[1,2,*]
[1]University of Dhaka, Dhaka-1000, Bangladesh
[2]Dhaka University Nanotechnology Center, Dhaka-1000, Bangladesh
**Corresponding email: susan@du.ac.bd*

ABSTRACT

Azobenzene (AB) and its derivatives are widely recognized for their reversible photoisomerization between its *E* (planar) and *Z* (bent) forms when exposed to external stimuli. Under UV irradiation, it converts to the *Z*-isomer, which can revert to the *E*-isomer upon exposure to visible light or thermal relaxation. Due to the distinct physicochemical properties of the isomers, such as differences in geometry, symmetry, and polarity, AB is a promising candidate for applications in molecular switches, multifunctional devices, and sensors. In this study, AB was incorporated into various self-assembled systems, such as micelles, reverse micelles, and microemulsions using two surfactants, cetyltrimethylammonium bromide (CTAB), a cationic surfactant, and Triton X-100, a nonionic surfactant. Alongside light, electrochemical potential was employed as a secondary stimulus to explore dual-stimuli responsive switching behavior. Dynamic light scattering confirmed particle sizes below 10 nm across all media, indicating nanoscale organization. UV-visible spectroscopy confirmed photoisomerization through a decrease in the π–π* transition (~313 nm) and an increase in the n–π* transition (~440 nm) upon exposure to UV-B radiation, indicating of the formation *Z*-isomer. Cyclic voltammetry revealed a quasi-reversible reduction of *E*-AB at approximately –0.6 V, while the *Z*-isomer, formed under UV-B irradiation, showed a reduction peak at a more positive potential (~ –0.5 V) at a glassy carbon electrode in the Triton X-100-based microemulsion. Interestingly in TX-100 based micellar system, a reduction peak was absent for the *E*-isomer but present for the *Z*-isomer. But CTAB based organized systems showed complexity in the electrochemical behavior of AB due to the reduction of surfactant itself. These findings demonstrate the medium-specific response of azobenzene to light and electrochemical potential, supporting the development of molecular switching systems with the control of dual external stimuli.

Paper ID: ICSHSD-273

Supramolecular Micellar Shuttle in Drug Delivery Application

Asima Monjur[1,2], and Md. Abu Bin Hasan Susan[2,3,*]
[1]Department of Science and Humanities, Military Institute of Science and Technology,
Mirpur Cantonment, Dhaka-1216, Bangladesh
[2]Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
[3]Dhaka University Nanotechnology Centre (DUNC), University of Dhaka, Dhaka-1000, Bangladesh
**Corresponding email: susan@du.ac.bd*

ABSTRACT

Selective aggregation behavior of block copolymers is a remarkable area of research in the fabrication of smart biomaterials for drug delivery systems. This work demonstrates solution behavior of triblock copolymers (Pluronic P123 and F127) in solvents with different characteristics, one in aqueous and in a hydrophobic ionic liquid (IL), 1-butyl-3-methylimidazolium hexafluorophosphate [C_4mim]PF_6. Dynamic light scattering measurements up to 65 °C showed that hydrodynamic diameters of Pluronic increase linearly with temperature from (10-30 nm) but with a sudden drop at ca. 45 °C in aqueous phase. Correlation between polymer solubilization and structural motifs provides a foundation for the development of supramolecular system that could switch in the biphasic system (water and IL) under particular stimuli. Also, the system leverages dynamic nature of supramolecular host-guest interactions to transfer cargo from one phase to another. Hydrophobic drug, Chlorpromazine has been employed as a molecular probe. The probe has simple heterogeneous kinetics at low scan rate during its being solubilized in micellar sphere. Thermal perturbation had its effect on the solubilization behavior of polymer in water and IL. Apparently, binding affinities of the drug has been realized from its redox behavior in both the solvents. Particle size distribution and the electrochemical behavior of drug both are supported by the molecular association of polymer and drug. Successful switching attempts are ascertained from the increment of hydrodynamic diameter, scattering light intensity, and change of the reduction current in respective phases. The study can be regarded as an initiation to unlock the potential of micellar shuttle as a switchable drug delivery system from aqueous to hydrophobic environment.

Paper ID: ICSHSD-355

Investigation of the Clouding Nature and Thermodynamic Properties of Triton X-100 and Chlorpheniramine Maleate Mixture in Presence of Electrolytes and Hydrotropes

Md. Milon Ali[1], Md. Rafikul Islam[1,*], Md. Rehan Alam[1], and Md. Anamul Hoque[2]
[1]Department of Chemistry, Dhaka University of Engineering & Technology, Gazipur, Gazipur-1707, Bangladesh
[2]Department of Chemistry, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh
Corresponding email: rafikchemduet@duet.ac.bd

ABSTRACT

The exploration of the clouding behavior in the surfactant-drug mixture is of importance as it elucidates the molecular interactions that describe the solubilization, thermodynamic stability of the employed system. In this investigation, the clouding behavior of Triton X-100 (TX-100) a non-ionic surfactant and chlorpheniramine maleate drug (CPM) mixture in the attendance of electrolytes and hydrotropes was explored by means of cloud point estimation technique. Chlorpheniramine maleate drug is commonly used as histamine blocker agent and as medication for runny nose, hay fever, and allergic diseases. To explore the mechanism of clouding behavior and thermodynamic characteristics of the TX-100 + CPM mixture, sodium-based electrolytes such as sodium chloride (NaCl), sodium carbonate (Na_2CO_3), and sodium citrate (Na_3CTA) and hydrotropes (HDTs) like sodium salicylate (NaSal), sodium benzoate (NaBenz), and urea were systemically employed. The cloud point demonstrated pronounced sensitivity to the presence of electrolytes and HDTs. A successive reduction in the CP values was attained with increasing the concentration of Na-electrolytes, whereas elongated CP values were observed with the increase of the contents of HDTs. The concentration effects of both Na-based electrolytes and HDTs on the CP values of TX-100 + CPM mixture followed the order as: $CP_{H_2O+NaSal} > CP_{H_2O+NaBenz} > CP_{H_2O+Urea} > CP_{H_2O+NaCl} > CP_{H_2O+Na_2CO_3} > CP_{H_2O+Na_3CTA}$. The thermodynamic study revealed that standard Gibbs free energy change (ΔG_c^o) values obtained as positive in magnitudes, thereby the confirming the nonspontaneous nature of the clouding phenomenon. The degree of nonspontaneity was progressively decreased with increasing concentration of electrolytes and HDTs. The enthalpy change (ΔH_c^o) and entropy change (ΔS_c^o) values for the employed mixture were found negative and positive in electrolytes and HDTs solvents, stating that clouding progression was exothermic in presence of electrolytes and endothermic in HDTs solvent. The binding forces between TX-100 and CPM drug in aqueous solution of electrolytes and HDTs involve hydrophobic and electrostatic interactions, along with hydrogen bonding, ion-induced dipole interactions, as evidenced by the positive and negative magnitudes of ΔH_c^o and ΔS_c^o. A straight line was obtained in the plot of ΔH_c^o and ΔS_c^o of TX-100 + CPM mixture for each solvent system signifying that enthalpy and entropy compensate each other. The current knowledge from this investigation might be effective in rational drug design and innovative excipient formulation strategies in the pharmaceutical industry.

Paper ID: ICSHSD-362

The Aggregation of Tetradecyltrimethylammonium Bromide and Levofloxacin Hemihydrate Mixture: Exploration of the Impact of Sodium Salts and Temperature on the Thermodynamic Properties and Interaction Forces

Md. Romjan Ali[1], Md. Eanur Rahman[1], and Md. Rafikul Islam[1,*]
[1]Department of Chemistry, Dhaka University of Engineering & Technology, Gazipur, Gazipur-1707, Bangladesh
**Corresponding email: rafikchemduet@duet.ac.bd*

ABSTRACT

Aggregation of surfactant is fundamental physico-chemical phenomenon that controls some important processes like detergency, solubilization, surface tension reduction, which are effective in cleaning, advanced drug delivery process, and various innovative industrial applications. In this exploration, conductivity method has been used to explore the aggregation behavior of tetradecyltrimethylammonium bromide (TTAB), a cationic surfactant and levofloxacin hemihydrate (LFH), an antibiotic drug mixture under the influence of Na-salts (sodium acetate, sodium carbonate, and sodium citrate) within the temperature ranges of 288.15 to 323.15 K with 5 K differences. LFH drug is a fluroquinolone antibiotic broadly employed for the treatment of bacterial diseases. Single critical micelle concentration (CMC) value was attained for the TTAB + LFH mixture in each solvent system. Both Na-salts and temperature have significant effects on the CMC values of the employed mixture. The CMC values were getting downward trends under the influence of Na-salts and followed the sequences as: CMC (H_2O + NaOAc) > CMC (H_2O + Na_2CO_3) > CMC (H_2O + Na_3CTA). The aggregation process of the mixture becomes feasible at elevated content of Na-salts. In contrast, the micellization process becomes hindered under the influence of temperature. The analysis of the thermodynamic parameters revealed that the Gibbs free energy change (ΔG_m^o) values were found negative suggesting the spontaneous process of aggregation. The enthalpy change (ΔH_m^o) values were positive at lower temperatures and negative at higher temperature ranges indicating that aggregation process was endothermic at low temperature and this process becomes exothermic at extended temperature. The entropy change (ΔS_m^o) values were attained positive at all thorough selected temperature ranges. The growth of micelles is an enthalpy and entropy driven process at low and high temperatures. The interaction forces operating between TTAB and LFH in aqueous solution of Na-salts are primarily hydrophobic, electrostatic, H-bonding, ion-induced dipole interaction forces. The plot of ΔH_m^o vs. ΔS_m^o of TTAB + LFH mixture was linear in fashion, confirming that the enthalpy and entropy compensate each other. The current research findings might be highly suitable in drug delivery and drug carrier system, new drug design, development of excipient formulations in the pharmaceutical industry.

Paper ID: ICSHSD-475

Investigation of potassium salts induced micellization of tetradecyltrimethylammonium bromide with cationic crystal violet dye: Physicochemical and thermodynamic aspects

Md. Mahade Hasan[1], and Md. Anamul Hoque[1*]
[1]Department of Chemistry, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh
**Corresponding email: ahoque_ju@juniv.edu*

ABSTRACT

Dyes-surfactants interactions play significant roles in the formulation of different products in industries, and they are of paramount importance in various potential applications. In the present study, the physicochemical and thermodynamic investigations have been carried out in the potassium-assisted micellization of cationic surfactant TTAB and cationic CI basic dye crystal violet (CV) using conductivity measurement technique in the presence of several aq. K-salts solutions (KCl, $K_2C_2O_4$, K_2HPO_4, K_2SO_4 and K_3PO_4) at a range of temperatures from 288.15 K to 323.15 K. The results revealed only single CMC for the TTAB and employed dye system in all water + K-salts media at various temperatures and the CMC values in equivalent K-salts media were varied significantly in different potassium salts media which followed the trend of: CMC (aq. KCl) > CMC (aq. $K_2C_2O_4$) > CMC (aq. K_2HPO_4) > CMC (aq. 1- K_2SO_4) > CMC (aq. K_3PO_4). The effects of K-salt compositions and temperatures on CMC, degree of ionization (α), degree of binding constants(β) and thermodynamic parameters (ΔG_m^0,ΔH_m^0, and ΔS_m^0) were effectively examined and evaluated. The magnitudes of CMC decreased with increasing in salts compositions and showed U-shaped curve formation from the CMC versus *T* plots associated with the respective surfactant-dye system in all aqueous potassium salts solutions. The negative free energy changes (ΔG_m^0) for all experimental surfactant-dye-additive mixtures indicate a spontaneous micellization of TTAB + CV system in all K-salts media. The enthalpy-entropy compensation for the studied system have been calculated and evaluated, which disclosed the nature of interaction forces worked between the TTAB and CV species in the presence of

different potassium electrolytes. These interesting and significant findings provide valuable insights of surfactant-dye interaction chemistry, which will be highly useful for future research as well as dye-surfactant, based industrial manufacturing processes.

Paper ID: ICSHSD-505

Cloud Point and Spectroscopic Investigations of the Interaction and Thermodynamics of Surfactant and Metformin Hydrochloride mixture in the Presence of Additives

Md. Abu Taleb[1], and Md. Anamul Hoque[1,*]
[1]Department of Chemistry, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh
**Corresponding email: ahoque_ju@juniv.edu*

ABSTRACT
Nonionic surfactants are widely employed in pharmaceutical formulations due to their ability to form micelles that encapsulate drug molecules and modulate their solubility. In this study, the interaction between the antidiabetic drug metformin hydrochloride (MNH) and the nonionic surfactant Tween-80 (TW-80) was systematically investigated in aqueous solutions containing different inorganic salts (NaCl, Na_2SO_4, CH_3COONa). Cloud point (CP) measurements combined with UV–visible spectrophotometry were applied to evaluate drug–surfactant association under varying salt concentrations. The clouding behavior of the TW-80 + MNH system was found to be strongly influenced by both the drug concentration and the nature and concentration of the salts. Increasing salt concentration led to a gradual decrease in solubility, reflected by lower CP values. UV–Vis spectra revealed enhanced absorption intensity of MNH in the presence of TW-80 micelles and salts, indicating stronger drug–micelle association. Binding interactions were quantified using Benesi–Hildebrand analysis at premicellar surfactant concentrations and the Kawamura equation at concentrations above the CMC. Thermodynamic evaluation demonstrated that the clouding process is non-spontaneous, whereas drug–surfactant binding is spontaneous. Key thermodynamic parameters including enthalpy and entropy changes; transfer thermodynamics, and enthalpy–entropy compensation parameters were analyzed to provide deeper insight into the mechanisms of clouding and binding. The findings of this work contribute to a better understanding of drug–surfactant interactions in complex environments and may support the design of improved drug delivery systems and formulation strategies in the pharmaceutical industry.

Paper ID: ICSHSD-506

Silica Induced Phase Transformation in Polyvinylidene Fluoride: Influence of Synthesis Method and Content of Silica

Nusrat Jahan Sumona[1], and Saika Ahmed[1,*]
[1]Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
**Corresponding email: saika@du.ac.bd*

ABSTRACT:
A high β-phase content in PVDF is crucial for achieving superior piezoelectric and dielectric performance in sensors, actuators, and energy devices. Incorporation of mesoporous silica (MCM-48), with optimized surfactant removal, promotes α- to β- transformation via surface silanol groups and mesoporous architecture, and yields high-performance composites. This study analyzes the incorporation of mesoporous silica of type MCM-48 into polyvinylidene fluoride (PVDF) to increase its β-phase via transformation of the α-phase. The investigation evaluates the influence of the content and preparation technique of silica, specifically the surfactant removal method of mesoporous silica. MCM-48 was prepared by conventional techniques, while the surfactant removal method was varied as (1) calcination, (2) solvent extraction, and (3) solvent extraction followed by calcination. The synthesized silica samples, with varying contents, were then incorporated into PVDF to prepare thin films of MCM-48/PVDF composite by solvent casting method. FTIR results of the composite films indicate that the surfactant removal method of MCM-48 significantly affects the concentration of surface silanol (Si-OH) groups and also the mesoporous architecture of MCM-48. These attributes are crucial for enhancing polymer-filler interactions, which impact the transformation of the α- to β-phase. The content variation suggested a non-linear correlation between silica concentration and phase transition. The solvent-extracted silica increased the β-phase content in all the compositions, underscoring the essential function of surface silanol groups. In contrast, the as-prepared and calcined silica demonstrated reduced efficacy in lowering silanol concentration and suboptimal surface characteristics. Characterization techniques like Fourier-transform infrared spectroscopy and X-ray diffraction confirmed that the enhanced β-phase enhancement in PVDF is enabled by strong hydrogen bonding and chain reorientation, promoted by silica with elevated silanol concentrations and unique mesoporous structures. This study thus demonstrates the substantial impact of silica structure, surface functionality, and filler content on the modulation of crystalline phases in PVDF. The insights obtained will establish a framework for developing high-performance polymer composites.

Paper ID: ICSHSD-518

Effect of Sodium Electrolyte on the Aggregation Behaviour of the Sodium Dodecyl Sulfate Surfactant and β-Cyclodextrin Host Molecule

K. M. Anis-Ul-Haque[1,*], Nasir Uddin[1], Md. Azizur Rahman Khan[1], and Md. Anamul Hoque[2]
[1]Department of Chemistry, Jashore University of Science and Technology, Jashore-7408, Bangladesh
[2]Department of Chemistry, Jahangirnagar University, Savar, Dhaka- 1342, Bangladesh
**Corresponding email: a.haque@just.edu.bd*

ABSTRACT

This study investigated the physicochemical properties of β-cyclodextrin (β-CD) and sodium dodecyl sulfate (SDS) in mixed systems within aqueous and aqueous electrolyte media using conductometric technique. The micellization of SDS was studied in (β-CD + H_2O/ β-CD+ H_2O + sodium electrolytes (NaBr, NaOAc and Na_2SO_4) media across a temperature range of 300.55 K to 320.55 K, with an increment of 5K. The critical micelle concentration (CMC) of the β-CD + SDS mixed system relied on the concentration of β-CD, the concentration and type of electrolytes, and temperature of the system. Notably, β-CD significantly inhibited the micellization of SDS, increasing the value of CMC. Micellization was completely inhibited at higher concentrations of β-CD, while the electrolytes facilitated micellization, leading to a decreased CMC. The magnitude of enthalpy (ΔH_m^0), and entropy (ΔS_m^0) revealed electrostatic and hydrophobic interactions are present between β-CD and SDS, with negative Gibbs free energy (-ΔG_m^0) indicating the spontaneous aggregation process. FTIR and SEM analyses indicates the creation of a host–guest inclusion complex, with β-CD acting as the host and SDS as the guest. Exploring the interactions between β-CD and SDS may promote the way for designing innovative supramolecular structures that enable researchers to modify surfactant properties, unlocking potential applications across diverse fields including pharmaceuticals, biochemical research, textiles, paints, household and industrial cleaners, personal care products, and industrial processes.

Analytical, Industrial and Environmental Chemistry

Paper ID: ICSHSD-16

Synergistic Adsorption of Lead (II) By Rice Husk-Tea Residue Blend: A Low-Cost, Sustainable Biosorbent Approach

Saad B. Hasan[1,*], Apurbo Pandit[1], Rajesh K. Chanda[1], and Biplob K. Biswas[1,*]
[1]Department of Chemical Engineering, Jashore University of Science and Technology, Jashore-7408, Bangladesh
**Corresponding email: saadbinhasan0@gmail.com; bk.biswas@just.edu.bd*

ABSTRACT

Lead (Pb(II)), a toxic heavy metal, poses significant threats to environmental and human health due to its persistence and bioaccumulative nature. Mitigating its presence in water sources has become an urgent priority for environmental safety. This study investigates the efficacy of a mixed biosorbent, comprising waste tea residue and rice husk, for the removal of Pb(II) ions from aqueous solutions. Bioadsorbents were collected, processed, and applied in batch experiments to evaluate key parameters including adsorbent ratio, dosage (0.05 – 1.0 g), solution pH (4.0 – 8.0), and initial metal concentration (50– 550 mg/L). Maximum adsorption efficiency was observed with an 80:20 tea residue-to-rice husk ratio, a dosage of 0.5 g, and pH 5.0. Adsorption equilibrium data aligned with the Langmuir isotherm model, indicating monolayer coverage and high affinity of the mixed adsorbent toward Pb(II) ions. These findings suggest that agricultural waste-derived biosorbents hold promise as low-cost and sustainable alternatives for heavy metal remediation in water treatment applications.

Paper ID: ICSHSD-24

Quantifying the Phenolic Composition and Light-Absorbing Properties of Brown Carbon from Biomass Combustion

Mehedi Shakil[1,*]
[1]Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
Corresponding email: mehediarshi21@gmail.com

ABSTRACT

Brown carbon (BrC)—the light-absorbing fraction of organic aerosol—contributes to climate forcing by preferentially absorbing near-UV and short-visible light. We characterized BrC optical properties and quantified eight phenolic derivatives emitted during controlled combustion of 14 biomass fuels (hardwood, softwood, and leaves) representative of Dhaka, Bangladesh. UV–visible spectrophotometry at 365 nm provided absorption coefficients (b_{abs}-365), mass absorption efficiency (MAE), absorption Ångström exponent (AAE), and the imaginary refractive index k(365). Phenolic compounds were identified and quantified by gas chromatography–flame ionization detection (GC-FID). Across fuels, b_{abs}-365 spanned (1.83 ± 0.28) ×10^4 to (8.37 ± 3.24) ×10^4 Mm^{-1}; softwoods exhibited the highest babs-365, the largest AAE (4.34 ± 1.02 to 6.24 ± 0.62), and higher MAE (0.65–1.39 m^2 g^{-1}), whereas softwood consistently showed the highest values. Among the eight phenolics quantified, the most abundant were phenol, 2-methoxyphenol, 2,4,6-trichlorophenol, 2-hydroxyphenol, and 4-nitrophenol. Phenol contributed 5.6–16.3% of total phenolics, with the highest fractions from softwood; leaf burning produced the largest relative shares of 2-hydroxyphenol (35.0–40.8%) and 4-nitrophenol (19.4–49.7%). Hardwood emitted fewer phenols and generated weaker BrC, indicating comparatively lower optical activity and suggesting hardwood as a cleaner fuel option, whereas leaves were inefficient fuel. These findings show that BrC from biomass burning can meaningfully affect air quality and short-wavelength radiative forcing, and they clarify how phenolic precursors from common regional fuels contribute to BrC formation in Dhaka.

Paper ID: ICSHSD-58

Synthesis of Biodegradable Materials from Textile Waste for Eco-Friendly and Sustainable Applications

Abdullah Al Sajib[1], Jagannath Biswas[1], Mahabubur Rahman[1], ASM Shihavuddind[2], and Mohammad Shariful Alam[1,*]
[1]Department of Textile Engineering, Green University of Bangladesh, Dhaka-1207, Bangladesh
[2]Department of Electrical and Electronic Engineering, Green University of Bangladesh, Dhaka-1207, Bangladesh
Corresponding email: shariful@tex.green.edu.bd

ABSTRACT
The global textile industry produces massive waste, with Bangladesh generating about 400,000 tons annually, causing environmental and economic damage. This study develops a cost-effective, eco-friendly process to convert garment waste into biodegradable non-woven fabric, supporting circular economy and SDGs. Using PVA, glycerol, ammonium chloride, and water, finely cut waste is bonded under controlled heat and pressure. The optimal ratio (4 g fabric: 7.5 g PVA at 60 °C for 70 min) yields fabric with 170.42 N tensile strength and 1.25 mm thickness. The biodegradable fabric suits shopping bags, interlinings, décor, and packaging, reducing landfill use and promoting sustainable, profitable textile manufacturing in Bangladesh.

Paper ID: ICSHSD-80

Characterizing Brown Carbon in Urban Dhaka: Insights into Optical Behavior, Precursors, and Morphology

Md. Al-Amin Hossen[1], and Abdus Salam[1,*]
[1]Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
**Corresponding email: asalam@gmail.com; asalam@du.ac.bd*

ABSTRACT
Brown carbon (BrC), a light-absorbing fraction of organic aerosols, plays a critical role in atmospheric radiative forcing and air quality, yet its chemical sources and optical characteristics remain poorly understood in South Asian megacities. To address this gap, we investigated BrC in Dhaka by collecting $PM_{2.5}$ samples from Dhaka North and Dhaka South between July 2023 and January 2024. Optical properties ($b_{abs-\lambda}$, MAE, AAE, $\kappa_{abs-\lambda}$), chemical composition, and morphology were examined using UV–vis spectroscopy, fluorescence excitation–emission matrices (EEM), gas chromatography-flame ionization detection (GC-FID), field emission scanning electron microscopy with energy-dispersive X-ray spectroscopy (FESEM–EDX), and ATR-FTIR. BrC concentrations (18.63 ± 3.84 μg m^{-3}) were comparable to black carbon (17.93 ± 3.82 μg m^{-3}), confirming major contributions from combustion. Higher AAE (up to 4.53), MAE, and $\kappa_{abs-\lambda}$ in Dhaka North indicated stronger absorption linked to traffic and industrial emissions. Fluorescence spectra revealed pH-dependent red-shifts and intensity changes, highlighting the structural sensitivity of BrC chromophores. Phenolic precursors, particularly 2-hydroxyphenol (2.31 ± 1.39 μg m^{-3}) and 4-nitrophenol (2.20 ± 1.21 μg m^{-3}), were abundant, with wintertime enhancement of 4-nitrophenol associated with biomass burning and atmospheric stability. Surface analyses showed irregular carbonaceous particles enriched with C, O, N, S, and trace metals (Pb, Cr, Cd), along with functional groups such as aromatics, carbonyls, and nitro compounds. Overall, this study demonstrates that phenolic compounds and environmental factors strongly govern BrC formation and optical behavior, underscoring its climatic relevance and the need to mitigate combustion emissions in Dhaka.

Paper ID: ICSHSD-108

Efficient Removal of Radiocesium from Contaminated Water Using Macrocyclic Based Porous Sorbent

Rashedul Islam Ripon[1,2*], Zinnat Ara Begum[3], Iqbal Hossen[2], Abhijit Barua[2], and I. M. M. Rahman[3,*]
[1]Department of Chemistry, Mawlana Bhashani Science and Technology University, Santosh, Tangail 1902, Bangladesh
[2]Graduate School of Symbiotic Systems Science and Technology, Fukushima University, 1 Kanayagawa, Fukushima-Shi, Fukushima 960-1296, Japan
[3]Institute of Environmental Radioactivity, Fukushima University, 1 Kanayagawa, Fukushima-Shi, Fukushima 960-1296, Japan
**Corresponding email: riponchem@mbstu.ac.bd; immrahman@ipc.fukushima-u.ac.jp*

ABSTRACT

Radio cesium (r-Cs: ^{137}Cs; $t_{1/2}$, 30.17 yrs) poses severe environmental and health risks, particularly after the Chornobyl and Fukushima accidents. Effective removal of r-Cs is therefore critical for remediation and monitoring. In this work, a macrocyclic-based porous sorbent, DFDB18C6@SBA-NH_2, was developed by anchoring a macrocyclic ligand, di-formyl dibenzo-18-crown-6-ether (DFDB18C6), into amino-functionalized mesoporous SBA-15 (Santa Barbara Amorphous-15), for the efficient removal of r-Cs from contaminated water. The structural, thermal, and morphological characteristics of the sorbent were comprehensively investigated. The sorbent demonstrated high Cs sorption capacity at pH 6, reaching equilibrium within 6 h. Kinetic and isotherm analyses indicated that Cs sorption followed a pseudo-second-order model and Langmuir mono layer sorption. Remarkably, DFDB18C6@SBA-NH_2 achieved approximately 85% r-Cs removal over four successive cycles from Fukushima-originated real ^{137}Cs contaminated water, maintaining selectivity even in the presence of competing matrix ions, *e.g.*, Ca^{2+}, Mg^{2+}, Na^{+}, and K^{+}. These findings underscore DFDB18C6@SBA-NH_2 as promising sorbent for r-Cs decontamination.

Paper ID: ICSHSD-153

Enhanced Adsorption of Textile Dyes using Graphene Oxide–MgO Nanocomposites

Mrinal Kanti Roy[1], Abdullah Al Rakib[1], Md. Jalil Miah[2], and Md. Shahabuddin[1,*]
[1]Department of Chemistry, Dhaka University of Engineering & Technology (DUET), Gazipur, Gazipur-1707, Bangladesh
[2]Department of Natural Science, Islamic University of Technology (IUT), Gazipur-1704, Bangladesh
**Corresponding email: shahab2018@duet.ac.bd*

ABSTRACT

The textile industry generates vast volumes of wastewater enriched with dyes and associated contaminants that pose serious environmental and human health hazards if left untreated. Due to the diverse chemical structures of dyes, developing efficient and sustainable removal strategies remains a significant challenge. Conventional treatment methods, including biological techniques such as biodegradation and bioremediation, alongside physicochemical approaches like adsorption, oxidation, and precipitation, have demonstrated varying levels of success. Among these, graphene oxide (GO) has emerged as a highly promising adsorbent due to its large surface area and oxygen-containing functional groups. When further integrated with magnesium oxide (MgO), GO-based nanocomposites exhibit enhanced adsorption performance, offering a novel solution for dye removal. In this study, graphene oxide was synthesized from waste dry cells using a modified Hummers method, while MgO nanoparticles were prepared via the sol–gel route from magnesium nitrate hexahydrate ($Mg(NO_3)_2 \cdot 6H_2O$). GO–MgO nanocomposites (NCs) were subsequently fabricated through the impregnation method and evaluated for their efficiency in removing Methylene Blue (MB) from aqueous systems. Structural and surface characterizations were conducted using SEM-EDX, XRD, FT-IR, and XPS, confirming the successful decoration of MgO nanoparticles on GO sheets. Adsorption studies investigated the influence of pH, contact time, initial MB concentration, and adsorbent dosage on dye removal performance. Results revealed that the Langmuir isotherm model provided the best fit for adsorption equilibrium data, while adsorption kinetics were accurately described by the pseudo-second-order model (R^2 = 0.994). The GO–MgO composite with a 1:2 ratio demonstrated the highest adsorption capacity of 38.75 mg/g, outperforming previously reported GO-based adsorbents. These findings highlight the potential of GO–MgO nanocomposites as efficient, sustainable, and scalable adsorbents for dye-contaminated wastewater treatment, providing a pathway for environmental remediation and valorization of waste materials.

Paper ID: ICSHSD-172

Determination of Anthracene and Pyrene in Road Dust Analysis Using UV-Vis Spectroscopy

Rashedul Islam[1] and Md. Monarul Islam[2,*]
[1]Department of Chemistry, Jashore University of Science and Technology (JUST), Jashore-7408, Bangladesh
[2]Synthesis Laboratory, Chemical Research Division, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka-1205, Bangladesh
**Corresponding email: mmipavel@yahoo.com*

ABSTRACT

Anthracene and pyrene belong to the class of polyaromatic hydrocarbons (PAHs) and are formed through incomplete combustion processes. PAHs have harmful effects on living organisms, and persist for a long time in environment. In our study, we developed and validated a reliable, easy, and rapid method for the detection and quantification of anthracene and pyrene by using a UV-Vis spectrophotometer. UV-Vis spectrophotometer is the most common, cheap, and easy-to-use instrument in any laboratory. The results of our study validated the linearity, accuracy, precision, ruggedness, repeatability, and recoveries following ICH guidelines. In addition, we have extracted and quantified these PAHs from water and road dust samples using our methodology. Extraction of anthracene and pyrene from synthetic water (artificially known amount of anthracene and pyrene added with distilled water) and roadside dust samples was done by liquid-liquid extraction (LLE), where n-hexane was used as the extraction solvent. The limit of detection (LOD) was found for anthracene, 0.0178 mg/L, and 0.0101 mg/L for pyrene. The LOQ was 0.0891 mg/L for anthracene and 0.0203 mg/L for pyrene. The results of the extraction data showed that approximately 97.8% and 86.1% of anthracene and pyrene were extracted from the synthetic water samples. The experimental dust sample ranges from 14.0 mg/kg to 98.0 mg/kg for anthracene, and pyrene concentrations ranged from 5.0 mg/kg to 20.0 mg/kg based on different sampling locations. Although it is not possible to estimate these two PAHs at very low concentrations, our method is nevertheless suitable for rapid detection and measurement of anthracene and pyrene in unknown samples.

Paper ID: ICSHSD-174

Comparative Study of Commercial TiO_2 And Garlic Extract-Mediated TiO_2 Supported on Coconut Shell Biochar for the Efficient Removal of Acid Orange 10 Dye

Nusrat Jahan [1], and Md. Nurnobi Rashed [1,*]
[1]Department of Chemistry, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
**Corresponding email: rashed@chem.buet.ac.bd*

ABSTRACT

The increasing presence of synthetic dyes in industrial wastewater poses a significant environmental threat due to their toxicity and persistence.Titanium dioxide (TiO_2) is widely used as a photocatalyst for dye degradation; however, its commercial forms often suffer from limited surface area, high recombination rates of charge carriers, and potential release of toxic chemicals, which raises environmental concerns. Despite extensive studies on TiO_2-based photocatalysts, there is a lack of research on green synthesis approaches using natural extracts and agricultural waste-derived supports**.** This study explores a sustainable approach to dye removal by comparing the performance of commercial TiO_2 with a green-synthesized TiO_2 supported on coconut shell biochar. The green TiO_2 was synthesized using titanium tetrachloride ($TiCl_4$) as a precursor and garlic extract as a natural reducing and stabilizing agent, while coconut shell biochar served as a low-cost, eco-friendly support material to enhance surface area and adsorption capacity. The catalysts were characterized using XRD, FESEM, FTIR, and UV-Vis DRS techniques. Adsorption and degradation of Acid Orange dye were optimized by catalyst dose, dye concentration, reaction time, pH of the reaction medium, and light sources. The green TiO_2-biochar composite demonstrated superior degradation efficiency, achieving over 90% removal under optimal conditions, compared to 80% for commercial TiO_2 under UV light. The enhanced performance arises from improved dye adsorption, reduced electron-hole recombination, and the synergistic effect of biochar support. This work highlights the potential of green-synthesized, biochar-supported TiO_2 as an effective and sustainable photocatalyst for wastewater treatment applications.

Paper ID: ICSHSD-178

Degradation of Azo Dyes by a Synergistic Sonochemical Process Using Additives and Various Nanoparticles (Cr_2O_3,MnO_2,Fe_2O_3)

Shagor Chad Mondol Akash[1], Minhaz Hossain[1], Shohan Ali[1], Jahangir Hossain[2], and Md. Helal Uddin[1,*]
[1]Department of Applied Chemistry and Chemical Engineering, Islamic University, Kushtia-7003, Bangladesh
[2]Department of Chemical Engineering, Jashore University of Science and Technology, Jashore-7408, Bangladesh
**Corresponding email: uddindrhelal@gmail.com*

ABSTRACT

Azo dyes are chemical or organic substances that have azo linkages, which are created when an amine or phenol is joined to a diazotized amine.Although azo dyes are widely utilized, they have serious negative effects on the environment and human health. The complex chemical structures **(–N=N–)** and resistance to traditional treatment procedures of azo dyes make them one of the most poisonous and persistent groups of synthetic dyes, posing serious environmental risks. Azo dyes are obstinate wastewater pollutants that require effective treatment methods. The improvement of sonochemical degradation of azo dyes in aqueous solutions by the use of additives and catalytic nanoparticles—Cr_2O_3, MnO_2, and Fe_2O_3 are investigated in this work. Additional radical production pathways were provided by the use of additives such carbon tetrachloride (CCl_4). According to experimental findings, the incorporation of nanoparticles significantly accelerated the rate at which azo dyes degraded by enhancing cavitation dynamics and enhancing radical production. All nanoparticles considerably accelerated degradation rates by increasing cavitation and reactive oxygen species formation, according to experimental results, with Fe_2O_3showing the best effectiveness. Additional radical production pathways were provided by the use of additives such carbon tetrachloride (CCl_4). The sonocatalytic activity of the prepared materials was evaluated through the degradation of a model azo dye under ultrasonic irradiation and the degradation process was monitored by using UV-Visible spectrophotometry. Co-precipitation method was used to create the nanoparticles, and they were then examined and characterized by using SEM-EDX. SEM-EDX, or scanning electron microscopy with energy dispersive X-ray spectroscopy, is a combined analytical method that gives a material's elemental composition in addition to its surface shape. SEM (Fig-2) provides a high-resolution view of the sample's microstructure, and EDX is a potent tool for materials characterization since it can identify and measure the elements present. According to this Research, the effectiveness of sonochemical treatment for azo dye degradation can be significantly enhanced by the use of metal oxide nanoparticles and additives. In fig-1, it indicates that 200 µliter $CCl_4$and 0.05g Cr_2O_3 lead to the most significant reduction in azo dye concentration over 25 minutes. In order to treat industrial effluents that contain persistent organic pollutants, the results point to a highly efficient, scalable, and sustainable method that may be incorporated into contemporary wastewater treatment systems.

Paper ID: ICSHSD-180

Biogenic and Chemical Synthesis of ZnO Nanophotocatalyst for Efficient Removal of Organic Dye

Msmt. Kulsum Akther[1], and Md. Nurnobi Rashed[1,*]
[1]Department of Chemistry, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
**Corresponding email: rashed@chem.buet.ac.bd*

ABSTRACT

This research aims to offer a dual benefit: utilizing green synthesis of ZnO nanoparticles from ginger extract and comparing the photocatalytic efficiency of green ZnO nanoparticles in degrading selected organic dyes (e.g., Eriochrome Black T) with chemically synthesized ZnO from the aqueous solution. Fresh ginger roots were combined with 100 mL of 70% acetone, vigorously stirred, and then filtered through Whatman No. 1 filter paper to create the powdered extract. The biogenic synthesis of pure ZnO NPs was carried out from ginger extract by the precipitation method. The chemical synthesis of pure ZnO was carried out according to the green synthesis of pure ZnO, but it only ignored the use of ginger extract. The crystalline phase purity of ZnO has been analyzed using an X-ray diffractometer. A Fourier Transform infrared spectrophotometer has been used to measure the bond formation of ZnO. The morphologies of the samples have been characterized via scanning electron microscopy (SEM). Biogenic ZnO, which was calcined at 400 °C and 500 °C, removed 82% and 61% of the EBT, while adsorption was determined to be 48% and 27%, respectively. On the other hand, the percentage of removal of EBT by chemical ZnO, which was calcined at 400 °C, is 51% whereas adsorption is found to be 31%. These percentages of dye removal were carried out at 60 minutes under UV light. The biogenic study utilizes the chemical ZnO for EBT degradation under UV light.In thiswork, simple and cost-effective ZnO NPs were successfully synthesized using ginger extract (biogenically) and without ginger extract (chemically).It has been observed that the biogenic ZnO (calcined at 400 °C) is better compared to biogenic ZnO (calcined at 500 °C) and chemical ZnO (calcined at 400 °C) in terms of efficiency and the time required for exposure.

Paper ID: ICSHSD-207

The Degradation of Azo Dyes Achieved Sonochemically with the Aid of Fenton Reagent, Carbon tetrachloride, Graphene oxide and Nickel oxide

Minhaz Hossain[1], Shagor Chad Mondol Akash[1], Shohan Ali[1], S.M. Abdur Razzaque[1], and Md. Helal Uddin[1,*]
[1]Department of Applied Chemistry and Chemical Engineering, Islamic University, Kushtia-7003, Bangladesh
Corresponding email: uddindrhelal@gmail.com

ABSTRACT

Azo dyes, widely used in textile and related industries, are major sources of water pollution due to their high chemical stability and resistance to biodegradation. Methylene Blue (MB, 25 mg/L) was selected as a model dye to evaluate degradation efficiency under sonochemical treatment. The sonochemical degradation of MB was investigated using Fenton reagent, Carbon tetrachloride (CCl_4), Graphene oxide (GO), and Nickel oxide (NiO) as catalysts. NiO nanoparticles were synthesized via co-precipitation, and GO was prepared by a modified Hummers' method. Dye concentration changes were monitored at 664 nm using UV–visible spectrophotometry after 5, 10, and 25 minutes of sonication. The catalysts were characterized by SEM–EDX to confirm morphology and composition. Results showed that sonication alone caused partial degradation, while catalysts significantly enhanced efficiency. Fenton reagent generated hydroxyl radicals, CCl_4 improved cavitation, and GO/NiO nanoparticles provided active sites. GO combined with H_2O_2 showed the highest efficiency, achieving rapid degradation within 25 minutes. This study demonstrates that ultrasound-assisted nanoparticles-catalytic processes offer a simple, effective, and eco-friendly approach for treating dye-contaminated wastewater.

Paper ID: ICSHSD-225

Hydro-chemical Assessment of Groundwater and River Water Quality for Drinking in Paikgachha Upazila, Khulna District, Bangladesh

Umme Tahera-Tun-Humayra[1,*], Md. Amzad Hossain[2], Md. Rabiul Islam[1], and Md. Biplob Hosen[1]
[1] Institute of Water and Environment, Dhaka University of Engineering & Technology, Gazipur, Gazipur-1707, Bangladesh
[2]Department of Civil Engineering, Dhaka University of Engineering & Technology, Gazipur, Gazipur-1707, Bangladesh
Corresponding email: humayraumme0@gmail.com

ABSTRACT

Water is an invaluable commodity in nature and can be a limiting resource for humans and other living beings, despite covering approximately two-thirds of the Earth's surface with water. Hydro-chemical studies were carried out at Paikgachha Upazila with the objectives of identifying the geochemical processes influencing water quality and suitability of river water and groundwater for agricultural and domestic uses. A total of forty samples were collected from ten unions and one branch of the Shibsha River during the pre-monsoon season and analyzed for major physicochemical parameters. Results revealed that river water exhibited extremely high salinity (mean 158 mg/L), TDS (mean 14,469 mg/L), EC (mean 28,750 µS/cm), chloride (mean 10,292 mg/L), and sodium (mean 8,630 mg/L), far exceeding WHO and Bangladesh standards, making it unsuitable for both drinking and irrigation. Groundwater showed comparatively lower concentrations but was still highly variable, with mean TDS (995 mg/L), EC (2,291 µS/cm), salinity (2,281 mg/L), chloride (202 mg/L), and sodium (535 mg/L). Although groundwater pH (mean 7.1) and calcium (20 mg/L) were within permissible limits, most samples exceeded standards for salinity, TDS, and sodium, rendering them unsuitable for drinking and, in many cases, irrigation. Nutrient concentrations were generally low, with nitrate (mean 0.85 mg/L) and phosphate (mean 0.50 mg/L) within safe limits. Overall, the findings indicate widespread salinization and mineral enrichment in both river and groundwater sources in Paikgachha Upazila, posing serious challenges for safe drinking water supply and sustainable agriculture.

Paper ID: ICSHSD-244

Evaluating Drinking Water Quality and Health Risks in Communities Adjacent to the Modhumoti River, Bangladesh

Md. Biplob Hosen[1,*], Md. Tofiquzzaman[2], Md. Rabiul Islam[1], and Umme. Tahera-Tun-Humayra[1]
[1]Institute of Water and Environment, Dhaka University of Engineering & Technology, Gazipur, Gazipur-1707, Bangladesh
[2]River Research Institute, Faridpur, Faridpur-7800, Bangladesh
**Corresponding email: mdbiplob9123@gmail.com*

ABSTRACT
Access to safe drinking water is a fundamental human right and a cornerstone of public health, yet river-dependent communities in Bangladesh remain highly vulnerable to water quality deterioration. This study evaluates the physicochemical quality of drinking water in settlements adjacent to the Modhumoti River, Gobra Union, Gopalganj, Bangladesh. Water samples were collected from tube wells and riverbank sources across multiple seasons and analyzed for temperature, pH, total dissolved solids (TDS), salinity, electrical conductivity (EC), and color. Results demonstrate significant deviations from World Health Organization (WHO) and national standards. Elevated TDS (up to 580 mg/L), salinity (up to 120 mg/L), and EC (up to 850 µS/cm) were recorded, particularly in riverbank water during the dry season, reflecting the influence of industrial effluents, agricultural runoff, and inadequate wastewater management. pH values ranged from slightly acidic (6.2) to alkaline (8.0), with implications for metal mobilization, scaling, and water treatment efficiency. Discoloration in several samples suggested high organic and particulate loads, potentially reducing disinfection effectiveness. These deteriorations pose direct risks to community health, including gastrointestinal illness, hypertension linked to high salinity and conductivity, and long-term renal and cardiovascular complications. The findings underscore the urgent need for integrated water quality monitoring, pollution control, and investment in affordable treatment technologies tailored to rural contexts. Strengthening regulatory enforcement, promoting sustainable agricultural practices, and enhancing public awareness are critical to ensuring safe and sustainable drinking water for vulnerable riverine populations.

Paper ID: ICSHSD-255

Assessment of Heavy Metal Concentration and the Physicochemical Parameters of the Outlet Wastewater: A Case Study of the Industrial Zone in Gazipur District, Bangladesh

Arun Roy[1,*], Rokshana Pervin[2], Md. Rabiul Islam[1], Zarjes Kader[1], Rifat Sarker[1], Md. Biplob Hosen[1], Umme.Tahera-Tun-Humayra[1]
[1]Institute of Water and Environment, Dhaka University of Engineering & Technology, Gazipur, Gazipur -1707, Bangladesh
[2]Department of Civil Engineering, Dhaka University of Engineering & Technology, Gazipur, Gazipur, 1707, Bangladesh
**Corresponding email: arunroy9676@gmail.com*

ABSTRACT
The treatment of wastewater is crucial for maintaining environmental quality and safeguarding human and animal health. This study aimed to determine the physicochemical parameters (temperature, pH, DO, BOD_5, COD, TSS, and TDS) and heavy metal concentrations (Fe, Pb, Cr, Cd, As, Ni, and Cu) in effluent wastewater from five export-oriented textile industries in Gazipur, Bangladesh. Wastewater samples were collected from the outlets of effluent treatment plants (ETPs) in January 2023. Heavy metal concentrations were analyzed using Flame Atomic Absorption Spectrophotometry and Hydride Generation Atomic Absorption Spectrophotometry. The average concentrations of Fe, Pb, Cr, Cd, As, Ni, and Cu were 0.589, 0.053, 0.104, 0.016, 0.004, 0.027, and 0.017 mg/L, respectively. A strong negative correlation was observed between Pb and Fe ($r = –0.900$, $p < 0.05$), while strong positive correlations were found between Cr and Fe ($r = 0.782$), Cd and Cr ($r = 0.752$), and Ni and Cr ($r = 0.723$). The mean values of temperature, pH, DO, BOD_5, COD, TDS, and TSS were 33.92 °C, 7.74, 5.58 mg/L, 28.4 mg/L, 78.6 mg/L, 1529.4 mg/L, and 52.4 mg/L, respectively. Significant positive relationships were observed between BOD_5 and pH ($r = 0.770$), COD and pH ($r = 0.641$), DO and COD ($r = 0.710$), and TSS and TDS ($r = 0.790$). Although most values complied with the Bangladesh Environmental Conservation Rules (ECR, 1997), all samples exceeded the permissible temperature limit, and BOD_5 levels in two industries surpassed the threshold set by ECR (2023). Based on heavy metal analysis, the wastewater was deemed suitable for irrigation but unsuitable for aquaculture.

Paper ID: ICSHSD-267

Electrochemical Detection of Arsenic (III) at Au Modified Ito Electrode

Mohammad Humayun Kabir[1], Iqbal Ahmed Siddiki[1], and Mohammad A. Hasnat[1,*]
[1]Department of Chemistry, Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh
**Corresponding email: mah-che@sust.edu*

ABSTRACT

Arsenic, historically associated with toxicity and homicide, has emerged as a critical global environmental threat due to widespread contamination of groundwater. Elevated concentrations have been reported in more than 21 countries, with Bangladesh and West Bengal, India, experiencing the highest population risk. Chronic exposure to arsenic-contaminated water is linked to severe health effects including skin, lung, bladder, and kidney cancers, along with neurological and dermatological disorders. Although the maximum contaminant level (MCL) has recently been reduced from 50 to 10 µg/L by the U.S. Environmental Protection Agency, effective removal technologies remain a pressing need. Conventional detection and remediation methods include coagulation, adsorption, ICP-MS, GF-AAS, HPLC, and precipitation. Among these, electrodeposition offers a promising alternative due to its rapid, selective, low-cost, and energy-efficient characteristics. Recent studies demonstrated successful electrochemical removal of As(III) and As(V) using reticulated vitreous carbon cathodes, producing arsine as the main reduction product. While arsenic electrodeposition has limited practical use beyond decorative coatings, its potential in water treatment highlights a valuable avenue for electrochemical research and development.

Paper ID: ICSHSD-297

Plant Extract-based Green Synthesis of TiO_2 Nanoparticles and Their Application in Mitigating Environmental Pollution

Md. Anayet Ullah[1,*], Fataha Nur Robel[1], Newaz Mohammed Bahadur[2], Muhammad Shahriar Bashar[3], Sanjida Khan[4], Md Farid Ahmed[5], Samina Ahmed[5] and Md. Sahadat Hossain[5]
[1]Department of Applied Chemistry and Chemical Engineering, Noakhali Science and Technology University, Noakhali-3814, Bangladesh
[2]Department of Chemistry, Noakhali Science and Technology University, Noakhali-3814, Bangladesh
[3]Institute of Energy Research & Development, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka-1205, Bangladesh
[4]Institute of Leather Engineering and Technology, University of Dhaka, Dhaka-1000, Bangladesh
[5]Institute of Glass & Ceramic Research and Testing, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka-1205, Bangladesh
**Corresponding email: anayet4089@gmail.com*

ABSTRACT

The rapid industrialization in recent decades has led to the continuous discharge of organic pollutants into the environment, necessitating the development of efficient, eco-friendly remediation strategies. Titanium dioxide (TiO_2), a widely studied metal oxide nanoparticle, exhibits remarkable photocatalytic activity and stability. This study aimed to synthesize anatase-phase TiO_2 nanoparticles using green extracts from five plant species: *Dillenia indica, Mikania micrantha, Pistia stratiotes, Ocimum sanctum,* and *Caesalpinia pulcherrima*, and evaluate their efficiency in degrading Congo Red dye and Ciprofloxacin antibiotic under simulated visible light. The nanoparticles were synthesized using the wet precipitation method and characterized via X-ray diffraction (XRD), Thermal weight loss analysis, Fourier-transform infrared spectroscopy (FT-IR), field emission scanning electron microscopy (FESEM), energy-dispersive X-ray spectroscopy (EDX) and optical band gap energy estimation. The XRD and FT-IR analyses provided confirmation of anatase-phase TiO_2 fabrication with crystallite sizes ranging from 1 to 70 nm except linear straight-line method had a higher estimate. FESEM revealed spherical-shaped nanoparticles, and EDX analysis validated the purity of the samples. Moreover, thermal weight loss analysis confirmed their thermal stability. The photodegradation performance of the TiO_2 nanoparticles was demonstrated with 100% degradation of Congo Red dye and 94.51% degradation of Ciprofloxacin antibiotic when subjected to visible light exposure. The superior photocatalytic performance was corroborated by the estimated optical band gap, which indicated improved visible-light absorption and efficient separation of photogenerated charge carriers. The underlying photodegradation mechanism, as revealed by scavenging experiments, demonstrated that hydroxyl radicals (•OH) and photogenerated holes (h^+) are the dominant reactive species, acting synergistically to drive the decomposition of both the dye and pharmaceutical contaminants. The findings underscore the potential of TiO_2 nanoparticles as a sustainable approach for wastewater treatment using a low cost and environmentally benign alternative to nanomaterial synthesis, offering significant promise for large-scale application in industrial effluent management and environmental conservation initiatives.

Paper ID: ICSHSD-327

Study of Controlled Accumulation, Ingestion and Excretion of Chromium (III) Sulphate, Lead (II) Sulphate, Heavy Toxic Metals, in Some Freshwater Fish Species

Sabiha Afrin Jolly[1], and Umme Salma[1,*]
[1]Department of Chemistry, Mawlana Bhashani Science and Technology University, Santosh, Tangail-1902, Bangladesh
**Corresponding email: ummesalma@mbstu.ac.bd*

ABSTRACT

The contamination of freshwater ecosystems with heavy metals is a growing concern in developing countries like Bangladesh, where rapid industrialization and poor effluent management have escalated ecological risks. Among heavy metals, chromium (Cr) and Lead (Pb) are major pollutants due to their widespread use in industries such as tanning, electroplating, textile dyeing, and mining. This study investigated the bioaccumulation and excretion behavior of trivalent chromium Cr (III)) and Lead (II) sulphate in two edible freshwater fish species Pangas (Pangasius pangasius), Tilapia (Oreochromis mossambicus) under controlled laboratory conditions. Fishes were exposed to chromium-treated feed for up to 14 to 30 days, and tissue samples (meat, intestine, bone, and spine) were analyzed for the acute and chronic effects at regular intervals using Flame Atomic Absorption Spectrophotometry (FAAS). Bone and spine tissues exhibited the highest Cr accumulation (up to 1.337 ppm and 1.055 ppm, respectively) and Pb accumulation (up to 1.184 ppm and 1.054 ppm) while muscle tissues showed comparatively lower levels but still exceeded the USEPA's permissible limit (0.01 ppm for Cr and 0.000125 ppm for Pb). A declining trend Cr and Pb levels in muscle tissues' suggests partial excretion through metabolic pathways. The findings highlight the risks associated with consuming contaminated fish if safe withdrawal periods are not maintained and emphasized the need for proper feed management, regular monitoring, and stricter regulation of industrial discharges to ensure food safety and sustainable aquaculture.

Paper ID: ICSHSD-335

Cellulose Nanocrystal Recovery from Mixed Office Wastepaper to Develop Coatings with Enhanced Barrier Properties for Packaging

Anik Baral[1], Md. Mustafizur Rahman[1], and Khandoker Samaher Salem[1, 2,*]
[1]Applied Chemistry and Chemical Engineering, University of Dhaka, Dhaka-1000, Bangladesh
[2] Department of Chemical and Biomolecular Engineering, North Carolina State University, Raleigh, NC, USA
**Corresponding email: samaher.salem@du.ac.bd*

ABSTRACT

This study on sustainable nanocellulose modifications for various packaging applications is driven by the global social awareness and growing demand for bioproducts to reduce the use of single-use plastics. Mixed office waste (MOW) was used as the raw material to extract cellulose nanocrystals (CNCs) via the acid hydrolysis method. The average length and diameter of the CNCs were approximately 104.08 ± 0.1 nm and 9.49 ± 0.3 nm, respectively. The crystallinity index was 87%, as confirmed using transmission electron microscopy and X-ray diffraction analysis. Coating solutions of varying concentrations were prepared by mixing CNCs with collagen hydrolysate and glycerin, and the coatings were applied to the surface of uncoated paper via a rod coating process. FTIR spectra confirmed the presence of CNCs in the coated paper. High-resolution FE-SEM images provided detailed information on the surface morphology of the coated papers. The barrier and mechanical performances of the coated paper were evaluated using the oil and grease resistance KIT, hot oil, water vapor permeability, air permeability, water contact angle, tensile index, burst index, percentage of elongation, and fold tests. All the coated paper samples passed the hot oil test and exhibited the highest KIT rating. The water vapor and air resistance values of the coated paper samples increased 14 times and 250 times, respectively, compared with the uncoated paper samples. The water contact angle of the coated paper samples increased to 99.40° from 60.13°, and the surface roughness decreased from 2.37 μm to 0.85 μm. The presence of coating also increased the tensile and burst indices by 5.28 times and 1.79 times, respectively, compared with the uncoated paper samples. No cytotoxic effects were found in the optimized coated paper, and all the samples were fully degraded within 49 days, as confirmed using the soil biodegradability test. Therefore, the coated paper can be a potential alternative to existing single-use plastics for packaging materials.

Paper ID: ICSHSD-345

Spatial and Temporal Variations of $Pm_{2.5}$ Concentrations Across Dhaka Using Tsi Bluesky^{tm} Sensors

Rakibul Omar[1,*], Shatabdi Roy[2], Shahid Uz Zaman Adil[3], and Abdus Salam[1]
[1]Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
[2]University of Michigan, 500 S State St, Ann Arbor, MI 48109, USA
[3]Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
**Corresponding email: rakibulovi268@gmail.com*

ABSTRACT

Air pollution, associated with fine particulate matter ($PM_{2.5}$), is a critical environmental concern with significant implications for public health. The purpose of this study is the analysis of $PM_{2.5}$ concentrations and finding their micro-environment sources in Dhaka City, a rapidly growing urban center facing substantial air quality challenges. The data set was evaluated by dividing the city into five parts (North, South, East, West, Central). Total sensor numbers selected from these five sites are 42. The $PM_{2.5}$ values were analyzed for the time period of August 2021 to October 2023. The hourly concentrations were converted to monthly, seasonal, and yearly values for evaluation. The data were found to be seasonally dependent. The highest concentrations were found in the winter season and the lowest during the monsoon the concentration of $PM_{2.5}$ was ~110 µg/m^3 for Dhaka city in winter and ~20 µg/m^3 for Monsoon. The study was carried out for total 27 months and in this period the concentration of $PM_{2.5}$ ranged from (3.11-992.63) µg/m^3. Among the sites, Dhaka South has the highest concentrations (65.18 µg/m^3), while the West site has the lowest concentration (51.66 µg/m^3), other three sites have almost similar value with the West site. Individually, the highest concentration throughout the study period was observed in Narayanganj, Gognogor (75.28 µg/m^3), whereas Khilkhet has the lowest (22.53 µg/m^3) and Rupnogor High School (32.93 µg/m^3). The hourly average was found higher in the morning rush hours and evening for most of the sites and lower in the midday. The annual mean concentration was above the WHO standard guideline value (10 µg/m^3 for annual exposure) 5–6 times for each site. The weekly average of Dhaka city has shown that in the last weekday (Thursday) the concentration is highest compared to the other weekdays and lowest is observed in the weekly off day (Friday). The temperature variation was shown for the trends of $PM_{2.5}$. When the concentration was found to be higher, the temperature was lower, and the reverse is also true.

Paper ID: ICSHSD-390

Alcohol and Heavy Metal Contaminated Health Risk Assessment in Beverage Samples Available in Bangladesh

Md. Hasan Ali[1], Md. Monarul Islam[1,*], and Md. Al-Amin[2]
[1]Synthesis Laboratory, Chemical Research Division, BCSIR Dhaka Laboratories, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka-1205, Bangladesh
[2]Institute of National Analytical Research and Service (INARS), Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka-1205, Bangladesh
**Corresponding email: mmipavel@yahoo.com*

ABSTRACT

This study primarily investigates the alcohol and heavy metals content in beverage samples available in Bangladesh. Gas Chromatography coupled with Flame Ionization Detection (GC-FID) method was developed and validate to determine the alcohol and trace metal contamination was assessed using Atomic Absorption Spectroscopy (AAS) to evaluate potential health risks. GC-FID results confirmed that all beverage samples were devoid of ethanol (EtOH) and methanol (MeOH), indicating alcohol-free status. Trace metal concentrations were found to be within the permissible limits established by the World Health Organization (WHO), the United States Environmental Protection Agency (USEPA), and the Bangladesh Standards and Testing Institution (BSTI). The average concentrations of trace metals followed the descending order: Ca > Fe > Zn > Ni > Cr > Pb > Mn > Cu > Cd > Co. Health risk assessments were conducted using these trace metal concentrations to estimate both non-carcinogenic risks via Estimated Daily Intake (EDI), Chronic Daily Intake (CDI), Target Hazard Quotient (THQ), and Hazard Index (HI) and carcinogenic risks via CDI, Excess Lifetime Cancer Risk (ELCR), and Total Cancer Risk (TCR). The calculated EDI and CDI values were in the micromilligram range per day (10^{-6} mg/day). All trace metals exhibited THQ values significantly below 1, and the cumulative non-carcinogenic risk (HI) remained consistently under the threshold of 1 across all beverage samples.

Paper ID: ICSHSD-399

Assessment of Environmental Noise Pollution and Its Impacts on Urban and Academic Areas in Jashore, Bangladesh

Debaroty Biswas[1,*], Rajesh Kumar Chanda[1], and Biplob Kumar Biswas[1,*]
[1]Department of Chemical Engineering, Jashore University of Science and Technology, Jashore-7408, Bangladesh
Corresponding email: debaroty12@gmail.com; bk.biswas@just.edu.bd

ABSTRACT

Noise pollution is becoming a significant environmental and public health concern as a result of fast-tracked urbanization. Over the years, anthropogenic activities coupled with inadequate enforcement of environmental regulations have emerged as the main causes of noise pollution. Noise over critical level has several severe consequences, including hearing loss, cardiovascular problems, along with psychological impacts such as anxiety and lack of concentration. According to the World Health Organization, 5% of the world population suffers from noise pollution to varying degree. By considering all aspects, this study aims to assess the outdoor noise levels across different locations in Jashore, Bangladesh, including academic facilities, hospital area, bus terminal, and major highway intersection. Noise levels were recorded using a sound level meter at five distinct locations of Jashore University of Science and Technology (JUST), representing comprehensive academic environment. Primary data were collected using a sound level meter between 9:00 AM and 5:00 PM during the months of September to November in 2021. The measurement periods were categorized into three time slots: morning (09:00-11:59), noon (12:00- 14:59), and evening (15:00-17:00). It is observed from the investigation that peak sound levels were recorded as 84.56 dB and 74.57 dB in the evening at Newmarket, Jashore, and the main gate of the university campus, respectively. However, in front of Jashore General Hospital, a sound level of 79.15 dB was noted. Within the university area, a sound level of 65.04 dB was detected at academic buildings in the morning and 67.7 dB in residential areas in the afternoon. Furthermore, the sound levels recorded near the on-campus construction site were notably higher than those in other areas, ranging from 68.60 dB to 84.03 dB. While these values exceed standard permissible thresholds, they are still comparatively lower than those documented for other in the literature. The study further revealed that a significant portion of urban residents, both contributors to and victims of noise pollution, remained largely unaware of its harmful effects. Contributing factors such as inadequate urban planning, inconsistent infrastructural development, and unregulated traffic flow have exacerbated outdoor noise levels. The findings highlight a troubling noise pollution scenario within the surveyed area, warranting urgent attention to mitigate environmental noise. Moreover, the study offers a valuable reference point (baseline data) for future research and urban planning initiatives aimed at safeguarding public health and promoting sustainable development.

Paper ID: ICSHSD-416

Assessment of Metal(Loid)S Contamination, Sources, and Ecological Risk in Buriganga River Sediments using Inaa and Multivariate Approaches

Farhad Hossain[1], Rahat Khan[2,*], Mohammad Aminur Rahman[1], Md. Saiful Islam[2], Debapriyo Paul[1], Mohtasim Hasan[1], Md. Abdullah[1], and Mir Tamzid Rahman[1]

[1] Department of Chemistry, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh

[2]Institute of Nuclear Science & Technology, Bangladesh Atomic Energy Commission (BAEC), Savar, Dhaka-1349, Bangladesh

**Corresponding email: rahatkhan.baec@gmail.com*

ABSTRACT

This study systematically investigates the influence of anthropogenic pressures on sedimentary response within the Buriganga River, a heavily urbanized, polluted river system in Dhaka, Bangladesh. A total of 32 benthic sediment samples were collected along ~20 km in length to evaluate industrial impact, especially leather tanning influence (Cr, Mn, Zn), examine spatial distribution (IDW) and contamination status of geochemically important 15 metal(loid)s (Na, Al, K, Ti, Cr, Mn, Co, Zn, As, Rb, Sb, Cs, Ba, Th, and U) using Instrumental Neutron Activation Analysis (INAA), a highly sensitive and non-destructive nuclear analytical technique and the high-purity germanium (HPGe) gamma emission spectroscopic technique. Findings revealed substantial variability in potentially toxic elements concentration, which were employed using a multivariate statistical approach (SPSS), and correlation with PCA explained 78.93% of the total variance across the river continuum. Relative standard deviation (RSDs) ranging from 40% to 92% for Cr, Mn, Zn, As, Sb, and Ba signified pronounced inhomogeneous distribution and observed the highest measured concentrations 383, 1297, 610, 9.3, 3.83, and 1374 μg/g, respectively, were ~3-19 times higher than upper continental crust (UCC) values. Geo-environmental index assessments classified the sediments as moderately to considerably contaminated, with Cr, Zn, As, Sb, Cs, and Th showing significant enrichment in mid- to downstream regions with non-crustal/anthropogenic sources. Source apportionment via positive matrix factorization (U.S. EPA-PMF) modeling indicated that approximately 72% of the metal(loid)s load originated from anthropogenic sources such as leather tanning effluents, urban runoff, mixed industrial waste, and municipal wastewater, with the remaining portion derived from natural inputs. Alarmingly, all samples surpassed the threshold effect level (TEL) for Cr, with most also exceeding the severe effect level (SEL) and effect range median (ERM); Zn and As concentrations similarly exceeded their lowest effect thresholds as per sediment quality guidelines (SQGs). Overall, a considerable ecological threat is experienced in the current study area. These findings highlight the urgent need for integrated pollution control, with methodologies offering globally relevant insights for assessing and managing metal contamination in urban rivers impacted by industrialization and poor waste management.

Paper ID: ICSHSD-422

Adsorptive Performance of Layered Double Hydroxides and Their Oxides with Mg/Al Molar Ratios (2:1, 1:2) for Chromium Removal from Synthetic Wastewater

Shashe Chowdhury[1], Mir Tamzid Rahman[1,*], and Shamshad B. Quarishi[2]
[1]Department of chemistry, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh
[2]Director, Atomic Energy Centre, Dhaka-1207, Bangladesh
**Corresponding email: mtrchem@juniv.edu*

ABSTRACT

Bangladesh, one of the world's nations with the densest populations, has a lot of water resources, yet these resources are constantly being polluted. Several dangerous trace elements, including chromium, are present in both surface water and groundwater sources. Due to its metallic nature and lack of biodegradability, chromium has a detrimental effect on the environment and human health as well as other living things. The synthesis of Mg-Al-Layered double hydroxide and Mg-Al-Layered double oxides and their use to get rid of chromium pollution and also comparison of adsorbent's molar ratio by analyzing adsorption and kinetic model studies are the main objectives of this work. By using the co-precipitation approach, Mg-Al-LDH & LDO intercalated with Cl ion and molar ratio of Mg/Al 1.2 & 2.1 were synthesized. The structures of Mg-AI-LDH, Mg-Al-LDO were examined using X-ray and IR spectroscopy. The highest level of equilibrium adsorption (qe) 26.904 after conducting an adsorption investigation is discovered of chromium ion per gram of Mg-AI-LDH & LDO. The Freundlich model's compatibility with the Mg-Al-LDH & LDO adsorption process with a correlation coefficient value which is 0.92, 0.91, 0.93, 0.96 for 1:2, 2:1 LDH & LDO respectively suggests that it is a multi-layer adsorption. The chromium ion elimination process is found to follow a pseudo-second order reaction mechanism with R2 value 0.99 which means chemisorption is the rate limiting step, and the effect of temperature is also discernible, according to a kinetic research based on the value of the correlation coefficient. According to thermodynamic analysis, the Gibb's free energy value is negative, indicating that the adsorption is occurring spontaneously. The positive value 4.85, 16.50 for 1:2 ratio of LDH & LDO of ΔH demonstrates the endothermic nature of the reaction and same goes for 2:1 ratio of LDH & LDO. Additionally, ΔS in this study is 32.18, 72.75 for 1:2 ratio of LDH & LDO, suggesting that when reactants turn into products, the level of chaos in the universe increase. Activation energy of LDH and LDO is more than 8.4 kJ/mol indicates the chemisorption mechanism.

Paper ID: ICSHSD-423

Preparation and Characterization of Zinc Oxide-Potato Peel Composite for the Removal of Toxic Organic Dye

Umme Tajrian[1], Md. Rehan Alam[1], Abdullah Al Rakib[1], Md. Shahidul Haque[1], and Ummey Rayhan[1,*]
[1]Department of Chemistry, Dhaka University of Engineering & Technology, Gazipur, Gazipur-1707, Bangladesh
**Corresponding email: ummeyrayhan@duet.ac.bd*

ABSTRACT

The rapid industrialization and urbanization of recent decades have intensified the release of synthetic dyes into aquatic environments, posing severe ecological and health threats due to their toxicity, carcinogenicity, and persistence. The development of affordable and sustainable alternatives is necessary since conventional wastewater treatment techniques, such as membrane filtration, chemical oxidation, and coagulation, are either expensive or ineffective. Adsorption has emerged as a promising technique owing to its simplicity, efficiency, and economic viability. In this study, a zinc oxide-potato peel (ZnO-PP) composite was prepared using various ratio and evaluated for the removal of Methylene Blue (MB), a model cationic dye, from aqueous solutions. Potato peels, abundant agro-waste rich in cellulose, hemicellulose, and lignin, were processed into fine powder and employed as a bio-adsorbent. Commercially available ZnO is combined with potato peel powder to form a uniform composite at 1:3 ratios. The composite was characterized using Fourier Transform Infrared Spectroscopy (FTIR) to identify functional groups, X-Ray Diffraction (XRD) to examine crystallinity, and Scanning Electron Microscopy (SEM) to study surface morphology. Batch adsorption experiments were conducted under varying operational parameters, including dye concentration, adsorbent dosage, contact time, and pH. The removal of dye adsorption was monitored by UV–visible spectroscopy. The ZnO-PP composite exhibited excellent performance, achieving ~92% MB removal under optimal condition (10 ppm initial dye concentration, 0.15 mg adsorbent dosage, 25 min contact time, pH 8). The MB adsorption process of ZnO-PP was examined by the linear pseudo-first order (PFO), pseudo-second order (PSO) and intra-particles diffusion (IPD) models. The PSO model confirmed a better agreement with a high correlation coefficient ($R^2 > 0.999$), while the equilibrium data fit the Langmuir isotherm ($R^2 > 0.993$), indicating monolayer adsorption on a homogeneous surface with favorable interactions. The maximum monolayer adsorption capacity was 27 mg/g. These results demonstrate that ZnO-PP effectively integrates biomass with the adsorption activity of ZnO, offering a sustainable, low-cost, and

environmentally friendly solution for dye-contaminated wastewater treatment with strong potential for industrial scalability.

Paper ID: ICSHSD-430

Chromium Adsorption from Aqueous Solution Using a Fish Scale–Microcrystalline Cellulose Composite

Masfia Jahan[1], Md. Arif Hossain[1,*], Zinia Nasreen[1,*], and Md. Abu Bakar Siddiqu[2]
[1]Department of Chemistry, Faculty of Science, Dhaka University of engineering & Technology, Gazipur, Gazipur-1707, Bangladesh
[2]Institute of National Analytical Research and Service (INARS), Bangladesh council of Scientific & Industrial Research (BCSIR), Dhaka-1205, Bangladesh
**Corresponding email*: arif.acce2610@gmail.com; zinia@duet.ac.bd

ABSTRACT
Heavy metal pollution, especially from chromium (Cr), remains a significant environmental challenge due to its high toxicity and persistence in aquatic systems. Effective and sustainable removal methods are therefore essential to ensure safe water quality. In this study, fish scale (FS) powder was prepared from hilsa fish and combined with microcrystalline cellulose (MCC) to develop FS–MCC composites through a solvent-based technique. The composites were synthesized with varying FS proportions and evaluated for their chromium adsorption performance from wastewater containing 65 ppm Cr. Among the tested materials, the composite containing 50% FS exhibited the highest adsorption efficiency. At a dosage of 150 mg, this composite achieved complete (100%) removal of chromium from the wastewater. The influence of pH revealed that adsorption was more favorable under basic conditions, while equilibrium was reached within 4 hours of contact time. To better understand the adsorption kinetic and isotherm studies were conducted. The adsorption of chromium onto the 50% FS–MCC composite followed the pseudo-second-order kinetic model, indicating chemisorption as the rate-controlling step. Furthermore, the equilibrium data fitted well with the Langmuir isotherm model, suggesting monolayer adsorption on a homogenous surface. Overall, the results demonstrate that FS–MCC composites, particularly those containing 50% fish scale, are highly effective adsorbents for chromium removal from aqueous systems.

Paper ID: ICSHSD-434

Ice Templated PDMS-doped Graphene Oxide Foam for Spillage Oil and Fog Deposition Mitigation

Mehedi Hasan [1], Khandoker S Salem[1,2*], and A. F. M. Mustafizur Rahman[1,*]
[1]Department of Applied Chemistry and Chemical Engineering, University of Dhaka, Dhaka-1000, Bangladesh
[2]Department of Chemical and Biomolecular Engineering, North Carolina State University, Raleigh, NC, USA
**Corresponding email: samaher.salem@du.ac.bd; mustafizacce@du.ac.bd*

ABSTRACT
In this article, the ice-templating method was employed to produce 3D graphene oxide (GO) foam from GO suspension prepared via an improved Hummer method. The GO foam was doped with PDMS and cured to improve flexibility and stability. The foam exhibited excellent oil absorption performance due to having high porosity, enhanced surface area, strong selectivity (highly oleophilic and hydrophobic). Structural characterizations using Raman, XRD, XPS, ToF-SIMS, SEM, BET, etc., confirmed PDMS successfully incorporated in interconnected three-dimensional multilayer GO foam. The GO/PDMS foam was employed as a substrate for oil/water separation, showing remarkable absorption for different types of oils ranging from 6.6-11.6 g/g, exceeding many conventional sorbents. The compressibility analysis and burning experiment of GO-PDMS foam showed that the foam did not compromise its structural integrity even after a hundred (100) cycles at 40% and 60% compressive strain and ten (10) cycles of subsequent burning. The PDMS-doped GO foam was then employed in artificial sewage wastewater to investigate the effect of the foam on fats, oil, and grease (FOG) deposit formation. The experiment was run for 15–45 days, and a 14.1-to-17.1-fold reduction of FOG deposition in the presence of the foam was observed compared to its absence. Therefore, GO-PDMS foam provides a unique opportunity to use nanomaterials to solve oil spillage scenarios and prevent FOG deposition. It exceptionally outperforms traditional materials in terms of capacity and reusability, and promises to be an eco-friendly material for environmental remediation.

Paper ID: ICSHSD-441

Adsorption of Chromium from Aqueous Solution by Activated Carbon-Microcrystalline Cellulose Composite

Md. Arif Hossain[1,*], Masfia Jahan[1], Touhidur Islam[1], and Zinia Nasreen[1]
[1]Department of Chemistry, Dhaka University of engineering & Technology, Gazipur, Gazipur-1707, Bangladesh
*****Corresponding email: arif.acce2610@gmail.com*

ABSTRACT

Heavy metal contamination, particularly with chromium (Cr), poses a serious threat to water quality in many regions. Chromium is highly toxic and must be removed from water sources before being used for drinking or domestic purposes. In this study, activated carbon (AC) and microcrystalline cellulose (MCC) were used to fabricate AC–MCC composites with varying weight ratios (0%, 5%, 10%, 20%, 50%, 75%, and 100%) through solvent-based techniques. The composites were then evaluated for their ability to adsorb Cr (50 ppm) from aqueous solutions. Among the tested formulations, the 50% AC–MCC composite exhibited the highest adsorption capacity (27.5 mg/g), outperforming both individual AC and MCC. The adsorption process was further investigated using the optimized 50% AC–MCC composite at different contact times, ranging from 1 minute to 18 hours. Results indicated that equilibrium was achieved within 4 hours. Dose-dependent studies revealed that increasing the amount of the composite enhanced Cr removal efficiency. To better understand the adsorption mechanism, kinetic and isotherm models were applied. The adsorption data closely fitted the pseudo-second-order kinetic model, suggesting chemisorption as the rate-limiting step. Moreover, the Langmuir isotherm model provided the best fit, indicating monolayer adsorption of Cr ions onto the composite surface. These findings highlight the potential of AC–MCC composites, particularly the 50% formulation, as an efficient and sustainable adsorbent for the removal of chromium from contaminated water.

Paper ID: ICSHSD-457

Selective Colorimetric Detection of Cu^{2+} in Aqueous Medium using an Acid Hydrazide-Based Chemosensor: Experimental and DFT/TDDFT Studies

Joardar Gim[1], Zannatul Kowser[1,*], Dipa Debnath[1], Redika Sarmin Prieety[1], Miss. Tasnim Jahan[1], Most Tahera Khatun[1], Sahara Khatun Munni[1], Md. Rashed Khan[1], and Rashedul Islam[1]
[1]Department of Chemistry, Jashore University of Science and Technology, Jashore-7408, Bangladesh
*****Corresponding email: zannatulkowser_che@just.edu.bd*

ABSTRACT

The design of selective molecular probes for heavy metal detection is of great interest in environmental and analytical chemistry. In this work, an acid hydrazide-based Schiff base N'-(4hydroxybenzylidene)picolinohydrazide (**HP**) has been designed and synthesized in a single-step process for the detection of Cu^{2+}. The structure of **HP** was comprehensively characterized using various spectroscopic and analytical techniques, including FTIR, ^{1}H NMR, ^{13}C NMR, and elemental analysis. The chemosensing performance of **HP** towards metal ions has been systematically investigated using UV–Vis spectroscopy. Remarkably, **HP** exhibits a rapid, highly selective, and sensitive response exclusively toward Cu^{2+} ions in the presence of a wide range of environmentally and biologically relevant competing cations (Na^{+}, Ni^{2+}, NH_4^{+}, K^{+}, Fe^{3+}, Cr^{3+}, Al^{3+}, Sn^{2+}, Cd^{2+}, Zn^{2+}, Hg^{2+}, Pb^{2+}, and Ag^{+}) in MeOH/H_2O (6:4 v/v, HEPES = 10 mM, pH 7.4). Notable spectrum alterations of probe **HP** have been observed with only Cu^{2+}; upon binding with Cu^{2+}, the characteristic absorption band of **HP** at 323 nm disappears, accompanied by the emergence of a new band at 280 nm and a red-shift of the 223 nm band to 230 nm. The probe **HP** achieves a detection limit (LOD) of 8.94 μM. The Job's plot analysis has confirmed 1:1 binding stoichiometry between probe **HP** and Cu^{2+}. The association constant ($\mathbf{K_a}$) was found to be 4.26×10^4 M^{-1}. The binding mechanism was established via FTIR analysis, where noticeable shifts in the –OH, –NH, and –C=N stretching vibrations after complexation confirm their role in Cu^{2+} coordination. FE-SEM analysis revealed clear morphological changes of the probe **HP** before and after complexation. Additionally, Density Functional Theory (DFT) and Time-Dependent DFT (TDDFT) calculations have provided theoretical insights highly consistent with experimental observations. Hole–electron analysis further confirms a charge transfer (CT) mechanism in the **HP–Cu^{2+}** complex. Most significantly, the **HP** probe has proven to be highly efficient in detecting Cu^{2+} in real water samples, demonstrating that it serves as a reliable and efficient chemosensor for environmental monitoring.

Paper ID: ICSHSD-477

Design of a Reversible UV-Vis Colorimetric Chemosensor for Cu^{2+}: Experimental and Computational Investigations

Zannatul Kowser[1,*], Joardar Gim[1], Redika Sarmin Prieety[1], Dipa Debnath[1], Miss. Tasnim Jahan[1], Most Tahera Khatun[1], Sahara Khatun Munni[1], and Rashedul Islam

[1]Department of Chemistry, Jashore University of Science and Technology, Jashore-7408, Bangladesh

Corresponding email: zannatulkowser_che@just.edu.bd

ABSTRACT

Selective molecular probe design plays a vital role in advancing heavy metal detection for environmental and analytical applications. In this work, we have reported the development of an acid hydrazide-based, water-soluble, reversible, and simple N, O-donor Schiff base probe (**MPH**) for the selective colorimetric detection of Cu^{2+} ions in a MeOH/H_2O (7:3 v/v, HEPES = 10 mM, pH 7.4) medium. The structure of **MPH** was confirmed by FTIR, ^1H NMR, ^{13}C NMR and elemental analysis. Upon coordination with Cu^{2+}, **MPH** exhibits a distinct color change from colorless to yellow accompanied by marked changes in its absorption spectrum. This rapid visual response enables naked-eye detection of Cu^{2+} ions without requiring sophisticated instrumentation. In contrast, other competitive cations (Fe^{3+}, Hg^{2+}, K^+, Mg^{2+}, Mn^{2+}, Na^+, NH_4^+, Ni^{2+}, Pb^{2+}, Sn^{2+}, Zn^{2+}, Al^{3+}, Ag^+, Ca^{2+}, Cd^{2+}, Co^{2+}, Cr^{3+}, Fe^{2+}, Cu^{2+}) showed no interference at the tested concentration. UV–Vis spectral analysis revealed that free **MPH** exhibited absorption bands at 218, 258, and 340 nm. Upon binding with Cu^{2+}, the bands at 218 and 258 nm shifted to 216 and 262 nm, while the 340 nm band diminished with the emergence of a new band at 298 nm, confirming the formation of the **MPH–Cu^{2+}** complex. The probe demonstrated a detection limit (LOD) of 4.4 μM with Job's plot analysis supporting a 1:1 binding stoichiometry. The association constant was found to be (K_a) of 2.25×10^4 M^{-1}. FTIR studies showed notable shifts in –C=O and –NH vibrations, indicating their role in Cu^{2+} coordination, while FE-SEM revealed clear morphological transformations upon complexation. Furthermore, Density Functional Theory (DFT) and Time-Dependent DFT (TDDFT) calculations are in strong agreement with experimental observations validating the electronic transitions and binding interactions. In addition, the actual usage of sensor **MPH** has been further demonstrated by test kits and real water analysis, which shows that it could serve as a reliable and efficient chemosensor for environmental monitoring. Overall, these results establish **MPH** as a promising, efficient, and user-friendly chemosensor for Cu^{2+} detection. Its high selectivity, low detection limit, visual colorimetric response, and successful performance in real environmental samples underscore its potential for practical monitoring of copper contamination.

Energy Conversion, Storage and Nuclear Chemistry

Paper ID: ICSHSD-56

Single Atom Catalysts: A Frontier in Designing Efficient Oxygen Evolution Reaction for Energy Storage Devices

Md. Rakib Khan[1], and Md. Shafiul Islam[2,*]
[1]Department of Chemistry, Jagannath University, Dhaka-1100, Bangladesh
[2]Department of Applied Chemistry and Chemical Engineering, Noakhali Science and Technology University, Noakhali-3814, Bangladesh
**Corresponding email:shafiulvcu@gmail.com*

ABSTRACT
The transition to sustainable energy technologies has intensified research into high-performance energy storage devices such as rechargeable metal–air batteries. Despite their promise of high energy density and environmental compatibility, their widespread application is hindered by the sluggish kinetics of the oxygen evolution reaction (OER) during charging. Conventional catalysts, including transition-metal oxides and alloys, often suffer from limited active sites, high overpotentials, and stability challenges, making the development of more efficient electrocatalysts imperative. Single-atom catalysts (SACs) have recently emerged as a breakthrough in electrocatalysis, offering atomic-level precision in catalyst design. By anchoring individual metal atoms onto conductive supports, SACs achieve maximum atomic utilization and generate well-defined active sites. These structural advantages enhance the adsorption and desorption of oxygen intermediates, thereby reducing kinetic barriers and improving OER efficiency. Furthermore, their unique atomic configuration allows mechanistic insights through advanced characterization and density functional theory (DFT), providing a fundamental understanding of OER pathways. This presentation will discuss recent progress in the design and application of SACs for OER enhancement in energy storage devices, particularly metal–air batteries. Strategies such as coordination environment tuning, heteroatom doping, and defect engineering will be highlighted for their role in boosting catalytic activity and stability. Challenges related to durability and large-scale synthesis will also be addressed, along with emerging solutions such as hybrid nanostructures and strong metal–support interactions. By bridging atomic-level design with practical performance, SACs represent a frontier in catalysis, offering a pathway to efficient, stable, and sustainable energy storage technologies.

Paper ID: ICSHSD-451

Enhanced Electrochemical Performance of Reduced Graphene oxide Decorated Manganese oxide Cathode for Aqueous Zinc-Ion Batteries

Md. Rana Sheikh[1], Md. Amir Hamza[1], Maharun Negar Mojumder[1], Syfulla Mansur[1], Bipul Chandra Majumder[1], Abdul Kuddus[1], and Chanchal Kumar Roy[1,*]
[1]Department of Chemistry, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
**Corresponding email: ckroy@chem.buet.ac.bd*

ABSTRACT
Aqueous zinc-ion batteries (AZIBs) are promising for safe and sustainable energy storage. However, manganese oxide (MnOx)-based cathodes suffer from poor conductivity and structural degradation. Here, MnOx nanorods uniformly wrapped by graphene oxide (GO) were synthesized via a simple hydrothermal method. The GO network enhances conductivity, mitigates MnOx dissolution, and stabilizes the structure during cycling. The rGO@MnOx cathode delivers 312 mAh g^{-1} at 0.1 A g^{-1}, an energy density of 214.3 Wh kg^{-1}, and 106% retention after 2500 cycles at 5 A g^{-1} current density. These findings establish rGO-decorated MnOx as a durable and high performance AZIB cathod

Paper ID: ICSHSD-459

Flower-Like Manganese Vanadate Nanosheet Cathodes for High-Performance Aqueous Zinc-Ion Batteries

Md. Amir Hamza[1], Md. Rana Sheikh[1], Maharun Negar Mojumder[1], Syfulla Mansur[1], Bipul Chandra Majumder[1], Abdul Kuddus[1], Chanchal Kumar Roy[1,*]
[1]Department of Chemistry, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
**Corresponding email: ckroy@chem.buet.ac.bd*

ABSTRACT
Aqueous rechargeable zinc-ion batteries (ZIBs) are gaining attention for grid-scale energy storage owing to their intrinsic safety, low cost, and the abundance of zinc. However, a major challenge remains in the development of cathode materials that could deliver high capacity, fast kinetics, and long-term durability simultaneously. Here, we report a facile one-step hydrothermal synthesis of manganese vanadate with a hierarchical, flower-like nanosheet morphology. The cathodes' mixed-valence state and layered structure allow an abundance of redox-active sites as well as to easy zinc ion diffusion pathways. The as-prepared manganese vanadate delivers 435 mAh g^{-1} at 0.1 A g^{-1}, retains 140 mAh g^{-1} at 10 A g^{-1}, and recovers to 365 mAh g^{-1} when the current returns to 0.1 A g^{-1}, with ~100% coulombic efficiency. These results highlight manganese-doped vanadium oxides nanoflowers as a robust, high-performance ZIB cathode.

Paper ID: ICSHSD-494

Comparative Analysis of Waste Products in Fusion vs. Fission: Implications for Long-Term Nuclear Waste Management

Sadi Mohammad Meraj[1,*], Raiyan Yusuf[1], Tamim Hasan Apurbo[1], Sadia Tasnim Shara[2], Md. Mortuza Ahmmed[3]
[1]Department of Computer Science, American International University-Bangladesh, Dhaka-1229, Bangladesh
[2]Department of Electrical and Electronic Engineering, American International University-Bangladesh, Dhaka-1229, Bangladesh
[3]Department of Mathematics, American International University-Bangladesh, Dhaka-1229, Bangladesh
**Corresponding email: 23-54766-3@student.aiub.edu*

ABSTRACT
The global discovery of durable and low carbon energy has accelerated interest in nuclear power, especially as an alternative to fossil fuels. Traditional nuclear fragmentation, although well established, produces long -term radioactive waste such as Plutonium -239 and less actinides, extends for thousands of years with half a life, facing important challenges for long -term governance. According to the International Nuclear Energy Agency (IAEA, 2020), the fragmentation reactor generally generates more than the fuel used 10,000 tonnes annually, most of which require geological disposal for hundreds of millennia. In contrast, nuclear mergers are presented as a cleaner alternative. Does not produce transuranic waste from time to time. Study by Fedecy et al. (2019) and Abdou et al. (2015) indicates that merger systems produce radioactive underwater through neutrons Activation of structural materials such as steel, vanadium alloys and tungsten. These active materials show half a lifetime from decades to a few centuries, which is much lower than the fragmentation waste, but still requires careful handling.This study does a comparative analysis of waste products from demerger and merger, and checks their isotopic composition, half-life, radio toxicity and decay heat. Conclusions of recent modeling functions (Taylor et al., 2021) suggest that a specific fusion demo reactor can produce the least intermediate level of 3000 tonnes per year, which is protected for recycling within 100-500 years. On the other hand, fuel maintains used fuel high radio toxicity for more than 100,000 years (World Atomic Association, 2022). In addition, progression in low-active materials-as-like silicon carbide and low activation of ferritic steel promis composes to reduce the long-term risk of fusion waste (Zincal and Gonim, 2018). Comparative insights emphasize that mergers represent sufficient improvement in fragmentation when it comes to waste life and control complexity, it is not entirely free of challenges with core waste. Research emphasizes the need to develop fusion-specific disposal and recycling strategies, especially closer commercial performance in the form of international projects such as Iter and Demo. The implications are expanded in addition to scientific evaluation of energy policy and stability scheme, as the preparation of regulations for merger waste is important for its future acceptance. Finally, merger energy provides a transformative route to permanent nuclear power, with waste profiles that are less dangerous and more manageable than fragmentation. However, the plan that is active in physics and waste management policy will be necessary to fully feel its ability.

Paper ID: ICSHSD-520

Solvothermal Engineering of Cathode Materials for Advanced Aqueous Zinc-Ion Batteries

Md. Zahid Hassan[1], Parbhej Ahamed[1,*], Nusrat Sultana[1], Md. Sadiqul Islam Sheikh[1], Muhammad Abu Yousuf[1]
[1]Department of Chemistry, Khulna University of Engineering & Technology, Khulna-9203, Bangladesh
**Corresponding email: parbhej@chem.kuet.ac.bd*

ABSTRACT

The global transition toward sustainable energy technologies necessitates the development of safe, cost-effective, and high-performance energy storage systems. Aqueous zinc-ion batteries (ZIBs) have emerged as promising candidates due to their intrinsic safety, environmental friendliness, and the high theoretical capacity of zinc anodes. Despite these advantages, the electrochemical performance of ZIBs is largely determined by the cathode material, where achieving structural stability, high capacity and efficient ion transport remains a critical challenge. In this study, we explore a solvothermal synthesis strategy to design and engineer advanced cathode materials for aqueous ZIBs. By carefully modulating reaction system using solvent we successfully tailored the phase, morphology, and crystallinity of manganese-based oxides. This approach provided precise control over microstructural features including particle size distribution, surface area and pore architecture, which are crucial for optimizing Zn^{2+} ion insertion/extraction dynamics. Comprehensive structural and morphological characterizations using X-ray diffraction (XRD) and field emission scanning electron microscopy (FESEM) confirmed the formation of well-defined nanostructured cathodes. Electrochemical assessments demonstrated that the solvothermally engineered cathode materials delivered enhanced specific capacity, superior rate capability and excellent cycling stability compared with conventionally synthesized counterparts. The improved performance is attributed to the synergistic effects of tailored morphology and controlled crystallinity, which facilitated fast ion diffusion and robust structural integrity during repeated charge–discharge processes. This work highlights the potential of solvothermal design as a versatile and eco-friendly route for engineering next-generation cathode materials. The findings provide fundamental insights into structure–property correlations and open new pathways for the rational design of high-performance aqueous ZIBs for large-scale energy storage applications.

Paper ID: ICSHSD-521

Morphology-Controlled MnO_2 Via Temperature-Tuned Ultrasonic Synthesis for Aqueous Zinc-Ion Batteries

Md. Baiazid Ismail[1], Md. Sadiqul Islam Sheikh[1], Muhammad Abu Yousuf[1], Parbhej Ahamed [1,*]
[1]Department of Chemistry, Khulna University of Engineering & Technology, Khulna-9203, Bangladesh
**Corresponding email: parbhej@chem.kuet.ac.bd*

ABSTRACT

The development of sustainable and high-performance energy storage devices is essential to meet the growing demand for renewable and eco-friendly power solutions. Among various candidates, aqueous rechargeable zinc-ion batteries (ZIBs) have attracted significant attention owing to their inherent safety, cost-effectiveness, and high theoretical capacity. However, the electrochemical performance of ZIBs is critically governed by the cathode material, where manganese dioxide (MnO_2) stands out due to its rich polymorphism, environmental benignity, and abundant availability. Despite these advantages, the morphology and crystal structure of MnO_2 remain decisive factors influencing ion diffusion pathways, structural stability, and overall electrochemical behavior. In this work, we report a **temperature-tuned ultrasonic synthesis** approach for the controlled fabrication of MnO_2 with diverse morphologies. By systematically varying the synthesis temperature under ultrasonic irradiation, distinct structural architectures such as nanorods, nanosheets like assemblies were obtained without the use of surfactants or hazardous solvents. The ultrasonic environment facilitated rapid nucleation, defect generation, and effective dispersion, while temperature variation modulated the growth kinetics and final morphology. Comprehensive characterization through X-ray diffraction (XRD), scanning electron microscopy (SEM) and transmission electron microscopy (TEM) confirmed the successful tailoring of phase composition and microstructure.Electrochemical evaluations in aqueous zinc-ion cells revealed a strong correlation between morphology and performance. The synergistic effect of ultrasonic energy and temperature control enabled the tuning of structural features that improved Zn^{2+} ion insertion/extraction dynamics. This study highlights a simple, scalable, and eco-friendly route for designing morphology-engineered MnO_2 cathodes, offering valuable insights into the rational development of high-performance aqueous ZIBs for future energy storage technologies.

Paper ID: ICSHSD-527

Lignin Reinforced Conductive Hydrogels with Antibacterial Properties for Flexible Supercapacitor Applications

Md. Tanzil Ahamed Shawon[a], Ilnaz Fargul Chowdhury[a], Partha Paul[a], Md. Salim Khan[a], Md. Anamul Haque[b], Zuwu Tang[c,*] and Ajoy Kanti Mondal[a,*]

[a] Institute of National Analytical Research and Service, Bangladesh Council of Scientific and Industrial Research, Dhanmondi, Dhaka 1205, Bangladesh

[b] Department of Chemistry, University of Dhaka, Dhaka 1000, Bangladesh

[c] School of Materials and Packaging Engineering, Fujian Polytechnic Normal University, Fuzhou, Fujian 350300, P. R. China

**Corresponding email: Tom1151045003@163.com & ajoymondal325@yahoo.com*

ABSTRACT

Lignin, a widely available yet underutilized natural polymer, has received significant interest for its environmentally friendly and sustainable benefits. Herein, a straightforward approach is presented to synthesize lignosulfonate sodium (LSS) ionic hydrogels through simple crosslinking with acrylamide (AAm) and aluminum chloride ($AlCl_3$), without using *N, N′*-methylenebisacrylamide (MBAA) and other external stimuli. The resulting LSS/PAAm/Al hydrogels are thoroughly analyzed using FTIR, XPS, mechanical testing, electrochemical workstation (ECW) and swelling/deswelling experiments. The abundant phenolic and sulfonic hydroxyl groups in the LSS-based hydrogels act a crucial role in providing multiple smart properties, including conductivity (as high as 5.79 Sm^{-1}), antibacterial activity and applications in supercapacitors. Robust hydrogen bonding and metal-coordination interactions among LSS, AAm and Al^{3+} imparted outstanding mechanical properties to the hydrogel. The hydrogel demonstrated a maximum tensile strength of approximately 321.4 kPa at an elongation of 175.6% and a peak compressive strength of around 2.82 MPa with a maximum stretchability of 70%. The hydrogel-based supercapacitor achieved a specific capacitance (C_s) of 467.7 Fg^{-1}, the highest energy density (E_d) of 64.96 $Whkg^{-1}$ and a power density (P_d) of 3.0 $kWkg^{-1}$. This study provides a pathway for incorporating renewable and biodegradable materials into the next generation of sustainable, high-performance flexible electronic devices.

Poster Papers

Paper ID: ICSHSD-107

Design and Characterization of Metal Oxide Catalysts for the Efficient Production of Furfural from Sugarcane Bagasse-Derived Hemicellulose

Abdullah Al Mamun[1], Tanvir Muslim[1,*], and Swapan Kumer Ray[2]
[1]Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
[2]Fiber and Polymer Research Division, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka-1205, Bangladesh
Corresponding email: tmuslim@du.ac.bd

ABSTRACT

In this work, three new nanostructured catalysts for the extraction of furfural from hemicellulose are synthesized and characterized: V_2O_5-ZrO_2, Al_2O_3-La_2O_3-V_2O_5, and TiO_2-SiO_2-La_2O_3. Effective nanoscale fabrication was demonstrated by the average particle sizes of 58 nm, 49 nm, and 65 nm for the corresponding catalysts as determined by scanning electron microscopy (SEM) and energy dispersive x-ray spectroscopy (EDS). Through the use of UV-vis spectroscopy, the optical band gap energies were determined to be 1.41 eV, 1.77 eV, and 1.50 eV, indicating high photocatalytic activity. By observing distinctive peaks at 700 cm^{-1}, 455 cm^{-1}, and 498 cm^{-1}, FTIR analysis verified the existence of functional groups. To establish catalyst stability and crystallinity, further structural and compositional confirmation was carried out using Raman spectroscopy, X-ray diffraction (XRD), and thermogravimetric analysis (TGA). Furfural was effectively extracted from 4 g of hemicellulose using these catalysts, producing about 1.30 ml. High-Performance Liquid Chromatography (HPLC) and Nuclear Magnetic Resonance (^{1}H NMR) were used to confirm the extracted product. A useful platform chemical generated from biomass, furfural has great potential as a sustainable precursor to biodiesel and other bio-based chemicals and fuels. These results highlight the potential of customized nano-catalysts in biomass valorization, offering a productive path toward applications using renewable energy.

Paper ID: ICSHSD-109

Evaluation of Cauliflower Stem Leaves as an Adsorbent for the Removal of Alizarin Red S Dye from Aqueous Solution

TonmoyMojumder[1], Hosne Ara Begum[1], and Md. Safiqul Islam[1,*]
[1]Department of Chemistry, Faculty of Science, University of Dhaka, Dhaka-1000, Bangladesh
Corresponding email: safique@du.ac.bd

ABSTRACT

The increasing amount of synthetic dyes in wastewater is a serious environmental issue and we need cost effective and environmentally friendly dye remediation methods. Cauliflower stem leaf powder (CFSL) derived from agricultural waste was evaluated as a bio-adsorbent for removal of Alizarin Red S (ARS) dye from aqueous solutions. CFSL was prepared by conventional method. SEM-EDX analysis confirmed the rough surface of CFSL for dye adsorption. The effects of temperature, solution pH, initial dye concentration, and adsorbent mesh size and contact times of solution with adsorbent were studied in batch adsorption tests. Equilibrium time for ARS adsorption was around 6 hours. Adsorption isotherms at three temperatures (30, 40 and 50°C) and pH 7.10 showed increasing adsorption with equilibrium concentration. Langmuir isotherm model gave the best fit with q_m of 257.70 mg/g at 50°C. Adsorption efficiency increased with increasing temperature from 30 to 50°C. pH dependent behavior showed optimal adsorption at pH 7.10 and decreased efficiency at basic condition. Thermodynamic analysis revealed the adsorption process to be spontaneous and endothermic with ΔH of 13.19 kJ/mol. ΔG decreased with increasing temperature from 303 K to 323 K indicating feasibility increased with temperature. CFSL powder is a low cost and sustainable adsorbent for ARS dye removal and an economical alternative to conventional adsorbents. This study opens up the possibility of its application in wastewater treatment and a practical and environmentally friendly solution for dye remediation.

Paper ID: ICSHSD-117

Graphene-Aminated Lignin Composite for Sustainable Removal of Congo Red and Hexavalent Chromium: Mechanistic Insights and Reusability

Md. Masum Billah[1], Md. Kamruzzaman[1,*], and Mohammad Amirul Hoque[2,*]
[1]Department of Applied Chemistry and Chemical Engineering, Gopalganj Science and Technology University, Gopalganj-8100, Dhaka, Bangladesh
[2]Fiber and Polymer Research Division, BCSIR Dhaka Laboratories, Bangladesh Council of Scientific and Industrial Research, Dhaka-1205, Bangladesh
**Corresponding email: mkamruzzamandu81@gmail.com*

ABSTRACT
This research aims at introducing a new composite capable of removing both a textile dye [Congo Red (CR)] and a toxic metal, hexavalent Chromium (Cr), present in the wastewater. The composite was developed through a facile and eco-friendly approach utilizing microwave-exfoliated graphene (MG) and bio-derived aminated lignin (AL). The uniqueness of this study lies in the synergistic combination of a pairing not widely investigated before to enhance adsorption selectivity, capacity, and stability. Comprehensive characterization using FTIR, SEM, XRD, and TGA confirmed successful functionalization, increased porosity, crystallinity, and thermal stability. Under optimal conditions, the MG-AL composite exhibited remarkable maximum adsorption capacities of 121.38 mg/g for CR and 356.55 mg/g for Cr(VI), surpassing many existing biomass-based adsorbents. Kinetic analyses revealed that the adsorption process followed a pseudo-second-order model, indicative of chemisorption, while equilibrium data were best described by the Langmuir isotherm model, suggesting monolayer adsorption onto a homogeneous surface. Thermodynamic parameters confirmed that the adsorption was spontaneous (ΔG^o=−9.09 KJ/mol for CR dye, and ΔG^o=−14.15 KJ/mol) and endothermic (ΔH^o=53.02 KJ/mol for CR dye, and ΔH^o=49.08 KJ/mol for Cr(VI)). Notably, the composite retained high removal efficiencies of 75.89% for CR dye and 85.31% for Cr(VI), even after five consecutive regeneration cycles, highlighting its promising reusability and potential for practical wastewater treatment applications. This study presents a scalable, sustainable lignin-based adsorbent with a mechanistic and thermodynamic framework for wastewater treatment, aligning with green chemistry and circular bioeconomy principles to advance eco-friendly pollutant removal.

Paper ID: ICSHSD-118

Green Synthesis of Cnc-Rgo Composites for Advanced Hybrid Super Capacitor Electrode Development

Md. Shohidul Islam[1], B.M. Mohibur Rahman[1], and Md. Mahbubur Rahman[2,*]
[1]Department of Chemistry, Dhaka College, Dhaka-1205, Bangladesh
[2]Fiber and Polymer Research Division, BCSIR Dhaka Laboratories, Bangladesh Council of Scientific and Industrial Research, Dhaka-1205, Bangladesh
**Corresponding email: Mahbub.bcsir@yahoo.com*

ABSTRACT
The rising demand for sustainable energy storage highlights the need for eco-friendly, high-performance supercapacitor electrodes. Here, we report a green, water-based synthesis of a hybrid electrode composed of cellulose nanocrystals (CNCs) and reduced graphene oxide (rGO). CNCs act as natural dispersants and nanoscale spacers, preventing rGO aggregation and forming a porous, interconnected network. Characterization (FTIR, XRD, TGA, SEM) confirms CNC-rGO integration, showing removal of oxygen functional groups, structural compatibility, enhanced thermal stability, and uniform CNC distribution that mitigates graphene restacking. Electrochemical tests reveal predominantly electric double-layer capacitance with minimal pseudocapacitive contributions. Cyclic voltammetry (CV) curves remain nearly rectangular at high scan rates, while galvanostatic charge–discharge (GCD) profiles exhibit symmetric triangular shapes and 100% Coulombic efficiency. The optimized 20 wt% CNC-rGO electrode achieves a specific capacitance of 220 F g^{-1}, over twice that of pure rGO, and demonstrates higher current densities, longer discharge times, and low voltage drops, indicating excellent charge storage and low internal resistance. Electrochemical impedance spectroscopy (EIS) shows low series and charge-transfer resistance for moderate CNC loading. These results demonstrate that incorporating bio-derived CNCs improves electrolyte wettability and ionic accessibility without compromising conductivity, providing a sustainable and high-performance CNC–rGO electrode suitable for advanced, high-rate supercapacitors.

Paper ID: ICSHSD-134

Synthesis, Characterization, and Biological Evaluation of Schiff Base Ligands and Their Metal Complexes

Md. Mizanur Rahman[1,*], Tulia Akter[1], and Md. Masuqul Haque[1,*]
[1]Department of Chemistry, University of Rajshahi, Rajshahi-6205, Bangladesh
Corresponding email: mizanur2317@gmail.com; **masuqul2003@ru.ac.bd*

ABSTRACT

A series of Schiff base ligands derived from furan-2-carbaldehyde, isoniazid, and anthranilic acid, along with their corresponding transition metal complexes, were synthesized and systematically investigated. The ligands and complexes were obtained via conventional condensation reactions, and their purity was confirmed using TLC and melting point analysis. Structural characterization involved UV–Vis and FT-IR spectroscopy as well as thermogravimetric analysis (TGA). FT-IR spectra indicated that the ligands act as bidentate donors, coordinating central metal ions through nitrogen (N) and oxygen (O) donor atoms. Spectroscopic and physicochemical analyses indicated that the synthesized complexes adopt either tetrahedral or octahedral geometries, determined by the nature of the central metal ion and its coordination mode. Electrical conductivity studies indicated non-electrolytic behavior, while magnetic susceptibility results reflected both diamagnetic and paramagnetic characteristics. The biological activities of the synthesized compounds were evaluated for antimicrobial, antioxidant, and antidiabetic potentials. Antimicrobial testing against *Escherichia coli* (Gram-negative) and *Staphylococcus aureus* (Gram-positive) revealed enhanced activity in metal complexes compared to the parent ligands. Antioxidant capacity, determined via DPPH radical scavenging assays with butylated hydroxytoluene (BHT) as the reference, demonstrated similar trends, where metal coordination improved radical scavenging efficiency. Conversely, α-amylase inhibition studies indicated that Schiff base ligands were more effective than their complexes, suggesting the free ligand framework plays a greater role in enzyme interaction. Overall, the study underscores the dual significance of Schiff base systems: metal complexation enhances antimicrobial and antioxidant effects, while the uncoordinated ligands retain superior antidiabetic activity. These findings reinforce the potential of Schiff bases and their metal complexes as multifunctional agents in medicinal chemistry. Further computational modeling, mechanistic insights, and in vivo evaluations are proposed to advance their therapeutic applications.

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Synthesis, Characterization, and Application of the Composite Material CeBiOIBr with g-C_3N_4 to Enhance Photocatalytic Activity

Md. Nizam Uddin[1,*], and SK Faisal Ahmed[1]
[1]Department of Chemistry, Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh
**Corresponding email: nizam3472@yahoo.com*

ABSTRACT

Efficient and sustainable photocatalysts synthesis is crucial for environmental and energy challenges in the present world. Concerning this, we synthesized CeBiOIBr precursor by hydrothermal method and combined it with graphitic carbonnitride (g-C_3N_4) to synthesis a composite with enhanced photocatalytic properties. The synthesis process involved controlled reaction conditions to ensure the successful formation of CeBiOIBr precursor and further composite synthesis with g-C_3N_4 in various percentage in order to find the best composition using an ultrasonic-assisted dispersion method. This process aimed to enhance charge separation, extend light absorption, and increase overall photocatalytic performance. We carried out a series of characterization techniques to discover the structure and properties of the materials, such as X-ray diffraction (XRD) confirmed the formation of pure-phase CeBiOIBr and its uccessful composite formation with g-C_3N_4, Fourier Transform Infrared (FTIR) Spectroscopy analysis confirms the successful integration of CeBiOIBr and g-C_3N_4, showing characteristic Ce–O, Bi–O, Bi–I, and Bi–Br vibrations along with shifted C=N and C–N peaks, indicating strong interfacial interactions. Also in UV-Visspectroscopy (UV) analysis confirmed the composite absorbed more visible light compared to its individual components. And Photoluminescence (PL) spectroscopy analysis indicated reduced electron-hole recombination and improved photocatalytic efficiency. This work aims at the successful synthesis of the CeBiOIBr/g-C_3N_4 composite through leveraging the strengths of both CeBiOIBr and g-C_3N_4, also to improve the resulting composite's efficiency and stability compared to the individual components, with better photocatalytic and antibacterial properties. The goal of this study is to further enhance the composites' performance, determine their long-term stability, and explore practical applications in the environmental and

energy sectors. This research work aims to pave the way toward the synthesis of unique nanomaterials that can contribute to cleaner water, renewable energy solutions, and sustainable technologies.

Paper ID: ICSHSD-139

Effect of Additives on the Phase Separation of Nonionic Surfactant in Aqueous Solution of Antibiotic Drug

Md. Selim Reza[1,*], Md. Anamul Hoque[2,*], and Md. Abu Taleb[2]
[1]Department of Chemistry, Sunamgonj Science and Technology University, Shantiganj, Sunamganj-3000, Bangladesh
[2]Department of Chemistry, Jahangirnagar University, Savar, Dhaka 1342, Bangladesh
**Corresponding emails:reza_chem@sstu.ac.bd;ahoque_ju@juniv.edu*

ABSTRACT

The phase separation characteristics and thermodynamic parameters of an aqueous mixture of nonionic surfactant Triton X-100 (TX-100) and the antibiotic drug ciprofloxacin hydrochloride monohydrate (CFH) were systematically investigated in the presence of various polyols including L-(+)-arabinose, D-(+)-glucose, D-(-)-fructose, D-(+)-xylose, and D-mannose. The cloudpoint (CP) values were measured for a fixed surfactant and drug concentration while varying the polyol content. The results revealed that the CP values are strongly dependent on the type and concentration of polyols. Among the tested additives, D-(+)-xylose exhibited the highest CP elevation effect, while D-(+)-glucose showed the most pronounced CP depression, indicating differences in polyol hydrophilicity and their interaction with the hydration shell of the micell araggregates. The obtained CP data wer eused to evaluate standard thermodynamic parameters of the clouding process, namely Gibbs freeenergy (ΔG_c^o), enthalpy (ΔH_c^o), and entropy (ΔS_c^o). All ΔG_c^o values were positive, suggesting the non-spontaneity of phase separation, which decreased with increasing polyol concentration. Most systems displayed negative ΔH_c^o and ΔS_c^o values, suggesting that the clouding process was exothermic and entropically unfavorable, likely due to enhanced ordering of water molecules around the micelles. The variation of thermodynamic parameters with polyol type suggests differing extents of hydrogen bonding and dehydration effects on the micellar structure. Enthalpy–entropy compensation was evident, confirming complex polyol–micelle interactions. These findings offer insights into the role of additives in drug–surfactant systems and inform the design of improved pharmaceutical formulations.

Paper ID: ICSHSD-145

Synthesis, Physico-Chemical Characterization, DFT Calculations, Antibacterial Activity, and Molecular Docking Analysis of Some First Row Transition Metal Complexes

Md. Saddam Hossain[1], Md. Abdul Latif[1], Md. Tariqul Islam[2], and Md. Kudrat-E-Zahan[2,*]
[1]Department of Chemistry, Begum Rokeya University, Rangpur-5404, Bangladesh
[2]Department of Chemistry, Rajshahi University, Rajshahi-6205, Bangladesh
**Corresponding email: kudrat.chem@ru.ac.bd*

ABSTRACT

Antibiotic resistance has been growing at an alarming rate. Consequently, the activity of antibiotics against Gram-negative and Gram-positive bacteria has dropped dramatically daily. In this sense, there is a strong need to synthesize new substances that have a good spectrum of activity and new mechanisms of action. A significant rise in interest in designing metal complexes as drugs and diagnostic agents is currently observed in scientific inquiry, specifically, medicinal inorganic chemistry. Many new metal-based medicines were developed from the metal complexes, potentially active against several ailments such as cancer, malaria, and neurodegenerative diseases. In this work, we have synthesized a Schiff base ligand, [(N-indol-2-oxo-3-ylidene)-2-aminophenol] and its Co(II), Ni(II), and Cu(II) metal complexes to explore their coordination mode and biological activity. The ligand was prepared from the condensation reaction of isatin and 2-aminophenol. All the synthesized compounds were characterized by 1H-NMR, IR, elemental analysis, ESI-MS spectroscopy, electronic spectroscopy, and some physicochemical measurements. The Schiff base behaved as a tridentate ligand and coordinated to the metal ions through azomethine nitrogen (=C=N). The Cu(II) complex preferred a tetrahedral geometry; on the other hand, Ni(II) and Co(II) complexes offered square planar and octahedral geometries, respectively. The ligand and its complexes exhibited mild to vigorous antibacterial activity against numerous pathogenic bacteria species. Moreover, quantum computational calculations based on the density functional theory (DFT) and molecular docking analysis were performed to analyze the molecular features of the new complexes and give deep insights into their role in their bacterial growth-inhibiting action.

Paper ID: ICSHSD-151

Efficient Elimination of Toxic Dyes from Aquatic Systems via Ni/Fe–Lignin Composites

Ebrahim Khalil[1], Abdullah Al Rakib[1], Md. Jalil Miah[2], Md. Mahfujul Hasan[3], and Md. Shahabuddin[1,*]
[1]Department of Chemistry, Dhaka University of Engineering & Technology, Gazipur, Gazipur-1707, Bangladesh
[2]Department of Natural Science, Islamic University of Technology, Gazipur-1704, Bangladesh
[3]Food Toxicology Research Section, Institute of Food Science & Technology, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka-1205, Bangladesh
**Corresponding email: shahab2018@duet.ac.bd*

ABSTRACT

Dyes discharged from textile operations contaminate water, reducing light penetration for aquatic photosynthesis and posing risks to human health and ecosystems. Among remediation options, adsorption offers simplicity and low operational cost, outperforming some conventional methods that may still generate toxic residues. Layered double hydroxides (LDHs), which are anionic clays in the hydrotalcite family, have attracted attention for their facile synthesis and enhanced dye uptake. In this study, lignin was isolated from *Sesbania sesban* L. stems using the Klason method. Ni/Fe LDHs were prepared via co-precipitation from $Ni(NO_3)_2{\cdot}6H_2O$ and $Fe(NO_3)_3{\cdot}9H_2O$, and Ni/Fe-lignin composites were formed by vigorous stirring of the LDH with lignin at room temperature. The adsorbents were characterized by FTIR, TGA, SEM, BET, XPS, and XRD to assess morphology and surface chemistry. Batch adsorption experiments examined the removal of methylene blue (MB) dye, exploring parameters including initial dye concentration, solution pH, contact time, and adsorbent dose. Adsorption of MB onto Ni/Fe-lignin was highly pH-dependent, achieving up to ~99% removal at pH 8. Kinetic data were best described by the pseudo-second-order model ($R^2 > 0.998$), with intraparticle diffusion contributing to the mechanism. Isotherms showed excellent fits to both Langmuir and Freundlich models ($R^2 > 0.988$) at 25°C, indicating monolayer adsorption on a heterogeneous surface with favorable interactions. The maximum monolayer adsorption capacity was 58.83 mg g^{-1} for the Ni/Fe-lignin composite. Overall, LDH-lignin composites demonstrate strong potential for effective removal of toxic dyes from wastewater.

Paper ID: ICSHSD-166

Organic Source Apportionment and Characterization of $PM_{2.5}$ Using FTIRand Positive Matrix Factorization (PMF): A Comparative Study and Health Impact Assessment in Dhaka, Cumilla, and Bhola

Md. Sahin Ahmed[1], and Abdus Salam[1,*]
[1]Department of Chemistry, Dhaka University, Dhaka-1000, Bangladesh
**Corresponding email: shahinahmed2490@gmail.com*

ABSTRACT

Fine particulate matter ($PM_{2.5}$) is a critical air pollutant with significant adverse effects on human health, particularly in urban environments. This study examines the source apportionment and chemical characterization of $PM_{2.5}$ in three major cities of Bangladesh: Dhaka, Cumilla, and Bhola, utilizing Fourier-transform Infrared Spectroscopy (FTIR) and the Positive Matrix Factorization (PMF) model. $PM_{2.5}$ samples were collected from these three locations during the winter and post-monsoon periods. The chemical composition of the samples was analyzed using FTIR, which identified organic components based on characteristic absorption peaks corresponding to functional groups. The EPA PMF-5 model was applied, using five factors, to apportion the sources of $PM_{2.5}$. This analysis provided insights into the contributions from various emission sources, including vehicular exhaust, industrial activities, biomass burning, and natural sources. The results revealed substantial spatial variation in source contributions: Dhaka exhibited the highest levels of vehicular emissions and industrial pollution, while Cumilla and Bhola were predominantly influenced by biomass burning and agricultural activities as the main sources of organic compounds in $PM_{2.5}$. Health impact assessments, based on the measured concentrations of $PM_{2.5}$, indicated elevated risks for respiratory and cardiovascular diseases, with Dhaka posing the highest health risks due to its elevated particulate levels. This study offers a comprehensive analysis of $PM_{2.5}$ pollution in Bangladesh and provides crucial data to inform policymakers in developing effective air quality management strategies to mitigate the public health risks associated with $PM_{2.5}$. The findings underscore the urgent need for targeted interventions, particularly in urban centers, to mitigate the health impacts of air pollution.

Paper ID: ICSHSD-168

One Step Solvothermal Synthesis of Core-Shell Bi-Bi_2O_3/MWCNT with 3-Dimentional Neural Network Structure for Adsorption and Biomedical Study

Md. Zaid[1], Faisal Islam Chowdhury[1,*], and Md. Kamrul Hossain[1,*]
[1]Nanotechnology, renewable energy and catalysis laboratory (NRCL), Department of Chemistry, University of Chittagong, Chattogram-4331, Bangladesh
**Corresponding email: faisal@cu.ac.bd; kamrulch@cu.ac.bd*

ABSTRACT

This is a one-step solvothermal synthesis of a hierarchical core–shell Bi–Bi_2O_3/MWCNT nanohybrid that self-assembles into a 3-dimensional "neural-network" scaffold for dual water-remediation (dye adsorption) and antimicrobial applications. Phase analysis by XRD confirmed biphasic Bi and Bi_2O_3; SEM revealed uniform spherical particles anchored across an entangled MWCNT network; EDS mapping verified homogeneous Bi–O–C co-distribution. FT-IR of the pristine hybrid displayed Bi–O and MWCNT bands; after exposure to methyl orange (MO), the spectra exhibited enhanced azo/aromatic features (~1550–1600 cm^{-1}), consistent with π–π stacking on CNTs, hydrogen-bonding/ion-pairing with surface –OH/–COO^-, and possible Bi-site complexation. Colloidal measurements showed a zeta potential of −27.5 mV (electrophoretic mobility ≈ -2.1×10^{-8} $m^2V^{-1}s^{-1}$; ELS resonance ~700 Hz) and sub-micron DLS sizes, indicating moderate dispersion stability in water. The nitrogen adsorption-desorption isotherms, pore-size distribution plots and the specific surface area are calculated by the Brunauer-Emmett-Teller (BET) method. Equilibrium adsorption of MO was highly favorable: a Langmuir fit (C_e/q_e vs C_e) gave Q_m= 1.52 mgg^{-1}, (R^2= 0.9999), with separation factors R_L= 0.033–0.053 over 12–20 mgL^{-1}; a Freundlich fit yielded n= 1.39 (R^2= 0.9677), reflecting modest site heterogeneity expected for the mixed Bi-Bi_2O_3/CNT interface. The nanohybrid also exhibited strong broad-spectrum antimicrobial activity: at 250 μgmL^{-1}, inhibition exceeded 92% for *Escherichia coli*, *Salmonella typhi*, *Bacillus cereus*, and *Staphylococcus aureus* (Gram-positives ~96%), and reached 93.07% for *Candida albicans* with an estimated IC_{50} < 50 μgmL^{-1}. Collectively, the structural, surface, and functional data establish that interfacial synergy among Bi-Bi_2O_3 junctions and the conductive MWCNT scaffold enables efficient dye uptake and potent antimicrobial action. The single-pot synthesis, validated mechanism, and dual performance highlight this Bi–Bi_2O_3/MWCNT architecture as a practical platform for integrated dye decolorization and disinfection, with clear routes to enhancement via surface engineering, non-linear isotherm/kinetic modeling, regeneration studies, and light-assisted operation.

Paper ID: ICSHSD-169

Facile And Novel Synthesis of ZnO Hollow Nanostructures via Turnbull Blue Analogues: Characterization and Application in Dye Degradation and Antimicrobial Activity

Mahmud Shareef[1], Md. Jahidul Islam[2], Md. Kamrul Hossain[1*], and Faisal Islam Chowdhury[1,*]
[1]Nanotechnology, Renewable Energy & Catalysis Laboratory (NRCL), Department of Chemistry, University of Chittagong, Chittagong-4331, Bangladesh
[2]Department of Chemistry, Temple University, USA
**Corresponding email: kamrulch@cu.ac.bd; andfaisal@cu.ac.bd*

ABSTRACT

Zinc oxide (ZnO) nanostructures have received considerable amount of interest for biomedical and environmental remediation applications because of their exceptional photocatalytic and antibacterial capabilities. However, developing a simple and effective method to synthesize well-defined hollow ZnO nanostructures remains challenging. In this research, we use Turnbull blue analogues as sacrificial precursors to present a simple and novel manufacturing methodology for ZnO hollow nanostructures. This approach allows for the controlled formation of uniform hollow morphologies under mild thermal conditions, without the need for surfactants or complex templates. The main objective was to develop an efficient and reproducible synthesis method to produce ZnO hollow nanostructures with high surface area and enhanced reactivity for multifunctional applications. The resulting ZnO nanostructures were characterized by XRD, SEM, TEM, EDX DLS, Zeta Potential, and FTIR confirming the formation of crystalline hollow nanoparticle. Additionally, crystalline parameter analyses were performed based on the XRD data. Under dark conditions, the ZnO hollow nanostructures showed significant adsorption of crystal violet dye, with the adsorption behavior validated by fitting the data to four different isotherm models which confirming strong interactions between the dye molecules and the catalyst surface. The process achieved over 80% degradation within 180 minutes. In addition, The ZnO hollow nanostructures show antibacterial activity at a dose of 250 µg/mL, with inhibition rates of 90.65% against *Escherichia coli*, 93.93% against *Staphylococcus aureus*, 92.30% against *Salmonella typhi*, and 93.66% against *Bacillus cereus*. At the same concentration, the compounds showed substantial antifungal action, preventing 99.08% of *Candida albicans* from growing. We also plan to test the battery applications, and the existing data obtained from this research further validate the synthesis method and overall findings of the ZnO nanoparticles.

Paper ID: ICSHSD-173

Bio-Templated Egg White Mediated Fe-Doped CuO Nanostructures: Structural Insights, Photocatalysis and Pathogen Control

Anika Nawar Ani[1], Md. Kamrul Hossain[1*], and Faisal I. Chowdhury[1,*]
[1]Nanotechnology, Renewable Energy & Catalysis Laboratory (NRCL), Department of Chemistry, University of Chittagong, Chittagong-4331, Bangladesh
**Corresponding email: kamrulch@cu.ac.bd; faisal@cu.ac.bd*

ABSTRACT

The simultaneous mitigation of industrial pollution and antimicrobial resistance remains a critical global challenge. A single step green energy-efficient synthesis of Fe-doped CuO nanoparticles using egg white via a modified sol–gel method, calcined at 300°C. Comprehensive characterization using X-ray Diffraction**(XRD),**Scanning Electron Microscopy **(SEM),***Energy-Dispersive X-ray Spectroscopy***(EDX),**Fourier-Transform Infrared Spectroscopy**(FTIR) and Brunauer-Emmett-Teller (BET)**confirmed the successful incorporation of Fe^{3+} into the CuO lattice, inducing **lattice contraction, band gap narrowing and pore-size distribution.** XRD revealed thatFe doping tailored the CuO lattice, yielding finer crystallites, elevated strain, reduced crystallinity, and a stabilized cubic phase. **SEM images** further confirmed the size reduction, showing 7 wt % Fe-doped CuO particles decreasing from 40.03 nm to 34.65 nm. **EDX analysis** verified an effective Fe incorporation of 6.93 wt %, confirming substitutional doping within the CuO lattice, while **FTIR spectra** displayed a Cu–O vibration shift to 531–534 cm^{-1}, evidencing **Fe–O bond formation and lattice distortion. Specific surface area is calculated by BET.**It demonstrated superior photocatalytic efficiency, removing 80 % of methyl orange (MO) at 6 ppm via first-order kinetics, far surpassing pristine CuO. It's thin film also demonstrated superior antibacterial and antifungal activity over pure CuO, highlighting their next-generation antimicrobial potential. This eco-friendly nanomaterial offers dual functionality for wastewater treatment and antimicrobial coatings, highlighting egg white as a sustainable template.

Paper ID: ICSHSD-177

Synthesis and Characterization of Silver Nano Particles Using Mango Peel Extracts

Suvashis Roy[1], Md. Zafrul Hasan[1], Md. Mobassir Billah[1], Md. Shamsuzzoha[1], Md. Atikul Islam[1], Md.Monowarul Islam[2], and Md. Rezaul Karim[1,*]

[1]Department of Chemistry, Hajee Mohammad Danesh Science and Technology University, Dinajpur-5200, Bangladesh
[2]Synthesis Laboratory, Chemical Research Division, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka-1205, Bangladesh
Corresponding email: reza@hstu.ac.bd

ABSTRACT

Green synthesis of nanoparticles by employing plant biomass is sustainable and eco-friendly as opposed to traditional chemical and physical methods. The current work focuses on the synthesis of silver nanoparticles (AgNPs) using mango (*Mangifera indica*) peel extract as a green reducing and capping agent. Mango peel, an agro-based waste rich in polyphenol, flavonoids and other bioactive substances, was washed, boiled, and processed to obtain the extract. Upon reaction of the resulting extract with silver nitrate ($AgNO_3$), a rapid color change from yellow to brownish-red was observed, providing an initial confirmation of silver nanoparticle formation. The optimal conditions for the reduction of AgNPs were determined using 10 mM $AgNO_3$ at pH 9, with a 1:20 ratio of peel extract to silver nitrate. The synthesized AgNPs were characterized using ultraviolet–visible spectroscopy (UV–Vis) and Fourier transform infrared spectroscopy (FTIR) spectroscopy. The nanoparticles exhibited their highest absorption in the UV–visible spectra at around 405 nm. while FTIR analysis identified –OH, –C=O, and –C–O functional groups, confirming the role of polyphenols in nanoparticle reduction and stabilization. Further characterization using Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD), Dynamic Light Scattering (DLS) and Zeta Potential analysis also revealed particle morphology, crystallinity, size distribution, and surface stability. This research provides a sustainable method to synthesizes AgNPs with not only broad antimicrobial, agricultural, and medical potential but also valorizes postharvest mango byproducts for the development of AgNP-based antibacterial composites to enhance fruit and vegetable preservation.

Paper ID: ICSHSD-187

Hydrothermal Synthesis of ZnO Nanoparticles with Tunable Morphology Using Ionic Liquid as Soft Template at Different pH

Md. Nimur Rahman[1], and Md. Abu Bin Hasan Susan[1,2,*]
[1]Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
[2]Dhaka University Nanotechnology Center (DUNC), University of Dhaka, Dhaka-1000, Bangladesh
**Corresponding email: susan@du.ac.bd*

ABSTRACT

ZnO nanoparticles (NPs) with varying morphology have been prepared from Zinc(II) nitrate hexahydrate using a hydrothermal method. An imidazolium-based ionic liquid (IL), 1-ethyl-3- methylimidazolium methanesulfonate ($[C_2mim]CH_3SO_3$) was used to regulate the morphology. The pH of the reaction medium was varied to understand the effect of pH on soft templating action of ($[C_2mim]CH_3SO_3$) in tuning morphology. Successful synthesis of ZnO NPs and removal of IL were confirmed using Fourier transform infrared (FTIR) and energy dispersive X-ray (EDX) spectroscopic techniques. Morphological analysis using field emission scanning electron microscopy (FESEM) reveals that, in presence of ($[C_2mim]CH_3SO_3$), the NPs exhibit granular shape in addition to nano flakes. With varying pH from 9 to 12 keeping concentration of ($[C_2mim]CH_3SO_3$) constant, transition from granules to flakes occur. ZnO NPs synthesized without ($[C_2mim]CH_3SO_3$) at pH~10, had particle size of 54 nm. In contrast, smaller particles with size of 21 nm were obtained for NPs synthesized in presence of ($[C_2mim]CH_3SO_3$) at that pH. While changing pH from 9 to 12, size of the NPs decreased till pH~11. At pH~12, it again increased to 60 nm. X-ray diffraction (XRD) results revealed excellent phase purity and highly crystalline wurtzite phase of ZnO in presence of IL. The smallest crystallite size was obtained for both the NPs synthesized at pH~10 in absence of ($[C_2mim]CH_3SO_3$) and at pH~11 in presence of ($[C_2mim]CH_3SO_3$). Observed changes in morphology indicates that ($[C_2mim]CH_3SO_3$) could restrict the growth of the cluster along [0001] direction and $< 2\bar{1}\bar{1}0>$ symmetry related family to produce granular particles. Highly alkaline solution favors the growth along $< 2\bar{1}\bar{1}0>$ symmetry related family to produce flakes. The band gap energy varies with varying morphology. The lowest band gap energy 2.90 eV was obtained for the ZnO NPs synthesized at pH~12 and the highest value 3.04 eV was obtained at pH~10 in presence of ($[C_2mim]CH_3SO_3$). The band gap energies of the product NPs are consistent with the size distribution. Therefore, morphology and band gap energy of ZnO could be modified using ($[C_2mim]CH_3SO_3$), where pH of the reaction media plays a decisive role in regulation of morphology.

Paper ID: ICSHSD-193

Green Synthesis of Zinc Doped Iron Oxide Nanoparticles by Using *Lagenaria Siceraria* Leaves Extract and its Environmental Applications

Marufa Jahan[1], Md. Kamrul Hossain[1,*], and Faisal I. Chowdhury[1,*]
[1]Nanotechnology, Renewable energy & Catalysis Laboratory (NRCL), Department of Chemistry, University of Chittagong, Chittagong-4331, Bangladesh
Corresponding email: kamrulch@cu.ac.bd; faisal@cu.ac.bd

ABSTRACT

Green synthesis has recently become a more useable nanomaterials synthesis technique over physical and chemical methods because it is cost effective and environment friendly method. In this research, pure and Zn doped iron oxide nanoparticles were synthesized by utilizing *Lagenaria siceraria* leaves extract which work as reducing and capping agent to transform metal ions into nanoparticle. Iron(III) nitrate nonahydrate [$Fe(NO_3)_3.9H_2O$] used as precursor for the synthesis of pure Fe_2O_3. Zn doped Fe_2O_3nanoparticles were produced by following same process as pure Fe_2O_3 NPs, with the addition of [$(CH_3COO)_2Zn.2H_2O$] precursor. Both doped and pure iron oxide nanoparticles were characterized by using Scanning Electron Microscopy (SEM), Energy Dispersive X-ray Spectroscopy (EDS), X-ray Diffraction (XRD) and Fourier Transform Infrared Spectroscopy (FTIR) for the conformation of the existence of nanoparticles and whether doping is occurred or not. SEM analysis of pure and Zn doped Fe_2O_3 NPs depicted that both of their average particle sizes were in nanometer range with cubic shape. The existence of Fe and oxygen elements in the material confirmed the formation of Fe_2O_3 NPs whereas the presence of Fe, Zn and oxygen indicated that doping of Zn with Fe_2O_3 nanoparticles was successful. Crystallite size, crystalline phases and effect of doping of NPs were analyzed by using XRD. The positions of the observed peaks indicated the phase as γ- Fe_2O_3 (maghemite) and due to doping the crystallite sizes of the maghemite nanoparticles were decreased. The presences of various functional groups of nanoparticles were examined by FTIR. The strong peaks at 558-553cm^{-1} detect the stretching vibration of Fe-O-Fe and confirmed the creation of pure and Zn doped γ- Fe_2O_3 NPs respectively since γ -Fe_2O_3 in FTIR spectra shows a strong absorption band in the range of 500-650 cm^{-1}. The synthesized materials were applied in photocatalysis to observe the photo-degradation of rhodamine blue. Doped worked more effectively by degrading 90.98% of dye while the photo-degradation efficiency of pure Fe_2O_3 NPs was only 56.90% under uv light irradiation for 180 minutes. Besides, these NPs were tested against *Bacillus cereus*, *Escherichia coli*, *Staphylococcus aureus*, *Salmonella typhi* and *Candida albicans* to evaluate their antimicrobial activity. Zn doped Fe_2O_3 NPs showed higher antimicrobial activity for all of these pathogens than pure Fe_2O_3 NPs. In conclusion, the produced Zn doped Fe_2O_3 nanoparticles using green synthesis process is more convenient than any other process and has strong capability to be used as photocatalyst.

Paper ID: ICSHSD-209

Comparative Study of Poultry Feed Composition: A Case of Different Companies

Jahidul Islam[1], Fakir Rafiqul Islam[2], and A.F.G. Masud Reza[3]*
[1]Department of Chemistry, Natural Science Group, National University, Gazipur-1704, Bangladesh
[2]Department of Chemistry, Natural Science Group, National University, Gazipur-1704, Bangladesh
[3]Department of Chemistry, Natural Science Group, National University, Gazipur-1704, Bangladesh
**Corresponding email: md.jahidmp@gmail.com*

ABSTRACT

Nutrient requirements in poultry feed must be needed. Its are affected by a large number of factors, including Genetics, Age, Sex, Reproductive state, ambient temperature, Health status, Production aims. Certain feed ingredients, poor feed quality or feed contamination can have adverse effects on voluntary feed intake due to poor palatability or the presence of toxic factors. Feeding strategies for broiler chickens will vary depending on the target market for the final product. Feed ingredients are broadly classified into cereal grains, protein meals, fats and oils, minerals, feed additives, and miscellaneous raw materials, such as roots and tubers. The raw materials of poultry feed have heavy metals. Especially water, which is used to produce feed, which contain heavy metals, is harmful for poultry, also human health. Feed samples were analyzed for dry matter, ash, crude protein, ether extract, crude fiber, neutral and acid detergent fiber, lignin, starch, sugars, amino acids, minerals, phytic acid, phytase activity, analyzed all the feed ingredients that were used in the feeding experiments. Furthermore, there is often lack of information concerning analyzed nutrient composition of produced feed materials. Information in this report can be used in feed optimization for poultry on farms and by feed manufactures. The hazards in different case also be check in same time. The purpose of the study more effective feed for all.

Paper ID: ICSHSD-217

Detection of Permethrin Residues in Flour Using Gc-Ecd

Fajilatun Nesa[1], Md. Monarul Islam[1,*], and SM Mahmudul Hassan[1]
[1]Synthesis Laboratory, Chemical Research Division, BCSIR Dhaka Laboratories, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka-1205, Bangladesh
**Corresponding email: mmipavel@yahoo.com*

ABSTRACT
Pesticide contamination in food commodities is a growing public health concern. There are fewer reports on pesticide such as permethrin contamination in wheat grain and flour samples especially in Bangladesh. Wheat grains are sprayed with permethrin insecticides in the field, which due to their persistence nature remain in the flours even after milling. The aim of this study was to collect flour samples from different districts of Bangladesh and analyzed permethrin by Gas Chromatography with Electron Capture Detector (GC-ECD) at ppb level. Permethrins in flour samples were extracted by simple QuEChERS method by using n-Hexane. A gas chromatographic method was developed and validated to accurately detect and quantify the intended pesticide. To validate the method, several calibration standard solutions (10-100ppb) of permethrin were prepared by serial dilution. The correlation coefficient obtained from calibration curves demonstrated excellent linearity ($R^2 > 0.995$). The average recovery was 89.39-109.11 % with low standard deviation (SD), which is in the acceptable range. Concerning Electron Capture Detector for permethrin analysis, the Limit of Detection (LOD) was 7.37 ppb and Limit of Quantification was 22.33 ppb. These parameters proved the method to be highly sensitive and reliable for the detection of permethrin residues in flour matrices.

Paper ID: ICSHSD-222

Green Synthesis and Characterization of Silver Nano Particles Using Mango Peel Extracts

Suvashis Roy[1], Md. Zafrul Hasan[1], Md. Mobassir Billah[1], Md. Shamsuzzoha[1], Md. Atikul Islam1 Md. Monarul Islam[2], and Md. Rezaul Karim[1,*]
[1]Department of Chemistry, Hajee Mohammad Danesh Science and Technology University, Dinajpur-5200, Bangladesh
[2]Synthesis Laboratory, Chemical Research Division, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka-1205, Bangladesh
**Corresponding email: reza@hstu.ac.bd*

ABSTRACT
Green synthesis of nanoparticles by employing plant biomass is sustainable and eco-friendly as opposed to traditional chemical and physical methods. The current work focuses on the synthesis of silver nanoparticles (AgNPs) using mango (*Mangifera indica*) peel extract as a green reducing and capping agent. Mango peel, an agro-based waste rich in polyphenol, flavonoids and other bioactive substances, was washed, boiled, and processed to obtain the extract. Upon reaction of the resulting extract with silver nitrate ($AgNO_3$), a rapid color change from yellow to brownishred was observed, providing an initial confirmation of silver nanoparticle formation. The optimal conditions for the reduction of AgNPs were determined using 10 mM $AgNO_3$ at pH 9, with a 1:20 ratio of peel extract to silver nitrate. The synthesized AgNPs were characterized using ultraviolet–visible spectroscopy (UV–Vis) and Fourier transform infrared spectroscopy (FTIR) spectroscopy. The nanoparticles exhibited their highest absorption in the UV–visible spectra at around 405 nm. While FTIR analysis identified –OH, –C=O, and –C–O functional groups, confirming the role of polyphenols in nanoparticle reduction and stabilization. Further characterization using Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD), Dynamic Light Scattering (DLS) and Zeta Potential analysis also revealed particle morphology, crystallinity, size distribution, and surface stability. This research provides a sustainable method to synthesize AgNPs with not only broad antimicrobial, agricultural, and medical potential but also valorizes postharvest mango byproducts for the development of AgNP-based antibacterial composites to enhance fruit and vegetable preservation.

Paper ID: ICSHSD-235

Optimizing Deposition of Platinum Nanoparticles on Functionalized Graphene Oxide

Mohiuddin Mahin[1], Howard Fairbrother[2], and Nur Uddin Ahamad[3,*]
[1]Department of Chemistry, Shahjalal University of Science and Technology, Sylhet- 3114, Bangladesh
[2]Department of Chemistry, Johns Hopkins University, USA
[3]Department of Chemistry, Shahjalal University of Science and Technology, Sylhet- 3114, Bangladesh
Corresponding email: nur-che@sust.edu

ABSTRACT

In this research, we explored different parameters for depositing platinum nanoparticles on sulfonated graphene oxide (S-GO). Platinum nanoparticles (NPs) were formed in situ by reduction of a platinum precursor with sodium borohydride in presence of an S-GO matrix. Prior to the deposition, GO was functionalized with sulphonic acid groups using a method developed in our research laboratory to improve the colloidal stability of GO in aqueous medium. The deposition process was optimized by varying the ratio of platinum precursor to S-GO (mass). The deposition was found to rely on the ratio of platinum cations to $NaBH_4$ (mole) as well as the reaction temperature and time. Chemical changes in GO due to reduction were followed with Fourier-transform Infrared Spectra (FT-IR) while elemental analysis was carried out by X-ray Photoelectron Spectroscopic technique (XPS), and size and shape of the platinum NPs was confirmed by analyzing Transmission Electron Microscopic (TEM) images.

Paper ID: ICSHSD-249

Value-Added Aluminum Sulfate from Multiple Recycled Aluminum Utensils: Kinetic Optimization and Application as Coagulant and Paper Filler

Md. Muntasir Soun[1], Shakil Ahmmed[2], Mohammad Razaul Karim[3,*]
[1]Department of Chemistry, Shahjalal University of Science & Technology, Sylhet-3114, Bangladesh
[2]Department of Chemistry, Shahjalal University of Science & Technology, Sylhet-3114, Bangladesh
[3]Department of Chemistry, Shahjalal University of Science & Technology, Sylhet-3114, Bangladesh
Corresponding email: krazaul@yahoo.com

ABSTRACT

For preparing daily utensils, aluminum is repeatedly recycled globally by physical methods. However, after multiple recycling cycles, it often becomes contaminated by unwanted metallic parts, which are persistent. This contaminated aluminum is a threat to food safety. Herein, we chemically extracted Aluminum in the purest form as sulfate from multiply recycled aluminum utensils. The synthesized coagulant was used as a potential water purifier and paper filler. The synthesis process was optimized, with the highest yield (85.6%) achieved using 12 M H_2SO_4 at pH 2, and 55 °C temperature. The prepared sample was characterized using surface morphology, Energy dispersive X-Ray spectroscopy (EDS) analysis and Fourier Transform Infrared Spectroscopy (FTIR) spectra. In case of water treatment, 0.8 mg of synthesized $Al_2(SO_4)_3$ achieved the highest mud deposition (46 mg/10 mL), exceeding the commercial alum by approximately 4.5%. Statistical analysis by means of t-test confirmed the repeatability and significance of this improvement ($p = 0.03$). In case of application as paper filler, the ink absorptivity was found to be reduced, whereas the sheet strength was increased significantly. These findings demonstrate that synthesized $Al_2(SO_4)_3$ can serve as a safe and effective alternative to commercial alum, contributing to waste valorization, food safety, and sustainable materials development.

Paper ID: ICSHSD-250

Eco-Friendly Zinc Oxide Nanoparticles by Using *Tagetes Patula*: Synthesis, Characterization, Photocatalytic, and Antimicrobial Promises

Pinak Chakraborty[1,*], Bithi Paul[2], and K.A.Khan[1]
[1]Department of Physics, Jagannath University, Dhaka-1100, Bangladesh
[2]Department of Physics, American International University-Bangladesh, Dhaka-1229, Bangladesh
**Corresponding email: pinakchakrs121@gmail.com*

ABSTRACT

The eco-friendly synthesis of metal oxide nanostructures using plant extracts has emerged as a sustainable alternative to conventional chemical and physical approaches, offering reduced toxicity, biocompatibility, and cost-effectiveness. Zinc oxide nanoparticles (ZnO NPs), in particular, have gained significant attention owing to their unique optical, antimicrobial, and photocatalytic properties, making them highly promising for environmental remediation and pharmaceutical applications. In the present study, we report the green synthesis of ZnO nanoparticles using *Tagetes patula* flower extract as a biogenic reducing and stabilizing agent. A defined concentration of $Zn(NO_3)_2 \cdot 6H_2O$ precursor was reacted with the filtered flower extract under optimized conditions, followed by air-drying and calcination to obtain stable ZnO nanostructures. Comprehensive characterization techniques were employed to confirm structural and functional properties. X-ray diffraction (XRD) analysis revealed the formation of a pure zincite phase with an average crystallite size of 20.62 nm, supported by dislocation density values of 2.64×10^{-3} nm^{-2}, while the Williamson–Hall (W–H) analysis indicated a crystallite size of 39.85 nm, reflecting slight lattice strain. The band gap of NPs was calculated using UV–visible spectra of ZnO NPs. FESEM imaging has been conducted to investigate surface morphology, and EDX data have confirmed elemental analysis. FTIR spectra identified the functional groups in the flower extract responsible for nanoparticle formation and stabilization. Further studies are underway to assess the antimicrobial activity and photocatalytic efficiency of the synthesized ZnO nanoparticles. The ongoing antimicrobial studies are expected to reveal significant inhibitory effects of the biosynthesized ZnO NPs against pathogenic microorganisms, thereby underlining their pharmaceutical potential. Parallel photocatalytic assessments are being conducted to evaluate their ability to degrade organic pollutants, which would support their role in environmental remediation. Overall, this work demonstrates a facile, sustainable approach for the synthesis of ZnO nanoparticles using *T. patula*, providing valuable insights into their physicochemical features and multifunctional applications.

Paper ID: ICSHSD-257

Synthesis of ZnO Nanoparticles in Presence of Ionic Liquids and their Double Salts

Md. Aminul Islam[1], Md. Abu Bin Hasan Susan[1,2,*], and Md. Emran Quayum[1]
[1]Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
[2]Dhaka University Nanotechnology Center, Dhaka-1000, Bangladesh
**Corresponding email: susan@du.ac.bd*

ABSTRACT

ZnO is a stable semiconductor with a wide band gap of around 3.37 eV and a significant free exciton binding energy of approximately 60 MeV. Electrical, optical, magnetic, and chemical properties of ZnO is dictated by the size and morphology in the nano-dimension. The variation in morphologies of ZnO is attainable by the use of different methods of synthesis. In this work, we are using hydrothermal method and carrying out the synthesis at a fixed temperature and pH using different templates. Ionic liquids (ILs) and their double salts are being used as soft templates to tune the morphology of ZnO nanostructures. 1-Ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide, 1-ethyl-3-methylimidazolium ethyl sulfate, 1-ethyl-3-methylimidazolium methylsulfate, and 1-ethyl-3-methylimidazolium ethyl sulfonate are the ionic liquids under exploration. Two double salt ionic liquids (DSILs) have already been prepared using equal mole ratio of two ILs. ZnO has been synthesized in presence of these two DSILs separately and confirmed by FT-IR and UV-visible spectroscopy. The hydrodynamic radii have been measured using dynamic light scattering analysis. Similar endeavors are ongoing in presence of pure ILs and other DSILs. XRD analysis will be used to reveal the crystallinity and phase properties. Field emission scanning electron microscopic (FESEM) and high-resolution transmission electron microscopic (HRTEM) images will also be taken to demonstrate significant characteristic features. It is expected that the sizes and shapes of the synthesized NPs will vary and the presence of DSILs will result in interesting morphologies compared to the single ILs. The hydrophilic and hydrophobic nature of the ILs is also expected to impact the route of synthesis. The effect of concentration of both ILs and DSILs will be explored. Photoluminescence spectroscopy will be used to measure the optical band gap energy of the NPs. The synthesized NPs will be used in the advancement of optoelectronic devices such as photoanode in solar cell.

Paper ID: ICSHSD-258

Electrochemical Detection of Dopamine Using Leaf-Shaped Zno from Recycled Battery Zinc Shells

Md Sakil[2], Afia Murshida Kusum[2], Md Abdul Jabbar[2], Md Yeasin Pabel[1], Md Humayun Kabir[3,*], and Sabina Yasmin[1,*]

[1]Institute of National Analytical Research and Service (INARS), Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka-1205, Bangladesh

[2]Department of Chemistry, Faculty of Science, University of Dhaka, Dhaka-1000, Bangladesh

[3]Institute of Food Science and Technology, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka-1205, Bangladesh

**Corresponding email: humayunkabir@bcsir.gov.bd; sabinayasmin@bcsir.gov.bd*

ABSTRACT

This study introduces an affordable and eco-friendly approach for producing ZnO from electronic waste (e-waste) to be used in the electrochemical detection of dopamine (DA) with a single metal oxide. The purity and properties of the synthesized ZnO were verified using advanced techniques. The ZnO clusters grow along the (001) direction, forming leaf-shaped structures with a direct band gap of 3.27 eV. Electrochemical tests, including cyclic voltammetry, differential pulse voltammetry, and amperometry, confirmed successful DA detection on a ZnO-glassy carbon electrode in aqueous solutions, demonstrating equal electron and proton pathways for DA oxidation. The sensor displayed a wide linear response range (0.01-100 μM), with an impressive low detection limit of 0.47 nM and a high sensitivity of 0.0389 AM^{-1}. Additionally, the sensor exhibited excellent selectivity, repeatability, and reproducibility, with a relative standard deviation of 4.80% for DA detection, and showed effectiveness in real sample analysis. These findings indicate that the proposed sensor is a sensitive, practical, and cost-effective tool for DA monitoring, while also contributing to the sustainable management of zinc-carbon battery waste by generating valuable ZnO.

Paper ID: ICSHSD-259

Prussian Blue Analog-Derived NiO Nanoparticles: Integrated Experimental and Theoretical Study for Malachite Green Adsorption and Antimicrobial Activity

Mujibur Rahman[1], Faisal Islam Chowdhury[1,*], and Md. Kamrul Hossain[1,*]

[1]Nanotechnology, renewable energy and catalysis laboratory (NRCL), Department of Chemistry, University of Chittagong, Chattogram-4331, Bangladesh

**Corresponding email: faisal@cu.ac.bd; kamrulch@cu.ac.bd*

ABSTRACT

Nickel oxide (NiO) nanoparticles were synthesized via a Prussian Blue Analog (PBA)-derived route. The materials were characterized using Field Emission Scanning Electron Microscopy (FESEM), Transmission Electron Microscopy (TEM), Energy Dispersive X-ray Spectroscopy (EDX), X-ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR), UV-visible Spectroscopy, Dynamic Light Scattering (DLS) analysis, and zeta potential analysis. FESEM images revealed NiO nanoparticles with a nanorod shape and sheet-like formations, forming an interconnected porous network. TEM images confirmed the nanosheet-like morphology. XRD analysis provided an average crystallite size of 5.089 nm, while FESEM measured the nanorod mean diameter as 2.86 nm. EDX analysis indicated nearly pure NiO with slight stoichiometric deviation. FTIR exhibited a strong band at 455 cm^{-1}, confirming Ni–O stretching vibration. UV-visible analysis revealed a widened band gap due to nanoscale effects. DLS analysis revealed an intense peak around 580 nm, with a hydrodynamic diameter of 1327 nm, supported by a zeta potential of -21.303 mV, indicating moderate stability and potential aggregation. The functional performance of NiO nanoparticles was evaluated for Malachite Green (MG) dye removal. Adsorption followed the Langmuir isotherm (q_{max} = 91.99 mg/g), while the Dubinin–Radushkevich model (E_{D-R} = 7.1 kJ/mol) confirmed physisorption. Kinetics followed the pseudo-second-order model. The intraparticle diffusion model indicated boundary layer effects rather than sole pore diffusion, and Boyd analysis confirmed film diffusion as the rate-limiting step. Thermodynamic parameters ($\Delta G^o < 0$, ΔH^o = +15.68 kJ/mol, ΔS^o = +0.133 kJ/mol·K) established the process as feasible, spontaneous, and endothermic. Beyond adsorption, the NiO nanostructures exhibited excellent antimicrobial and antifungal activity against *Bacillus cereus*, *Escherichia coli*, *Staphylococcus aureus*, *Salmonella typhi*, and *Candida albicans*, achieving over 90% inhibition at 250 μg/mL as determined by the IC_{50} method. Complementary DFT/B3LYP calculations provided global reactivity descriptors for NiO, Malachite Green (MG), and NiO–MG clusters via frontier molecular orbital (HUMO-LUMO) analysis. Electrostatic potential (ESP) maps highlighted reactive sites and molecular bonding. Thermodynamic evaluations of NiO–MG clusters (1:1 and 1:2) confirmed that adsorption is spontaneous, and the presence of non-covalent interactions between NiO and MG supports a physisorption-dominated mechanism. Integrated experimental and computational analyses demonstrate that Prussian Blue Analog–derived NiO nanoparticles effectively remove Malachite Green and inhibit microbes, providing a mechanistic basis for multifunctional nanomaterials in environmental and biomedical applications.

Paper ID: ICSHSD-272

Influence of Different Dissolved Gases on Electrocatalytic Nitrate Sensing Performance at Cu-Modified Au Electrode

MotasimB. Islam[1], and Mohammad A. Hasnat[1,*]
[1]Electrochemistry & Catalysis Research Laboratory (ECRL), Department of Chemistry, School of Physical Sciences, Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh
**Corresponding email: mah-che@sust.edu*

ABSTRACT

The present study investigates the electrocatalytic nitrate reduction reaction (NRR) on a Cu/Au electrode surface in a neutral pH potassium chloride (KCl) environment saturated with nitrogen, oxygen, and carbon dioxide, three of the most abundant atmospheric gases. The electrode was characterized using OCP, EIS, SEM, EDX, XPS, and XRD to assess its electrochemical properties, catalytic feasibility, and surface morphology. Results indicated that nitrate ions undergo a consecutive reduction process ($NO_3^- \rightarrow NO_2^- \rightarrow NH_3$) on the Cu/Au electrode. O_2 saturated environment impeded the NRR process through O_2 adsorption on the electrode surface prior to the $NO_3^- \rightarrow NO_2^-$ conversion. In contrast, CO_2 saturated condition enhanced the reaction by neutralizing the NRR byproduct OH^- ions, thus accelerating the overall NRR kinetics. Under CO_2 environment the NRR process was found more facile compared to that of other two gases. NRR took place at a peak potential of –0.71 V and –1.06 V for the first and second reduction wave, respectively. Kinetic analysis showed that the reduction reactions in presence of CO_2 followed first-order, diffusion-limited kinetics. The Cu/Au electrode exhibited high sensitivity (3.49×10^{-1} μA μM^{-1}) with an LOD of 0.46 μM for nitrate detection, and finally demonstrated excellent performance in real sample analysis.

Paper ID: ICSHSD-280

A Validated Stability-Indicating Rp-Hplc Method for Quantitative Determination of L-Carnitine and Voglibose in Pharmaceuticals

Md. Ekhlass Uddin[1], Raisa Islam[2], Md. Faruk Hossen[1], Md. Ali Asraf[1], and Md. Kudrat-E-Zahan[1,*]
[1]Department of Chemistry, University of Rajshahi, Rajshahi-6205, Bangladesh
[2]Department of Pharmacy, North South University, Dhaka-1229, Bangladesh
**Corresponding email: kudrat.chem@ru.ac.bd*

ABSTRACT

L-carnitine and voglibose are two active ingredients that are being more commonly included in medicines and dietary supplements, particularly for treating metabolic and lifestyle-related issues like type 2 diabetes and obesity. A robust, precise, and accurate RP-HPLC method was developed and validated according to ICH guidelines for L-carnitine and voglibose in pharmaceuticals and supplements, demonstrating high reproducibility, sensitivity, and cost-effectiveness, and covering key validation parameters including specificity, linearity, accuracy, precision, LOD, LOQ, robustness, system suitability, and stability-indicating forced degradation studies. Specificity ensured the method can distinctly quantify L-carnitine and voglibose without interference from excipients, impurities, or degradation products. This was tested by comparing chromatograms of blank, standard, placebo, and sample under normal and stress conditions. The procedure was analyzed with standard solutions of L-carnitine and voglibose separately at multiple target concentration levels with correlation coefficient. Recovery studies showed 99.57–101.05% for L-carnitine (60%, 100%, 140%) and 99.80–101.20% for voglibose (50%, 100%, 150%), confirming no excipient interference. Precision assessed the reproducibility of the method where multiple injections by the same analyst on the same day and on different days by different analysts or instruments. Limit of detection and limit of quantification determined the smallest amount of analyte that can be reliably detected or quantified with signal-to-noise ratio. Small but intentional adjustments to the technique parameters had no negative impact on the method's performance, indicating that the approach was found to be robust for L-carnitine and voglibose.

Paper ID: ICSHSD-282

Sustainable Synthesis of a Graphene Oxide-based Nickel–Iron Superparamagnetic Nanoadsorbent Derived from Electronic Waste for the Removal of Doxycycline in Aqueous Solution

Afia Murshida Kusum[1,2*], Md Sakil[1,2], Fahima Mojumder[2], Sabina Yasmin[1*], and Md Humayun Kabir[3,*]
[1]Institute of National Analytical Research and Service (INARS), Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka-1205, Bangladesh
[2]Department of Chemistry, Faculty of Science, University of Dhaka, Dhaka-1000, Bangladesh
[3]Institute of Food Science and Technology (IFST), Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka-1205, Bangladesh
**Corresponding email: afiakusum0003@gmail.com; humayunkabir@bcsir.gov.bd; sabinayasmin@bcsir.gov.bd*

ABSTRACT

A graphene oxide-based nickel–iron super paramagnetic nanoadsorbent (GO/Ni-Fe) was synthesized from electronic waste and evaluated for the removal of doxycycline (DXC) from aqueous solutions. Ultrafine Ni–Fe nanoparticles (~4.26 nm) were deposited onto graphene oxide sheets, resulting in increased surface area, more active sites, and improved magnetic properties. Structural and surface analyses (XRD, FTIR, TEM, EDX, XPS, VSM, and zeta potential) confirmed the incorporation of Ni–Fe nanoparticles and the super paramagnetic behavior of the nanoadsorbent, enabling rapid magnetic separation and easy reusability. Batch adsorption studies showed rapid kinetics, achieving about 90% DXC removal within 20 min at pH 5 using only 0.1 g/L of adsorbent. The adsorption followed a pseudo-second-order kinetic model, indicating chemisorption dominated by hydrogen bonding, electrostatic interactions, and π–π stacking. Equilibrium data fitted the Langmuir isotherm, with a maximum adsorption capacity of 13.02 mg/g at 25 °C, suggesting monolayer adsorption on a homogeneous surface. The super paramagnetic properties allowed quick separation under an external magnetic field, and the adsorbent was effectively regenerated with methanol, maintaining high removal efficiency over multiple cycles. These results demonstrate that GO/Ni-Fe is a sustainable, magnetically retrievable nanomaterial with excellent adsorption performance for antibiotic removal from wastewater, offering a promising environmentally friendly strategy to mitigate pharmaceutical contamination.

Paper ID: ICSHSD-287

Sustainable Synthesis of Magnetic Graphene Oxide from Waste Batteries for Arsenic Removal from Aqueous Media: Adsorption Mechanism from DFT Calculations

Monira Akter Somapti[1], Md. Sanwar Hossain[2], Md. Humayun Kabir[3,*], and Sabina Yasmin[2,*]
[1]Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
[2]Institute of National Analytical Research and Service (INARS), Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka-1205, Bangladesh
[3]Institute of Food Science and Technology (IFST), Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka-1205, Bangladesh
**Corresponding email: humayunkabir@bcsir.gov.bd; sabinayasmin@bcsir.gov.bd*

ABSTRACT

Arsenic contamination in drinking water is a critical global concern, posing severe risks to human health and the environment. Finding effective ways to remove arsenic from water is therefore essential. To address this challenge, a waste battery-derived graphene oxide-modified magnetic nanocomposite (MGO-Fe_3O_4) was synthesized via co-precipitation of $FeCl_3$•$6H_2O$ and $FeCl_2$•$4H_2O$ on GO and evaluated as an effective adsorbent for As(III) removal from water. The material was thoroughly characterized using FTIR, FESEM, TEM, XRD, XPS, zeta potential, and VSM analyses. Batch adsorption experiments demonstrated optimum As(III) removal (98%) at pH 7, a contact time of 20 min, an initial concentration of 100 ppb, and an adsorbent dosage of 0.14 g/L. The adsorption process followed pseudo-second-order kinetics and was best described by the Freundlich isotherm, with a maximum adsorption capacity of 50.2 mg/g at room temperature. Thermodynamic analysis confirmed that the adsorption was spontaneous and exothermic. Furthermore, Density Functional Theory (DFT) calculations supported that As(III) binding on MGO-Fe_3O_4 primarily occurs through surface complexation and hydrogen bonding. These findings highlight the high efficiency, cost-effectiveness, and sustainability of this nanocomposite, underscoring its broader significance in mitigating arsenic contamination. this study not only provides a promising material for safe drinking water but also contributes to long-term environmental protection and the advancement of sustainable water treatment technologies.

Paper ID: ICSHSD-289

Carboxymethylcellulose Functionalized Magnetic Graphene Oxide for the Efficient Removal of Tetracycline from Aqueous Media

Nosheen Tabassum Dipannita[1], Sabina Yasmin[2,*], Md. Kamrul Hasan[1], Md. Sanwar Hossain[2], Monira Akter Somapti[1], and Md Humayun Kabir[3,*]

[1]Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
[2]Institute of National Analytical Research and Service (INARS), Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka-1205, Bangladesh
[3]Institute of Food Science and Technology (IFST), Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka-1205, Bangladesh
**Corresponding email: sabinayasmin@bcsir.gov.bd; humayunkabir@bcsir.gov.bd*

ABSTRACT

Carboxymethylcellulose (CMC) functionalized magnetic graphene oxide **(**m-GO/Fe_3O_4/CMC) nanoadsorbent was successfully synthesized, to remove tetracycline (TC) in aqueous media. The prepared m-GO/Fe_3O_4/CMC nanoadsorbent has been characterized using several instrumental techniques, including X-ray diffractometer, Fourier transforms infrared spectroscopy, vibrating sample magnetometer, transmission electron microscopy, scanning electron microscopy, and energy dispersive-X-ray. These techniques confirmed the successful synthesis of this nanoparticle and also revealed its superparamagnetic behavior, exhibiting a saturation magnetization of 50.69 emu g^{-1}. The batch experiments were conducted under different conditions, including contact time, adsorption dosage, pH, concentration, and temperature, to determine the optimal conditions of the adsorption process. The maximum adsorption (96.04% removal) was established within 25 min, while the adsorbent dose was only 0.1 g L^{-1} at pH 5. The adsorption process was best fitted with the pseudo-second-order model, which suggests the interaction of TC with this nanoadsorbent is mainly controlled by the chemisorption process. This may be due to hydrogen bonding as well as electrostatic and π-π interaction between adsorbates and adsorbents. The isotherm data of the adsorption process was best fitted with the Langmuir isotherm model with a maximum adsorption capacity of 54.73 mg g^{-1}, indicating that the adsorption is monolayer adsorption to heterogeneous surfaces with electrostatic interaction. Furthermore, reusability tests revealed the nanoadsorbent's excellent stability, retaining high adsorption efficiency even after ten consecutive cycles. The findings unambiguously demonstrated that this m-GO/Fe_3O_4/CMC nanoadsorbent could be a good choice to remove TC from wastewater sources.

Paper ID: ICSHSD-292

Kinetics of Electrocatalytic Oxidation of Gallic Acid by Activated Glassy Carbon Electrode in Acidic Medium

Munira Siddika[1,*], Mohammad A. Hasnat[2]

[1]Department of Chemistry, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
[2]Electrochemistry & Catalysis Research Laboratory (ECRL), Department of Chemistry, School of Physical Sciences, Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh
**Corresponding email: munira@chem.buet.ac.bd*

ABSTRACT

An electrochemically functionalized glassy carbon (GC) electrode was prepared to study Gallic acid (GA) oxidation reaction in an acidic medium. The functionalized GC electrode was found to enhanced GA oxidation reaction in acidic medium by lowering oxidation potential and increasing corresponding current in comparison to a pristine GC. Electrochemical impedance spectroscopy (EIS), cyclic voltammetry (CV), and x-ray photoelectron spectroscopy (XPS) methods were used to analyze functionalized GC surface. The development of electro positive C=O functional groups were assumed to enhance the catalytic process. The specific capacitance of the electrode was calculated to be 92.91μF by analyzing EIS. Kinetics of GA oxidation over activated GC was calculated from CVs data. By analyzing concentration dependent CVs it was found that the electrode process followed mass transfer limited first order kinetics. The GA oxidation mechanism is potential-dependent. For potentials above 0.42V, the oxidation reaction involves the transfer of $2e^-$ and $2H^+$ via a concerted mechanism, while at potentials below 0.42V, the mechanism is stepwise. The reaction's standard rate constant (k°) was evaluated as 2.08×10^{-4} cm s

Paper ID: ICSHSD-293

Investigation of Antibacterial Activity of Green Synthesized Zinc Oxide Using the Flower Extract of *Plumeria Rubra*

Syeda Tanha Hossain Progga[1], Jannatul Mawa Rodela[1], H.M. Fahim[1], Bithi Paul[2] and Farzana Sabeth[2,*]
[1]Department of Computer Science and Engineering, Faculty of Science and Technology, American International University, Bangladesh, Dhaka-1229, Bangladesh
[2]Department of Physics, Faculty of Science and Technology, American International University, Bangladesh, Dhaka-1229, Bangladesh
**Corresponding email: fsabeth@aiub.edu*

ABSTRACT

Green-synthesized zinc oxide (ZnO) metal oxide nanoparticles (MNPs) have attracted considerable attention in advanced research fields owing to their unique properties and wide-ranging applications in biosensors, cosmetics, drug delivery, and antibacterial formulations. With the rising threat of microbial contamination and multidrug-resistant pathogens, which are now recognized as major global health concerns and leading causes of mortality, the exploration of effective antimicrobial agents has become crucial. In this context, we report a facile single-pot green synthesis of ZnO nanoparticles (KG-ZnO) employing aqueous flower extract of *Plumeria rubra* (locally known as Kathgolap) as a reducing, capping, and stabilizing agent, along with an evaluation of their antibacterial activity against four distinct bacterial strains. The aqueous extract of *Plumeria rubra* flowers was utilized as a reducing and capping agent for the eco-friendly synthesis of KG-ZnO MNPs. The optical properties, structure and morphology of the as-synthesized KG-ZnO metal oxide nanoparticles have been characterized by UV-Visible spectroscopy (UV-Vis), Fourier transform infrared spectroscopy (FT-IR), X-ray diffraction (XRD), field emission scanning electron microscopy (FE-SEM) supported with energy dispersive X-ray spectroscopy (EDX), and transmission electron microscopy (TEM). The disc diffusion method on Mueller-Hinton agar was employed to test the antimicrobial efficacy of KG-ZnO MNPs. Inhibition zones were measured after a 24-hour incubation at 37°C. X-ray diffraction (XRD) analysis using Rietveld refinement confirmed the hexagonal wurtzite phase with crystallite sizes of 51 nm for KG-ZnO. UV–visible spectroscopy showed band gaps of 2.98 eV. The green-synthesized KG-ZnO displayed significant antibacterial activity against both Gram-positive and Gram-negative bacteria. For *E. coli*, inhibition zones were 11.5 mm and 12.5 mm, for *P. aeruginosa*, inhibition zones were 8.5 mm and 10 mm, for *S. flexneri*, the inhibition zones were 9.0 mm and 10.5 mm, and finally, for S. aureus, the zones were 9.0 mm and 10.0 mm, for KG-ZnO NPs at 200 µg/disk and 400 µg/disk, respectively. Hence, the green-synthesized KG-ZnO nanoparticles have the potential to be used as a bactericidal component.

Paper ID: ICSHSD-296

Study of Photocatalytic Dye Degradation of Methylene Blue of Green Synthesized Zinc Oxide Using*Chrysanthemum Grandiflorum*

Jannatul Mawa Rodela[1], SyedaTanha Hossain Progga[1], H.M. Fahim[1], Bithi Paul[2] and Farzana Sabeth[2,*]
[1]Faculty of Science and Technology, American International University – Bangladesh, Dhaka-1229, Bangladesh
[2]Department of Physics, Faculty of Science and Technology, American International University – Bangladesh, Dhaka-1229, Bangladesh
**Corresponding email: fsabeth@aiub.edu*

ABSTRACT
Dye discharged into water resources from many industrial sources causes severe environmental damage, affecting both land and aquatic living creatures. Photocatalytic dye degradation process assisted by a green synthesized semiconductor depends on various parameters, like the nature and concentration of the organic substrate, concentration and type of the semiconductor, light source and intensity, pH, temperature, etc. Among several photocatalytic materials, green-synthesized zinc oxide (ZnO) has several advantages, and its catalytic properties were studied extensively as it has very high photochemical reactivity, low-cost, and is non-toxic in nature. We report a single-pot green synthesis of zinc oxide (YCM-ZnO) nanoparticles using the aqueous flower extract of *Chrysanthemum grandiflorum* (locally called Chandramallika) as both the reducing, capping, and stabilizing agent. The synthesized nanoparticles were thoroughly characterized for their optical, structural, and morphological properties using UV–Visible spectroscopy (UV–Vis), Fourier transform infrared spectroscopy (FT–IR), X-ray diffraction (XRD), field emission scanning electron microscopy (FE–SEM) coupled with energy-dispersive X-ray spectroscopy (EDX), and transmission electron microscopy (TEM). The photocatalytic properties of prepared YCM-ZnO nanoparticles were studied by using MB as a model organic pollutant by UV Irradiation. XRD analysis confirmed the formation of phase-pure ZnO nano structures with a hexagonal wurtzite lattice, and Rietveld refinement revealed an average crystallite size of 47 nm for the synthesized YCM-ZnO nanoparticles. The optical band gap was estimated to be 2.9 eV. Morphological studies using FE-SEM and TEM showed predominantly spherical to hexagonal-shaped particles, while FT-IR spectra confirmed the presence of phytochemical capping agents from the extract. The YCM-ZnO nanoparticles demonstrated excellent photocatalytic activity, achieving 89% degradation of methylene blue under UV irradiation. These findings suggest that the green-synthesized YCM-ZnO nanoparticles hold strong potential as efficient photocatalysts.

Paper ID: ICSHSD-300

Plasmonic Solar Cell

Md. Ali Akbar Sabbir[1], and Nur Uddin Ahamad[1,]
[1]Department of Chemistry, Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh
**Corresponding email: nur-che@sust.edu*

ABSTRACT
$Ag@TiO_2$ core-shell nanostructures in plasmonic solar cells present a promising pathway to improve light harvesting and charge carrier generation via localized surface plasmon resonance (LSPR). $Ag@TiO_2$ nanoparticles were synthesized for this study using a modified process that was previously reported in the literature. An acid-etching technique was used to investigate variations in the shell's (TiO_2) thickness, and the extinction spectra of colloidal and solid-supported $Ag@TiO_2$ NPs were used to track the shell's deterioration. Uniform core-shell shape and elemental distribution were confirmed by structural and compositional studies using SEM-EDS and TEM. Nanostructures containing Ag, Ti, and O components are confirmed by SEM-EDS. Through the TEM image, the $Ag@TiO_2$ NPs' core (Ag) and shell (TiO_2) dimensions are observed. UV-Vis spectroscopy revealed distinct LSPR peaks and broadened absorption in the visible region, indicative of enhanced optical activity. Further research is being conducted to optimize the parameters and continuing study of the hot-electron involvement in the photoconductivity of the prepared platform.

Paper ID: ICSHSD-302

Experimental and Computational Insights into Antibacterial and Antioxidant Properties of Metal Complexes with Isoniazid-based Schiff Base Ligands

Md. Ashraful Islam[1], Md. Sajib Hossain[1], Md. Tariqul Islam[1], Md. Toukir Biswas[2], Faria Tasnim[3], Md. Robiul Islam[1], Md. Ali Asraf[1], Md. Faruk Hossen[1], and Md. Kudrat-E-Zahan[1,*]
[1]Department of Chemistry, University of Rajshahi, Rajshahi-6205, Bangladesh
[2]Department of Applied Chemistry and Chemical Engineering, University of Rajshahi, Rajshahi-6205, Bangladesh
[3]Department of Genetic Engineering and Biotechnology, University of Rajshahi, Rajshahi-6205, Bangladesh
**Corresponding email: kudrat.chem@ru.ac.bd*

ABSTRACT
Isoniazid-based Schiff base ligands coordinate with transition metals through azomethine nitrogen and oxygen donors, enhancing electron delocalization and influencing redox properties. This structural modification impacts antibacterial and antioxidant behaviors by modulating metal-centered redox reactions, with geometry and oxidation states playing critical roles. Schiff base metal complexes derived from isoniazid and benzaldehyde were synthesized with Cu(II), Ni(II), and Co(II) ions and characterized using UV-Vis, FT-IR, NMR, and DFT analyses. The Cu(II) complex (CuL) exhibited the highest antibacterial activity, showing a 13.83±0.44 mm inhibition zone against Staphylococcus aureus. Antioxidant activity, assessed via DPPH radical scavenging, revealed CuL as the most effective, with an IC50 of 194 µg/mL. Molecular docking studies with the MurA protein (PDB ID: 3KR6) highlighted NiL's strong binding affinity (binding energy: -10.5 kcal/mol), suggesting therapeutic potential. Frontier molecular orbital (FMO) analysis indicated lower energy gaps for CuL, NiL, and CoL, correlating with higher biological activity. These findings underscore the potential of these metal complexes as agents for combating bacterial infections and oxidative stress.

Paper ID: ICSHSD-306

Quantum Chemical Investigations into the Structural and Spectroscopic Properties of Choline Chloride-Based Deep Eutectic Solvents

M. Ashraful Hasan[1,*], Ismail M. M. Rahman[2,*], M. Rithoan Hossain[1], and Faisal Islam Chowdhury[1,*]
[1]Department of Chemistry, Faculty of Science, University of Chittagong, Chattogram-4331, Bangladesh
[2]Institute of Environmental Radioactivity, Fukushima University, Kanayagawa, Fukushima City, Fukushima 960-1296, Japan
**Corresponding email: ashrafulhasan.chem.cu@gmail.com; immrahman@ipc.fukushima-u.ac.jp; faisal@cu.ac.bd*

ABSTRACT
The chemical process industries are progressively embracing green technologies and sustainable waste management techniques due to growing environmental concerns and the impact of climate change. Deep Eutectic Solvents (DESs), formed by combining neutral molecules (e.g., choline chloride, ChCl) with hydrogen bond donors, have emerged as promising eco-friendly solvents with diverse applications in chemical, pharmaceutical, and separation processes. In this context, modern quantum-based research is focused on eutectic mixtures, particularly those formed by ChCl as a hydrogen bond acceptor with various hydrogen bond donors at specific mole ratios. The properties and validity of these DESs are investigated through density functional theory (DFT) analysis of their molecular dynamics simulations. This quantum computational approach offers valuable insights for designing the desired conductive liquids. Furthermore, the density of states analysis allows for studying the electronic structure and quantifying the number of states occupied per unit of energy. The quantum and vibrational properties of experimentally synthesized DESs are simulated using DFT B3LYP/6-31G(d,p). Current research aims to design and understand the properties of eutectic solvents to develop novel, environmentally benign alternatives for the chemical industry.

Paper ID: ICSHSD-316

Assessment of Heavy Metals in Beef and its Health Risk in Jashore Municipality Area

Suman Chandra Mohanta[1,*], Abu Shamim Khan[2], Rabiul Islam[1], Mahbub Hasan[1], Zahid Hasan[1], Golam Mortuza[1], Belal Hossen[1], Masud Rana[1], Jannatul Mawya[1], Joy Rahman[1], and Rajib Ali[1]
[1]Department of Chemistry, Jashore University of Science and Technology (JUST), Jashore-7400, Bangladesh
[2]Environmental Laboratory, Asia Arsenic Network, Arsenic Center, Benapole Road, Krishnobati, Pulerhat, Jashore-7400, Bangladesh
**Corresponding email: smohantabd@just.edu.bd*

ABSTRACT
Beef is a basic source of protein which is essential for human body. On the other hand, beef is a common source on animal protein in our country which is popular for its delicious taste and locally accessibility. Beef originates from cow which safety depend on quality of animal feed. Farmers are using raw feed, natural feed and artificial feed for cow rearing and fattening process. Feed should be safe from heavy metals for food safety. Metal contaminated feed may be influenced to accumulation of heavy metals in beef muscle, lungs, liver and tripe which has adverse effect on human health such as cancer and non-cancer diseases. Heavy metal exposure may harm the nervous system, kidney and other organs. Long term exposure can lead to developmental issues in children and increase the risk of various diseases in adults. The presence of heavy metals at higher concentrations in food is considered as a potential health hazard to both animals and humans. This study assessed the concentrations of heavy metals in the meat, tripe, lungs and liver of cattle. It was conducted on November 2023 in Jashore district. The dried samples were digested by using USEPA method and the concentration of arsenic, iron, manganese, lead and chromium was measured by HG-AAS and. Flame-AAS method respectively. Daily intake of metals and its health risk was calculated by using USEPA method. The concentration range of arsenic, iron, manganese, lead and chromium were 0.03mg/Kg to 0.39mg/Kg, 7.87 mg/Kg to 88.59mg/Kg, 0.48 mg/Kg to 6.38mg/Kg, 0.24mg/Kg to 2.56 and 2.71 mg/Kg to 4.98respectively. Maximum level of lead and chromium was found in muscle due to consume huge volume of metals contaminated cattle feed, grass and straw. The range of total non-carcinogenic and carcinogenic based health risk was 1.73 to 7.65 and 0.69 to 8.40 which were alarming for food safety and human health. Order of average carcinogenic health risk was arsenic (2.66)> chromium (0.0361)> lead (0.0154).It is crucial to minimize exposure through proper disposal of electronic waste, avoiding contaminated water and food, and allowing safety guidelines in industrials settings. This study will contribute some information on heavy metals contamination in beef and its health risk.

Paper ID: ICSHSD-318

Efficacy of Gibberellic Acid (Ga3) and Different Nutrient Sources on The Growthand Yield of Sweet Gourd (Cucurbita Moschata D.) During Summer

Md. Rosiquzzaman[1], Md. Azmain Faique[2], Saidul Islam[2], and Mohammad Ahsanul Kabir[1*]
[1]Department of Horticulture, Hajee Mohammad Danesh Science and Technology University, Dinajpur-5200, Bangladesh.
[2]Department of Chemistry, Hajee Mohammad Danesh Science and Technology University, Dinajpur-5200, Bangladesh.
**Corresponding email: kabirhstu@yahoo.ie*

ABSTRACT
Gibberellic acid (GA_3) is a plant hormone that promotes cell growth and is used to improve crop yield at lower input costs.This study tested GA_3 with different nutrient sources on sweet gourd (Cucurbita moschata D.) under summer conditions. Afield experiment with nine treatment combinations showed that chemical fertilizer plus 5 t/ha organic matter and 200ppmGA_3 gave the best results for plant growth, fruit size, and yield. In contrast, 400 ppm GA_3 with mustard oil cake reduced performance. A balanced mix of organic and inorganic fertilizers with moderate GA_3 improved yield and sustainability.

Paper ID: ICSHSD-322

Synthesis of Magnetically Separable Fe_3O_4/Zno Nanocomposite for Photocatalytic Degradation of Methylene Blue

Md. SeratulMustakin[1], AmenaJaman[1], Md. Sajib[1], and Muhammad Shah Miran[1,*]
[1]Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
**Corresponding email: shahmiran@du.ac.bd*

ABSTRACT

Environmental pollution is one of the major problems of this century. Due to the growth of various industries, environmental pollution has become a serious issue. Persistent organic pollutants (POPs) released from industries pose serious risks to aquatic life and human health. There are many physical and chemical methods for removal of POPs, but they are not as effective as advanced oxidation processes (AOPs), which are recognized as a more powerful and promising solution to these problems. In AOPs, photocatalysis is more effective because all other methods have some limitations. Several effective photocatalysts are available, such as ZnO, TiO_2, Bi_2WO_6, WO_3, CuO, and Fe_3O_4 but they are not effective in visible light That's why it is important to develop an efficient visible-light active photocatalyst to degrade POPs. In the present work, magnetically separable Fe_3O_4/ZnO nanocomposite is synthesized for the efficient degradation of methylene blue (MB) under irradiation of visible light. Low temperature (100 °C) hydrothermal method is used to synthesize this nanocomposite as an efficient and eco-friendly alternative to conventional high temperature method. Using this approach, Fe_3O_4/ZnO nanocomposites are prepared with Fe_3O_4 loadings of 5%, 10%, 15%, and 20% (w/w), denoted as FZ-5, FZ-10, FZ-15, and FZ-20, respectively. Various analytical techniques, including Fourier-transform infrared spectroscopy (FTIR), UV-visible diffuse reflectance spectroscopy (UV-DRS), field emission scanning electron microscopy (FESEM), thermogravimetric analysis (TGA), and X-ray diffraction (XRD), are employed to characterize the structural and morphological properties of the synthesized material. Pure ZnO NPs removed 58% of 10 ppm methylene blue within 60 min under UVA light in water, catalyst dose 0.3g/L. About 90% removal is achieved within 60 min using the FZ-10 composite under the same conditions. The effect of pH, catalyst dose, and dye concentration, are studied and optimized for highest removal of MB.

Paper ID: ICSHSD-323

Machine Learning-Driven Classification of Electrochemical System Compatibility: The Role of Dielectric Constant

Saidul Islam[1,*], Md. Azmain Faique[1], and Ahmad Parvez[1]
[1]Department of Chemistry, Hajee Mohammad Danesh Science and Technology University, Dinajpur-5200, Bangladesh
**Corresponding email: saidul23.hstu@gmail.com*

ABSTRACT

The current study develops machine learning model to classify materials compatibility of electrochemical systems. The predictive framework employed three supervised classification models: SVM, RF and KNN. After preprocessing and hyperparameter tuning, the SVM model demonstrated superior performance, achieving an accuracy of 95% with a macro F1-score of 0.90, an AU-ROC of 0.98 and a log loss of 0.116 on test set. Pearson correlation and permutation importance analysis revealed that the dielectric constant is a key factor in compatibility. This finding highlights SVM's potential in classifying compatibility and material screening for better electrochemical system.

Paper ID: ICSHSD-329

Preparation and Characterization of Magnetic Ionic Liquids as Electrolyte for Electrochemical Applications

Mariom Jahan[1], and Md. Abu Bin Hasan Susan[1,2,*]
[1]Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
[2]Dhaka University Nanotechnology Center (DUNC), University of Dhaka, Dhaka-1000, Bangladesh
**Corresponding email: susan@du.ac.bd*

ABSTRACT

The ongoing energy demand worldwide has led to the continual growth of battery performance in recent years. Electrolytes, which are the junction of ions between electrodes, play a key role in enhancement of battery performance. The low viscosity, non-flammability, and large potential window are the prime requirements for electrolytes for better ionic mobility. But conventional electrolytes possess low potential electrochemical window as well as high viscosity and flammability. Magnetic ionic liquids (MILs) with high energy storage capability may serve as electrolyte in battery and offer more efficient approach towards future energy demands. In this work, two MILs were synthesized by mixing 1-ethyl-3-methylimidazolium chloride ([C_2mim]Cl) and 1-butyl-3-methylimidazolium chloride ([C_4mim]Cl) with $FeCl_3 \cdot 6H_2O$. UV–visible spectroscopy confirmed the formation of [C_2mim]$FeCl_4$ and [C_4mim]$FeCl_4$. The MILs responded moderately to an external magnetic field. They are paramagnetic with the magnetic susceptibility of 45 μemu/g and 41 μemu/g for [C_2mim]$FeCl_4$ and [C_4mim]$FeCl_4$, respectively. Thermogravimetric analysis indicated high thermal stability (~500 °C) for both MILs. The electrochemical behavior of [C_4mim]$FeCl_4$ was investigated by cyclic voltammetric analysis. These findings help to understand the effect of magnetic fields on electrolysis and develop efficient electrolytes for lithium-ion batteries and other electrochemical applications.

Paper ID: ICSHSD-332

Phase Transformation in Poly(Vinylidene Fluoride) Using Porous Silica Fillers for Improved Dielectric Performance

Mst. Rumana Akter[1], Mst. Momotaz Begam[1], and Saika Ahmed[1,*]
Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
**Corresponding email: saika@du.ac.bd*

ABSTRACT

Poly(vinylidene fluoride) (PVDF) has emerged as a prominent material in materials science due to its remarkable flexibility, semi-crystalline structure, chemical resistance, and unique pyroelectric, piezoelectric, and dielectric properties, which arise from its electroactive *β*-phase. The widespread applicability of the electroactive *β*-phase has motivated research on enhancing the transformation of other crystalline phases into the *β*-phase. In this study, SBA-16 and MCM-41 mesoporous silica were employed as filler, with variations in their content and surface silanol (Si-OH) group concentration, to investigate their effects on the *α*- to *β*-phase transformation and the dielectric properties of PVDF. SBA-16 and MCM-41 were synthesized using a non-ionic and ionic surfactant template respectively. Several characterizations were carried out to determine the properties of these materials. The mesoporous structure of the materials was confirmed by N_2 adsorption-desorption analysis, *α*- to *β*-phase transformation by XRD analysis, and particle morphology characterized via SEM. The silanol group concentration was determined using FTIR and TGA. Results showed that composites with higher silanol content exhibited enhanced *β*-phase formation due to improved interactions between the filler and PVDF chains. While the *β*-phase fraction was higher at lower silica content, composites with increased silica loading demonstrated superior dielectric properties. These findings offer valuable insights into tailoring filler characteristics to optimize the electroactive and dielectric performance of PVDF for advanced applications.

Paper ID: ICSHSD-342

Purification of Bioactive Compounds from *Aphanamixis polystachya* Leaves Extract and In Vitro Assessment of Their Antibacterial and Antioxidant Potentials

Shohan Ali[1,*], Atiqur Rahman[1],Md. Zakariya Alam Bappi[2], and Shagor Chad Mondol Akash[1]
[1]Department of Applied Chemistry and Chemical Engineering, Faculty of Engineering and Technology, Islamic University, Kushtia-7003, Bangladesh
[2]Department of Biotechnology and Genetic Engineering, Faculty of Biological Sciences, Islamic University, Kushtia-7003, Bangladesh
**Corresponding email: shohan.acce23.iu.bd@gmail.com*

ABSTRACT

The present study was conducted to detect possible chemicals (phytoconstituents), and investigate antioxidant and antibacterial activities of the extract of *Aphanamixis polystachya* (leaves).The various organic extracts (125 µg/disc) displayed a great potential of antibacterial activity against all two Gram-positive bacteria: *Staphylococcus aureus* and *Enterococcus faecalis* and moderate to low activity against three Gram-negative bacteria: *Pseudomonas aeruginosa, Klebsiella pneumonia* and *Escherichia coli*. The zones of inhibition of different concentration of different organic extracts against the tested bacteria were found in the range of 9-11 mm and the minimum inhibitory concentrations (MIC) were recorded between 32-256 µg/ml. For investigating the antioxidant activity, two complementary test methods namely DPPH free radical scavenging assay and total phenolic content determination were carried out. In various leaves extract total phenolic compounds of *Aphanamixis polystachya* found 122.53 ± 2.6 (mg GAE/g dw) for petroleum ether extract, 36.73 ± 0.8(mg GAE/g dw) for ethyl acetate extract and 85.10 ± 1.9(mg GAE/g dw) for ethyl acetate extract fraction (3), values are given as the mean ± S.D. of triplicate experiments. In DPPH free radical scavenging test, the ethanol soluble extract showed the highest free radical scavenging activity with IC50 value 22.41 µg/ml and methanol soluble extract the lowest free radical scavenging activity with IC50 value 10.35 µg/ml while compared to that of the reference standards ascorbic acid. In this study, we screened for phyto-constituents to isolate the medicinally important compounds from *Aphanamixis polystachya* leaf, a Bangladeshi medicinal plant of traditional usage. Further, the bioassay guided fractions (3) of ethyl acetate extract afforded (3-*O*-[6'-*O*-stearen-4,6,8-trienoyl-*β*-D-glucopyranosyl]-stigmasta-5,7,22(23)-triene), whose structures were identified by spectral data (1H-NMR and 13C-NMR) analyses. The isolated compounds also displayed potent antibacterial and antioxidant activities. The presence of antibacterial activity of various organic extracts of *Aphanamixis polystachya* against a range of pathogenic bacteria indicated that the possible future use of the plant extracts as alternative safer antibacterial agents and also their future use in the food, flavoring and other industries. The results of our study demonstrate that the natural products derived from *Aphanamixis polystachya* might be used in food, pharmaceutical, and other industries due to their broad range of bioactivities.

Paper ID: ICSHSD-346

Investigating the Molecular Mechanisms of Mucuna Pruriens in Treating Parkinson's Disease: A Network Pharmacology and Bioinformatics Approach with Molecular Docking and Dynamics Validation

Md. Sakhaoyat Hossain[1,*]
[1]Department of Chemistry, Chittagong University of Engineering & Technology, Chattogram-4349, Bangladesh
**Corresponding email: sakhaoyat.chem@gmail.com*

ABSTRACT

Parkinson's disease (PD) is the most rapidly increasing neurological ailment worldwide and presents significant management difficulties due to increased impairment. In this study, we took a novel approach by exploring the therapeutic potential of bioactive compounds from *Mucuna pruriens* (MP), a plant renowned for its neuroprotective properties, using a network pharmacology approach. This approach allowed us to elucidate the molecular interactions and pathways involved, revealing key targets associated with PD. Targets for active phytocompounds of MP and PD were meticulously screened. The STRING database was then utilised to construct a robust PPI network, which was further analysed using the MCODE plugin for cluster analysis. DAVID and the Metascape database were employed for comprehensive GO enrichment and KEGG pathway analyses. The results were then rigorously verified through molecular docking and MD simulations analysis, instilling confidence in the validity of our network pharmacology approach. Our GO and KEGG analyses revealed that the main biological processes involved included positive regulation of Phosphorylation, protein phosphorylation, signal transduction, negative regulation of the apoptotic process, response to xenobiotic stimulus, angiogenesis, and response to hypoxia. We identified significant pathways related to Pathways in cancer, PI3K-Akt signaling pathway, Proteoglycans in cancer, Apoptosis, EGFR tyrosine kinase inhibitor resistance, HIF-1 signaling pathway, and AGE-RAGE signaling pathway in diabetic complications. The network pharmacological results showed that mucunone A, medicarpin, and isoflavanones are the main active compounds, and CASP3, TNF, MAPK1, EGFR, and HSP90AB1 are key target proteins. We conducted a verification of the relationship between key compounds and target genes through molecular docking, molecular dynamics simulations, and trajectory analysis. This investigation illuminated the potential therapeutic mechanisms of *Mucuna pruriens* in the treatment of Parkinson's disease. However, it is important to note that our study was confined to the molecular level, which presents certain limitations; therefore, further clinical experiments are necessary for validation.

Paper ID: ICSHSD-350

Assessment of Humic Acid in Groundwater and Its Impact on Water Quality at Coastal Area in Bangladesh

Abu Shamim Khan[2,*], Suman Chandra Mohanta[1], Rabiul Islam[1], Mahbub Hasan[1], Zahid Hasan[1], Golam Mortuza[1], Masud Rana[1], Rajib Ali1, Joy Rahman[1]
[1]Department of Chemistry, Jashore University of Science and Technology (JUST), Jashore-7400, Bangladesh
[2]Environmental Laboratory, Asia Arsenic Network, Arsenic Center, Benapole Road, Krishnobati, Pulerhat, Jashore-7400, Bangladesh
**Corresponding email: abuskhan2000@yahoo.com*

ABSTRACT

Groundwater is ordinary source of drinking water in Bangladesh which should be safe from color and organic contaminants. Groundwater is a reliable source of drinking water which is extraction procedure is easy and cheap. Coastal area people are facing drinking water quality crisis due to salinity, color and organic pollution problem in groundwater. Organic pollution in groundwater and its color problems monitoring is important for water quality and health safety. This study was measured color and humic acid in groundwater and its impact on water quality. It was conducted in June to November, 2023 at coastal area in the Bengal Delta Palin district Barguana and Patuakhali. Concentration of pH, TDS, Chloride, turbidity, color, humic acid, BOD5, CODMn and iron was measured by membrane electrode, conductivity, Mohr's, attenuated radiation, PtCo, UV-VIS, 5days incubation, wet oxidation and flame-AAS methods respectively. Concentration of pH, TDS, chloride, turbidity and iron was matched with Bangladesh drinking water guideline. Concentration range of color, humic acid, BOD5 and CODMn in groundwater was detected 61.00-190.00PtCo mg/L, 2.20-7.40mg/L, 2.90-5.13mg/L and 7.60-15.60mg/L which were exceed than the drinking water guideline in Bangladesh. Average pollution index value for groundwater was calculated 1.83 which is moderately polluted by dissolving humic acid. Concentration of humic acid in groundwater has a co-relation with color, BOD5 and pollution index value which coefficients were 0.867, 0.507 and 0.745. In addition concentration of color in groundwater has a co-relation with CODMn which coefficients was 0.478. It is concluded that humic acid in drinking water affect the water quality and health safety.

Paper ID: ICSHSD-377

Synthesis of Carbohydrate Derivatives: Drug Design and Pharmaceutical Interests for Future Visions

Ivy Islam[1], Md. Farhan Labib[1], Jahidul Islam Sajal[1], Sajid Hassan Shammo[1], Abonti Barua[1], Nazia Islam[1], Khurshida Jahan Suma[1], Abida Sultana[1], Md. Raihan Sarker[1], and S. M. Abe Kawsar[1,*]

[1]Lab of Carbohydrate and Nucleoside Chemistry (LCNC), Department of Chemistry, University of Chittagong, Chittagong-4331, Bangladesh

**Corresponding email: akawsarabe@yahoo.com; akawsar@cu.ac.bd*

ABSTRACT

Carbohydrates, among the most abundant and widespread biomolecules in nature, play indispensable roles in diverse biological functions and represent a treasure trove of untapped potential for pharmaceutical applications. Therefore, to explore new leads toward future endeavors for potent antibacterial agents, a series of carbohydrate derivatives have been synthesized using direct methods. The structures of the newly synthesized derivatives were elucidated with various spectroscopic methods, such as FTIR, ^{1}H-NMR, ^{13}C-NMR, and mass spectrometry, with elemental and physicochemical analyses. The antimicrobial activities of the compounds against human pathogenic bacteria and phytofungi were evaluated *in vitro*, and the presence of particular groups in the test compounds increased their sensitivity to the growth of the microorganisms. Moreover, gram-positive bacteria are more effective than gram-negative pathogens. The MIC, MBC and MFC of the compounds exhibited excellent activity. The MTT assay revealed anticancer activity against *Ehrlich ascites* carcinomacells. Moreover, cytotoxicity testing revealed that the compounds are less toxic. An SAR investigation revealed that the combination of long acyl chains (C-10 to C-16) and halo-aromatic chains with sugars had the most potent activity against bacterial and fungal pathogens. The thermodynamic and physicochemical parameters were calculated via the DFT method. Molecular docking studies provided further evidence of the advantageous antibacterial effects of the carbohydrate derivatives. A 150-ns molecular dynamic simulation indicated stable conformation and binding patterns in a stimulating environment. *In silico* ADMET calculations suggested that the designed carbohydrate compounds had good drug-likeness. In summary, these findings indicate that carbohydrate derivatives exhibit considerable potential as therapeutic agents/drugs for treating microbial infections in future endeavors.

Paper ID: ICSHSD-378

Synthesis of Nucleoside Analogs as Drugs in the Fight against SARS-CoV-2 and Other Coronaviruses

Sajjad Hossain[1], Akibul Islam[1], Tasfia Tabassum Eshika[1], Niloy Bhattacharjee[1], Md. Rithoan Hossain[1], S. M. Abe Kawsar[1,*]

Lab of Carbohydrate and Nucleoside Chemistry (LCNC), Department of Chemistry, University of Chittagong, Chittagong-4331, Bangladesh

**Corresponding email: akawsarabe@yahoo.com; akawsar@cu.ac.bd*

ABSTRACT

Nucleoside-based analog drugs are widely used for the treatment of both acute and chronic viral infections. Nucleoside derivatives play important roles in the treatment of viral respiratory pathologies, especially during the current COVID-19 pandemic. Coronaviruses (CoVs) are positive-sense RNA enveloped viruses, which are members of the family Coronaviridae, that cause infections in a broad range of mammals, including humans. Several CoV species lead to mild upper respiratory infections, which are typically associated with the common cold. However, three human CoV (HCoV) species, severe acute respiratory syndrome (SARS)-CoV-1, Middle East respiratory syndrome (MERS)-CoV, and SARS-CoV-2, are responsible for severe respiratory diseases at the origin of two recent epidemics (SARS and MERS), and of the current coronavirus disease 19 (COVID-19), respectively. From this perspective, the present study was designed to explore and evaluate the synthesis and spectral characterization (FTIR, ^{1}H-NMR, ^{13}C-NMR, ^{13}C-DEPT, mass, etc.) of nucleoside analogs with different aliphatic and aromatic groups. *In vitro*, antimicrobial tests against bacteria and fungi, along with the prediction of activity spectra for substances, indicated promising antibacterial functionality for these nucleoside analogs compared with antifungal activity. In support of this observation, molecular docking experiments were performed against the main protease of SARS-CoV-2, and significant binding affinities and nonbonding interactions were observed against the main protease. Moreover, a 100 ns molecular dynamics simulation process was performed to monitor the behavior of the complex structure, which revealed a stable conformation and binding pattern in a stimulating environment of nucleoside analogs. Pharmacokinetic predictions were investigated to evaluate their ADMET properties, and the combination of pharmacokinetic and drug-likeness predictions has shown promising results *in silico*. In conclusion, the findings of the present study should be of great help in the development of nucleoside-based, novel, multiple drug-resistant antimicrobial and COVID-19 drugs as potential antiviral agents.

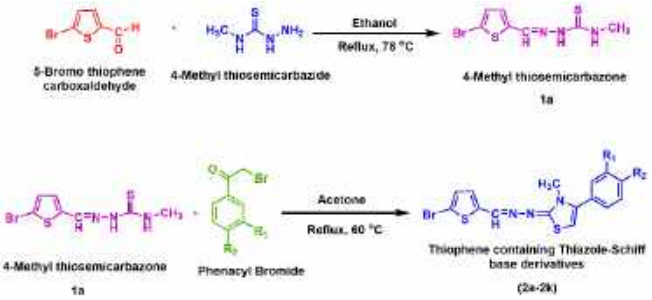
Paper ID: ICSHSD-383

Synthesis, Antimicrobial and Antioxidant Evaluation with *In Silico* Admet Prediction, Molecular Docking and Dynamics Studies of Novel Halogen-Substituted Thiophene Containing Thiazole-Schiff Base Derivatives

Alin Tasnim Aurora[1], Md. Aminul Haque[1,*], and Mohammad Mostafizur Rahman[1,*]
[1]Department of Chemistry, Jagannath University, Dhaka-1100, Bangladesh
**Corresponding email: mostafiz@chem.jnu.ac.bd*

ABSTRACT

In recent years, scientists are dedicated to design new antibiotics with increased bioactivity owing to emergence of antimicrobial resistance. In this sense, a series of halogen substituted thiophene containing Thiazole-Schiff base **(2a-2k)** were synthesized through two step synthetic pathways **(Scheme 1)**. The structures of the synthesized compounds were verified *via* spectral analysis, including IR, ^{1}H NMR and HRMS. In addition, the freshly synthesized compounds were assessed for their *in vitro* antimicrobial studies by agar disc diffusion method, where compound **2i** exhibited outstanding activity against gram-positive bacteria and gram-negative bacteria as compared with standard drug ceftriaxone, **2d** exhibited excellent antifungal activity as compared with standard amphotericin B. Moreover, the DPPH free radical scavenging method was employed to assess the antioxidant activity of the synthesized analogues. *In silico* molecular properties, drug-likeness, and ADMET predictions were evaluated. Molecular docking studies and MD simulations of the synthesized compounds were performed to get an insight of the binding profile of the ligand-protein complexes as well as to observe their stability. These findings will contribute to the potentiality of the synthesized derivatives in the proceeding drug designing and development process.



Compd.	R_1	R_2	Compd.	R_1	R_2
2a	H	Cl	2f	H	NO_2
2b	Br	H	2g	H	OCH_3
2c	NO_2	H	2h	H	Br
2d	H	OH	2i	H	H
2e	H	CN	2j	H	CH_3
			2k	H	

Scheme: Synthesis of halogen-substituted Thiophene containing Thiazole-Schiff base derivatives.

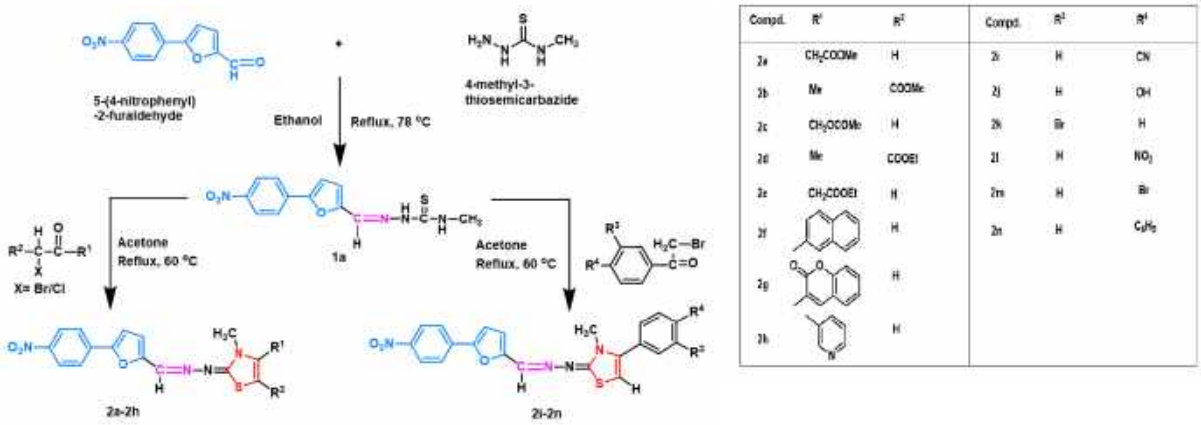
Paper ID: ICSHSD-384

Synthesis, Characterization, *In Vitro* Biological Activities, and *In Silico* Studies of Novel Thiazole-Schiff Base Derivatives Containing Furan Moiety

Md. Imtiaz Sultan[1], Md. Aminul Haque[1,*], and Mohammad Mostafizur Rahman[1,*]
[1]Department of Chemistry, Jagannath University, Dhaka-1100, Bangladesh
Corresponding email: mostafiz@chem.jnu.ac.bd

ABSTRACT

The synthesis of biologically active compounds containing thiazole, Schiff base, and furan moieties has a tremendously attractive individual interest among researchers. In this study, a series of new thiazole-Schiff base derivatives containing furan scaffolds was synthesized *via* two-step synthetic routes **(Scheme 1)**. All compounds were structurally characterized using spectroscopic techniques, including IR, ^{1}H NMR, and HRMS. The novel derivatives were screened for antimicrobial activities against twelve bacterial strains, and six fungal strains by agar disc diffusion method. Among all tested compounds, **2C** showed prominent potency against gram-positive bacteria *Listeria monocytogenes* (22.2 ± 0.5 mm), and gram-negative bacteria *Salmonella typhi* (23.4 ± 0.6 mm) compared to standard ceftriaxone (44.3 ± 0.5 mm). Furthermore, the antioxidant activity of scaffolds was investigated by DPPH free radical scavenging assays, where compounds displayed a potent **IC_{50}** value compared to standard ascorbic acid. In addition, *in silico* pharmacokinetics properties with drug-likeness, ADMET, and toxicological parameters were computed and analyzed. Moreover, molecular docking studies and MD simulations were performed for selected complexes to explore the possible binding interactions and stability.



Compd.	R^1	R^2	Compd.	R^3	R^4
2a	CH_2COOMe	H	2i	H	CN
2b	Me	COOMe	2j	H	OH
2c	CH_2COOMe	H	2k	Br	H
2d	Me	COOEt	2l	H	NO_2
2e	CH_2COOEt	H	2m	H	Br
2f		H	2n	H	C_6H_5
2g		H			
2h		H			

Scheme 1. Synthesis of furan-containing thiazole-Schiff base derivatives.

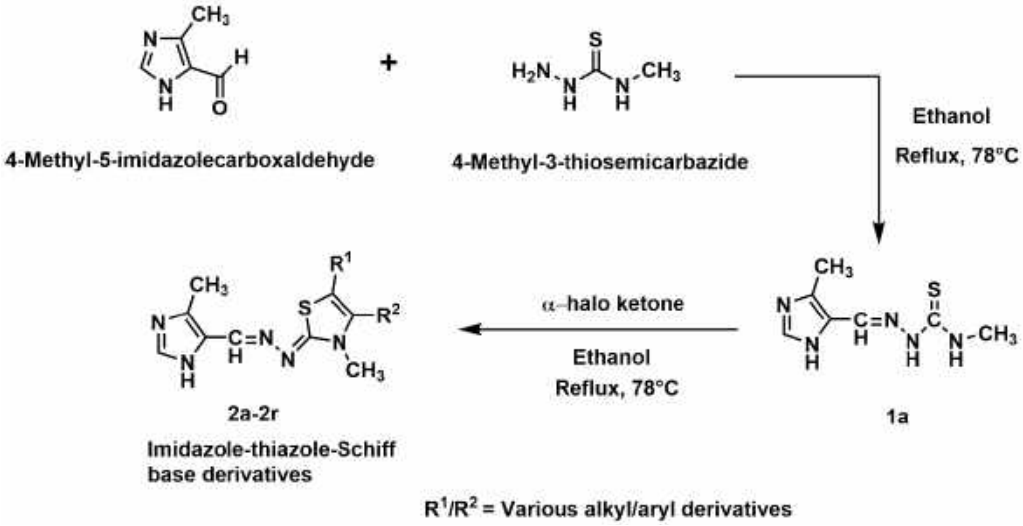
Paper ID: ICSHSD-387

Design, Synthesis, Molecular Docking, and Dynamics Studies of Imidazole-Containing Thiazole-Schiff Base Derivatives and the Assessment of Their Antimicrobial and Antioxidant Activity

Monika Das[1], Mohammad Mostafizur Rahman[1], and Md. Aminul Haque[1,*]
[1]Department of Chemistry, Jagannath University, Dhaka-1100, Bangladesh
Corresponding email: amin2k12@chem.jnu.ac.bd

ABSTRACT

The growing intensity of antimicrobial drug resistance and the increasing ineffectiveness of antibiotics threaten to reverse the progress made in the antibiotic era. To combat this situation, a two-step conventional approach was adopted to synthesize eighteen imidazole–thiazole–Schiff base derivatives (**2a- 2r**). The structures of the newly obtained compounds were confirmed through spectral characterization, including ^{1}H NMR, IR, and HRMS analyses. Antimicrobial activity was evaluated *in vitro* using the agar disc diffusion method, while antioxidant potential was assessed via the DPPH radical scavenging assay. Notably, several derivatives exhibited superior antimicrobial activity compared to the reference standard. *In silico* studies were also carried out, where ADMET profiling was performed to predict oral bioavailability. Furthermore, molecular docking, supported by molecular dynamics (MD) simulations, was conducted to investigate the binding interactions of the most active compounds with target receptor proteins, correlating with their observed antimicrobial and antioxidant activities.



Scheme: Synthesis of imidazole-thiazole-Schiff base derivatives.

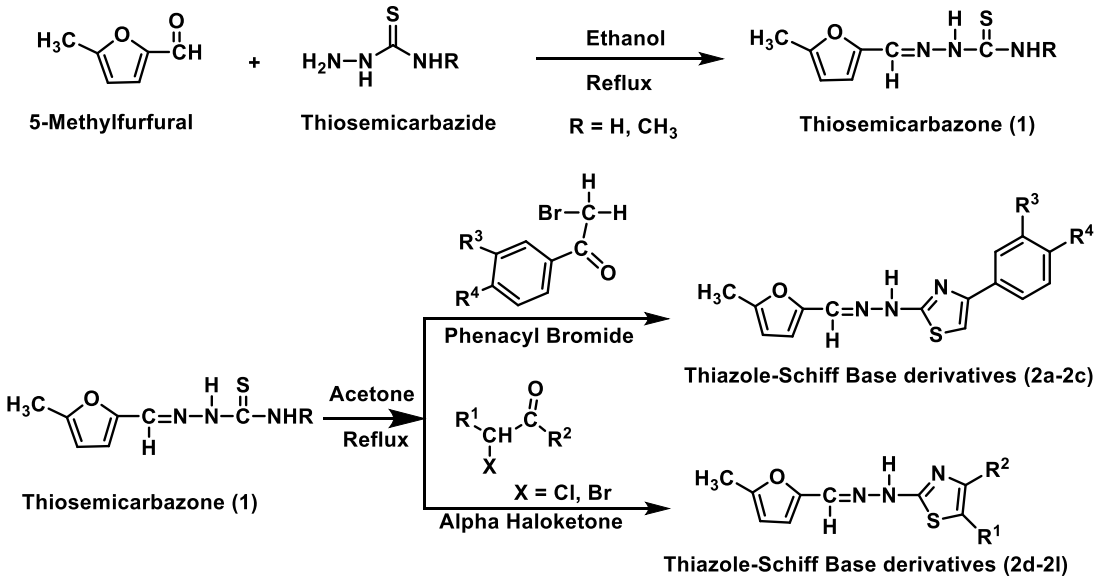
Paper ID: ICSHSD-391

Synthesis, Biological Activity, Molecular Docking and Dynamics Studies of Methylfuran-Thiazole Derivatives

Farid Uddin Ahmad[1], Mohammad Sayed Alam[1], Md. Aminul Haque[1,*], and Mohammad Mostafizur Rahman[1,*]
[1]Department of Chemistry, Jagannath University, Dhaka-1100, Bangladesh
Corresponding email: mostafiz@chem.jnu.ac.bd

ABSTRACT

From the last few decades, infectious diseases caused by microorganisms are the second prime cause of death. The reported resistance of microorganisms to several antimicrobial agents deteriorated the situation. Thiazole and thiazole-derived derivatives are the most important analogues in the sector of medicinal chemistry due to their wide varieties of biological activities. On the other hand, furan is a planer five-membered heterocyclic compound that occupied a unique place in the field of Medicinal Chemistry. In the present study, twelve novel thiazole-Schiff base derivatives containing furan moiety were synthesized *via* simple two step synthetic procedures where, the first step is the condensation of thiosemicarbazide with methylfurfural to yield thiosemicarbazone and the second step is the cyclization of thiosemicarbazone with alpha haloketones or phenacyl bromides (**Scheme 1**). The anti-microbial activities against nine gram-negative bacteria, four gram-positive bacteria, and six fungal strains were studied by disc diffusion method. Some of the synthesized compounds showed good antimicrobial activities. Computational studies of the synthesized compounds were also performed in support of experimental results. The promising antimicrobial activities of the compounds would be helpful for the development of future drug.



Scheme 1. Synthesis of Methylfuran-thiazole Schiff bases.

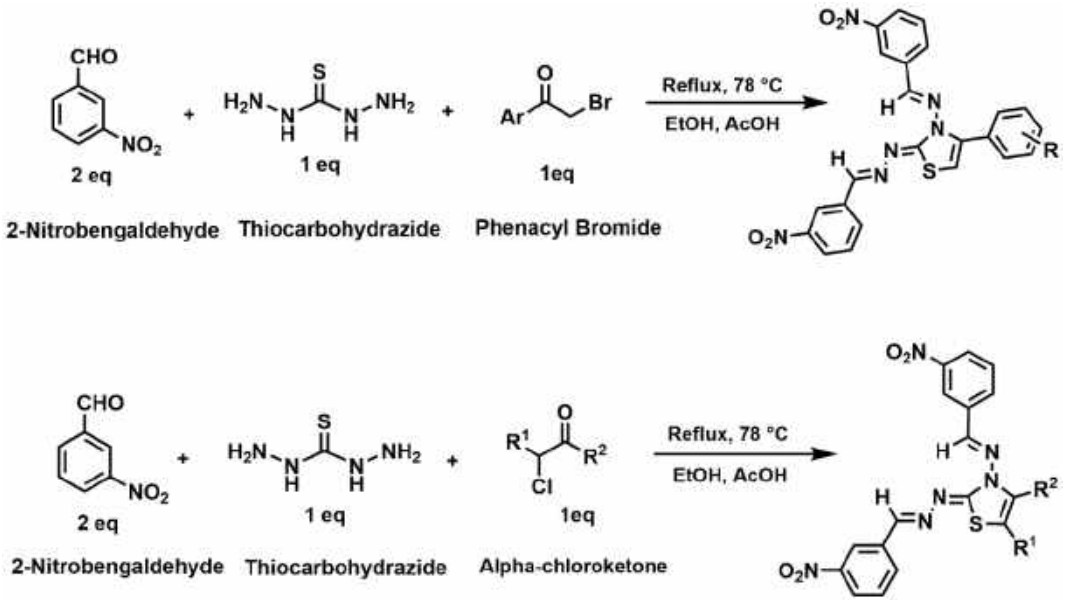
Paper ID: ICSHSD-392

Synthesis, Biological Activity and *In Silico*Admet Prediction and Docking Studies of Nitrobenzene-Based Substituted Thiazoles

Md. Khalilur Rahman[1], Md. Aminul Haque[1,*], and Mohammad Mostafizur Rahman[1,*]
[1]Department of Chemistry, Jagannath University, Dhaka-1100, Bangladesh
**Corresponding email: mostafiz@chem.jnu.ac.bd*

ABSTRACT

Morbidity and death caused by infectious diseases due to the development of antimicrobial resistance are a prime concern all over the world. The effectiveness of many commercial drugs is decreasing due to the rise of antimicrobial resistance. On the other hand, Reactive oxygen species (ROS) have a vital role in the formation of several serious diseases. So, it is an urgent need to discover and develop new antimicrobial drugs and antioxidant agents. Eleven hybrid thiazole derivatives were synthesized using a single-step, three-component synthesis protocol. In this single synthetic pathway, α-chloroketones and phenacyl bromides were incorporated to have a series of thiazole substituents along with nitrobenzaldehyde and thiocarbohydrazide. IR, ^{1}H NMR, and HRMS clarified the structures of the synthesized compounds. After confirming the structures of the synthesized analogues, antimicrobial activities of the compounds were evaluated using the agar disc diffusion method. For antimicrobial activity, nine gram-negative and four gram-positive bacteria, as well as five fungal strains, were used. Compound **1c** showed the maximum activity against *B. megaterium* and *P. notatum* compared to the standard ceftriaxone. On the other hand, the antioxidant activities of the derivatives were measured by DPPH free radical scavenging assays, where compounds displayed a potent IC_{50} value compared to standard ascorbic acid. Following the wet lab assays, various software was employed for *in silico* pharmacokinetics properties, with drug-likeness, ADMET, and toxicological parameters were computed and analyzed. Moreover, molecular docking studies were performed for selected complexes to explore the possible binding interactions and stability.



Scheme 1. Synthesis of nitrobenzene-based substituted thiazoles

Paper ID: ICSHSD-407

A Digital Survey on User-Reported Safety and Performance of Mobile Power Banks in Daily Use

Kazi Warisa Tabassum[1,*], Jannatul Ferdous[1], Nazmus Sakib Sami[1], and Md. Mortuza Ahmmed[2]
[1]Department of Computer Science, American International University- Bangladesh, Dhaka-1229, Bangladesh
[2]Department of Mathematics, American International University-Bangladesh, Dhaka, Bangladesh
*Corresponding email: 23-52623-2@student.aiub.edu

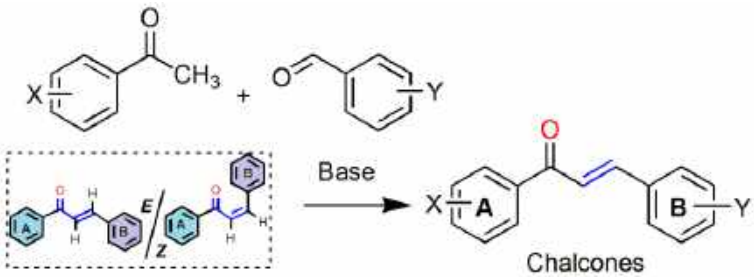
ABSTRACT
Mobile phones are essential in daily life. People often use power banks to keep them charged. However, problems like overheating, swelling, and leakage from low-quality power banks create safety risks. A digital survey offers a safe method to gather real-world user experiences on power bank performance and safety. This helps identify trustworthy brands and common issues while providing guidance on safer usage practices. The report looks at the safety and performance of mobile power banks based on user feedback. It also identifies common problems and heating issues. The survey data highlights reliable brands and safer usage practices to help users make informed decisions. A digital survey uses online forms to gather real-world user experiences with various power banks. Participants report their brand, capacity, charging duration, heating, leakage, and any safety issues. The data is described to find trends, common problems, and brand reliability without assuming any fixed outcomes. This method is safe and exploratory, based entirely on user-reported information. The survey shows that some brands are used more often and are usually seen as safe. Many users felt minor heat during extended charging sessions. However, a few mentioned swelling or leakage in low-quality power banks. In general, the data indicates that certified brands perform better and have lower safety risks. The study concludes that digital surveys offer a safe and effective method to evaluate user-reported performance and safety of power banks. It identifies common safety issues and trustworthy brands. This information helps users make informed choices. Overall, the study recommends safe usage practices based on patterns observed from user experiences.

Paper ID: ICSHSD-417

Synthesis dndDft Computational Study of Chalcone Derivatives

Rabeya Akter[1], Md. Wahidul Islam[2], and Md. Monarul Islam[1,*]
[1]Synthesis Laboratory, Chemical Research Division, BCSIR Dhaka Laboratories, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka-1205, Bangladesh
[2]Department of Chemistry, Gopalganj Science and Technology University, Gopalganj-8105, Bangladesh
Corresponding email: mmipavel@yahoo.com

ABSTRACT
Substituted chalcones containing nitro or methoxy groups were synthesized by Claisen–Schmidt condensation reaction to investigate their configurational isomerism and biological properties. Chalcones, a prominent class of *α*,*β*-unsaturated carbonyl compounds, are well recognized for their diverse pharmacological properties and structural versatility. Chalcones are important class of open-chain flavonoids, which have a wide range of applications in synthetic and medicinal chemistry. They are also promising intermediate to generate different types of heterocyclic rings.It is possible to synthesize a wide range of chalcone derivatives by treating aromatic aldehydes with aryl ketones in the presence of an appropriate amount of condensing agents for specific application and industrial uses. The chemical structures of the synthesized chalcones are confirmed by using spectroscopic techniques. To understand the electronic structure and molecular stability, Density Functional Theory (DFT) calculations were performed at the B3LYP/6-311++G(d,p) level.



Paper ID: ICSHSD-424

Phytochemical and Biological Studies on the Stem Bark of the Medicinal Plant *Calophylluminophyllum*Linn

Rahima Akter[1,*], Rima Akter[1], Md Aliul Azim Zim[1], Md. Farid Uddin[1], and Koushik Saha[1]
[1]Department of Chemistry, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh
**Corresponding email: rarita46147@gmail.com*

ABSTRACT

Calophylluminophyllum, locally known as Tamanu, is a tropical evergreen tree of the family Calophyllaceae and genus *Calophyllum*, native to the coastal regions of Bangladesh and widely recognized for its traditional medicinal applications. DPPH free radical scavenging assay exhibited that ethyl acetate extract showed significant free radical scavenging activity with IC50 value 22.90 µg/mL compared to standard ascorbic acid with IC50 value 6.04 µg/mL, while methanol extract showed moderately significant activity with IC50 value 68.64 µg/mL. Other extracts showed non-significant activity. The cytotoxicity study of the extracts exhibited that ethyl acetate extract has significant cytotoxicity with LC50 value 35.64 µg/mL compared to standard vincristine sulfate with LC50 value 3.57 µg/mL. Again, methanol and chloroform extracts showed good cytotoxicity (LC50 value 80.79 and 125.11 µg/mL, respectively) compared to standard while n-hexane extract showed non-significant cytotoxicity compared to standard. Phytochemical study on the stem bark of *C. inophyllum*has resulted the isolation of two compounds from n-hexane and methanol extracts. Among this, RCI-2was isolated for the first time from the stem bark as well as from the plant *C. inophyllum*Linn.

Paper ID: ICSHSD-428

Effect of $NaBH_4/AgNO_3$ Ratio on Size Control and Long -Term Electrostatic Stabilization of Silver Nanoparticles

M. Habibur Rahman[1,*], M. Nabul Sardar[1], Shah-Alam, Arzuma Aktar[1], Md Mahadi Hasan,[1]M. Shahinur Rahaman[1], AAS Mostofa Zahid[1], M. Shamim Hossan[1] and M. Nazrul Islam[1]
[1]Department of Chemistry, University of Rajshahi, Rajshahi-2205, Bangladesh
**Corresponding email: mhr@ru.ac.bd*

ABSTRACT:

The size of electrostatically stabilized silver nanoparticles can be controlled by simply varying the initial ratio (**R**) of the amounts of sodium borohydride ($NaBH_4$) to silver nitrate ($AgNO_3$) in aqueous solutions used for the preparation of stable silver nanoparticle dispersions. Excess borohydride ions used for the synthesis provided electrostatic stabilization to the dispersion by dynamically adsorbing on the nanoparticle surface. The position of the surface plasmon resonance bands of the nanoparticles in UV-Visible Spectra regularly shifted to lower wavelengths as R in the reaction mixture increased, indicative of a regular decrease in the size of the silver nanoparticles. This was confirmed from the measurement of the z-average size of the nanoparticles by the Dynamic Light Scattering (DLS) technique. Monitoring the absorbance of the surface plasmon resonance band for months and the z-average size and Zeta-potential values obtained from the DLS data clearly demonstrated that the stability of the prepared nanoparticle dispersions was an increasing function of R. Furthermore, the $NaBH_4/AgNO_3$ ratio also influenced the appearance and intensity of bimodality in the nanoparticle size distribution.

Paper ID: ICSHSD-431

Hydrothermal and Microwave Synthesis of Folic-Acid-derived Carbon Dot–assisted EDTA-Modified Mg–Al LDH

Suma Akter[1], Mir Tamzid Rahman[1,*], Md. Ayub Ali[1], Md Mizanur Rahman[1], and MasumBillah Siam[1]
[1]Department of Chemistry, Jahangirnagar University, Savar, Dhaka -1342 Bangladesh
**Corresponding email: mtrchem@juniv.edu*

ABSTRACT

Uranium contamination in water represents both a chemical and radiological hazard to human health and ecosystems, necessitating the development of cost-effective, selective, and regenerable treatment materials that can be employed in decentralized settings. In this study, a novel hybrid adsorbent was synthesized by integrating EDTA-functionalized Mg–Al layered double hydroxide (LDH) with folic-acid derived carbon dots (C-dots). Two synthesis routes—hydrothermal assembly and microwave irradiation—were explored. The composite design relies on the chelating strength of EDTA combined with the abundant oxygen- and nitrogen-rich functional groups of C-dots (–COOH, –OH, $–NH_2$), providing highly compatible sorption sites for uranyl ions. The hydrothermal method was conducted in a autoclave at 120oC,24 hours and Microwave process was conducted at power-50, 5 mins. Preliminary characterizations confirmed successful composite formation. X-ray diffraction (XRD) patterns showed peaks at 11.4, 22.7, 34.9 and 45.3 degree indication the presence of characteristic hydrotalcite reflections of LDH. Ultraviolet–visible spectroscopy of the C-dots showed absorption peaks near 280 nm and around 360 nm, characteristic of aromatic $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ transitions, confirming C-dot formation. Fourier transform infrared (FTIR) spectra revealed broad O–H/N–H stretching near 3400 cm^{-1}, conjugated C=C bands near 1610 cm^{-1}, N–H stretching around 1510 cm^{-1}, C–H bending near 1440 cm^{-1}, and C–O bands at 1180 cm^{-1}, further verifying the incorporation of EDTA and C-dot chemistry on the LDH surface. Ongoing studies will evaluate Uranium(VI) adsorption capacity, kinetics, thermodynamics, selectivity in multi-ion systems, and regeneration efficiency to determine optimal synthesis conditions. It is anticipated that the EDTA–C-dot–LDH composites will demonstrate synergistic improvements in uranium uptake compared to unmodified LDH, with microwave-derived samples showing enhanced adsorption rates and hydrothermal products exhibiting greater structural stability. This dual-pathway approach highlights the potential of functionalized LDH–carbon dot hybrids as efficient adsorbents for uranium remediation from contaminated water sources.

Paper ID: ICSHSD-439

Recycling Spent Dry Cells into rGO/MnO_2 Nanocomposites for Advanced Supercapacitor Electrodes

Othai Saha[1,3], Md Humayun Kabir[2,*], Md. Mazharul Islam[3], Md. Sanwar Hossain[1], and Sabina Yasmin[1,*]
[1]Institute of National Analytical Research and Service (INARS), Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka-1205, Bangladesh
[2]Institute of Food Science and Technology (IFST), Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka-1205, Bangladesh
[3]Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
**Corresponding email: sabinayasmin@bcsir.gov.bd; humayunkabir@bcsir.gov.bd*

ABSTRACT

Electronic waste (e-waste) poses a critical environmental challenge due to improper disposal, leading to pollution, ecosystem degradation, and resource depletion. Addressing this issue, we present an innovative solution by repurposing e-waste into high-performance energy storage materials. This study demonstrates the successful synthesis of a cost-effective rGO/MnO_2 nanocomposite entirely derived from waste dry cell batteries for supercapacitor applications. Structural and morphological characterizations (FT-IR, XRD, SEM, TEM) confirmed the formation of a porous nanocomposite with a large surface area, promoting efficient charge storage and ion transport. Electrochemical tests using CV, GCD, and EIS in 1 M KOH (three-electrode setup) confirmed the excellent performance of the rGO/MnO_2 nanocomposite. It achieved a high specific capacitance of 532 F g^{-1} at 1 A g^{-1}, surpassing individual rGO and MnO_2 electrodes. Additionally, the composite delivered a high-power density of 350 W kg^{-1} at an energy density of 36.22 Whkg[1]. It also retained 80% capacity after 1500 cycles. Furthermore, impedance spectroscopy revealed low charge transfer resistance and rapid ion diffusion, indicating favorable charge kinetics. This sustainable approach for converting e-waste into advanced supercapacitor materials represents significant progress toward green energy technologies.

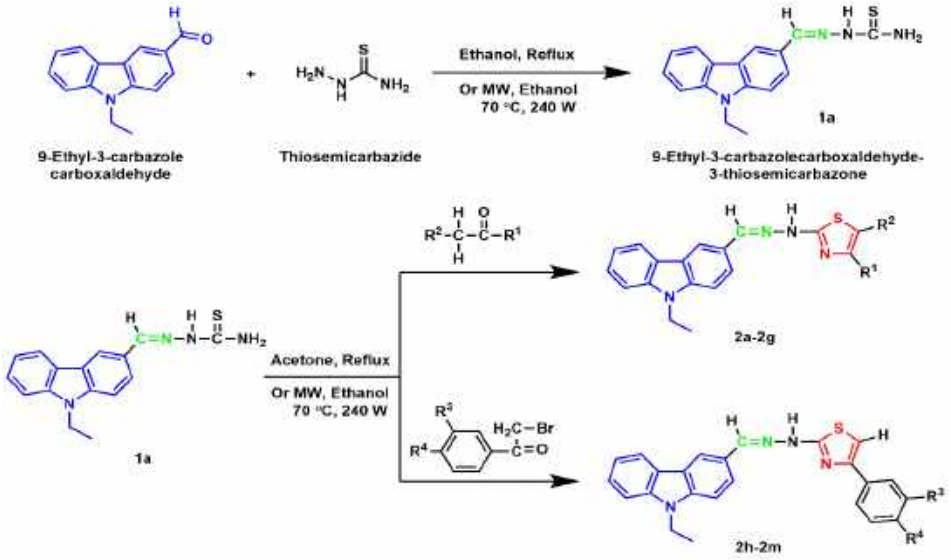
Paper ID: ICSHSD-446

Conventional and Microwave-assisted Synthesis, Antimicrobial and Anti-Oxidant Activity Evaluation with *In Silico* Studies of Carbazole-Thiazole-Schiff Base Hybrids

Sumita Saznin Marufa[1], Mohammad Mostafizur Rahman [1], Mohammad Syed Alam[1], and Md. Aminul Haque[1,*]
[1]Department of Chemistry, Jagannath University, Dhaka-1100, Bangladesh
**Corresponding email: amin2k12@chem.jnu.ac.bd*

ABSTRACT

The intensifying global concern over antimicrobial resistance (AMR) has highlighted the therapeutic potential of heterocyclic compounds, owing to their versatile biological activities and strong affinity for target proteins. In this study, thirteen carbazole-thiazole-Schiff base hybrids (**2a–2m**) were synthesized using both conventional and microwave irradiation (MWI) methods. MWI-assisted synthesis was a benign approach to green synthesis, owing to its minimal reaction time and solvent usage. The structures of the synthesized derivatives were confirmed by means of spectral analytical data. All the compounds were evaluated for dual biological potency, i.e., antimicrobial and antioxidant activity. The tested analogues showed some modest antimicrobial activity, and compounds **2f** and **2i** exhibited higher antioxidant activity compared to the standard ascorbic acid. Oral bioavailability and adverse effects of the new entities were considered based on druglikeness descriptors, with no violation of Lipinski's rule of five and Veber's rule for the synthesized compounds, except for **2i**, **2l**, and **2m**. The compounds that exhibited relatively high activity were explored further for molecular docking studies to understand the mode of binding interactions with the receptor protein. Molecular dynamics (MD) simulation was further studied to predict the stability of selective compounds inside the receptors, which was well in agreement with wet lab outcomes.



Scheme: Synthetic route of carbazole-thiazole-Schiff base hybrids.

Paper ID: ICSHSD-454

Synthesis, Characterization and Antimicrobial Evaluation of Azo-Functionalized Schiff Bases against Plant Pathogens

Mamiya Chowdhury[1], Md. Eanur Rahman[2], Sanjoy Belwar[3], Rummana Islam[4], Md. Shamim Akhter[4], Fatema Tuzzohora Islam[5], and N. M. Mofiz Uddin Khan[2,*]

[1]Department of Chemistry, Tennessee Tech University, Cookeville, USA
[2]Department of Chemistry, Dhaka University of Engineering & Technology, Gazipur, Gazipur-1707, Bangladesh
[3]Department of Natural Science, BGMEA University of Fashion and Technology, Dhaka-1230, Bangladesh
[4]Plant virology lab, Plant Pathology Division, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh
[5]Department of theoretical and computational chemistry, University of Dhaka, Dhaka-1000, Bangladesh
Corresponding email: mofizchemdu@duet.ac.bd

ABSTRACT

Azo compounds are organic molecules characterized by the presence of a –N=N– (azo) group, known for their vivid colors and versatile applications in dyes and medicinal chemistry. Schiff bases are compounds containing a –C=NR functional group, formed by the condensation of an amine with a carbonyl compound, and are recognized for their structural diversity and biological activities. Combining these two, azo-Schiff bases integrate the azo and Schiff base functionalities in a single molecule, offering enhanced chemical versatility and promising biological properties, making them valuable in antimicrobial and pharmaceutical research. Pathogenic microorganisms pose a significant global health challenge, driving the need for biologically active scaffolds with enhanced antimicrobial efficacy. Consequently, Schiff bases and azo compounds have generated a lot of interest due to the ease of synthesizing these compounds, structural diversity, and known medicinal properties. In this study, two azo-functionalized Schiff bases were synthesized, characterized, and evaluated for their antimicrobial potential with a particular focus on plant pathogens. The synthesis involved producing an intermediate azo aldehyde, (E)-4-((3-formyl-4-hydroxyphenyl)diazenyl)be nzenesulfonamide, which was subsequently used to synthesize the target Schiff bases SB-1 (4-((3-hydroxy-4 (((4methoxyphenyl)imino)methyl)phenyl)diazenyl) benzenesulfonamide) and SB-2 (4-((4-((ethylimino)methyl) 3-hydroxyphenyl)diazenyl)benzenesulfonamide). The reactions yielded moderate results (SB-1: 35.25%; SB-2: 22.13%), and product formation was confirmed via TLC. Additionally, FTIR, NMR, and UV-Vis spectroscopy verified the structures. Specifically, FTIR showed hydroxyl (3448–3452 cm^{-1}), imine (1635–1647 cm^{-1}), and azo (1508–1514 cm^{-1}) groups. Moreover, UV-Vis spectra revealed $\pi \rightarrow \pi^*$ transitions with hypsochromic shifts for SB-1 (266, 398 nm) and SB-2 (268, 354 nm). Furthermore, ^1H NMR for SB-1 displayed aromatic protons (δ 6.76–8.06 ppm), imine (δ 8.72 ppm), hydroxyl (δ 14.20 ppm), sulfonamide $–NH_2$ (δ 7.47 ppm), and ethyl signals (δ 1.30 ppm), while SB-2 showed methoxy (δ 3.81 ppm), hydroxyl (δ 14.28 ppm), azomethine (δ 9.16 ppm), and aromatic protons (δ 7.05–8.31 ppm), confirming their molecular structures. Furthermore, SB-1 and SB-2 were evaluated for antimicrobial activity. Notably, SB-2 exhibited 62.5% inhibition against *Ralstonia solanacearum* at 1000 ppm, while SB-1 showed 77.14% inhibition against *Sclerotium rolfsii* at 1.8 ppm on day 3, and SB-2 achieved 71.43% under the same conditions. These findings suggest SB-2 has greater antibacterial potential, while SB-1 excels as a rapid antifungal agent, positioning them for future development as targeted agricultural treatments.

Paper ID: ICSHSD-455

Enhanced Degradation of Waste Engine Oil by Immobilized Pseudomonas Sp. In B-Cd Nanosponge–Sodium Alginate Matrix

Abu Bin Imran[1,*], Md. Mahbub Alam[1], and Sharif Neaz[1]
Department of Chemistry, Bangladesh University of Engineering and technology, Dhaka-1000, Bangladesh
**Corresponding email: abimran@chem.buet.ac.bd*

ABSTRACT

Accidental or intentional engine oil spills increase environmental contamination. Used engine oil is particularly challenging to degrade due to its high content of heavy metals resulting from engine wear. While various physical and chemical methods have been employed to remediate oil-contaminated soils, bioremediation remains the most cost-effective and eco-friendly approach, especially for restoring damaged soils. This study aimed to isolate and identify efficient oil-degrading bacteria from soil samples collected at three different auto workshops in Mirpur, Dhaka, Bangladesh. After nine days of aerobic incubation, Pseudomonas sp. emerged as the most effective degrader, achieving 89% degradation efficiency of 1% (v/v) spent engine oil. The degradation was optimal at 1% concentration, while no significant breakdown occurred at 3% (v/v), indicating a threshold for microbial tolerance and activity. To enhance the stability and reusability of the bacterial strain, immobilized beads containing Pseudomonas sp., β-cyclodextrin nanosponges, and sodium alginate were developed. The immobilized cells demonstrated a superior ability to use spent engine oil as the sole carbon source and produced biosurfactants that facilitated hydrocarbon breakdown. Compared to free cells, the immobilized system showed enhanced degradation of the major constituents of motor oil in batch cultures. Furthermore, phytotoxicity assays confirmed the non-toxic nature of the metabolites produced during the biodegradation process, supporting the environmental safety of this bioremediation strategy. These findings suggest that immobilized Pseudomonas sp. could be effectively applied in field conditions to remediate soils contaminated with used motor oil.

Paper ID: ICSHSD-458

Turning Citrus Waste into Functional Nutrition: A Comprehensive Study on Bakery Products Development Using Fruit Peel Powders

Nowshin Tarannum Orin[1], Rahadul Islam Auvi[1], Md. Ashikur Rahman[2], and Farzana Rahman[1,*]
[1]Department of Nutrition and Food Engineering, Daffodil International University, Dhaka-1216, Bangladesh
[2]Institute of Food and Radiation Biology, Bangladesh Atomic Energy Commission, Dhaka-1207, Bangladesh
**Corresponding email: frahman.nfe@diu.edu.bd*

ABSTRACT

The growing interest in functional foods has driven the exploration of natural by-products, such as citrus peel powders, for their health benefits and potential to enhance food quality. Rich in bioactive compounds, dietary fiber, and antioxidants, citrus peels can improve both the nutritional value and sensory attributes of bakery products. This study investigated the effects of incorporating orange, Malta, lemon peel powders into bread and cookies at substitution levels of 0%, 4%, 6%, 8%, assessing their impact on sensory characteristics, proximate composition, and antimicrobial activity. Composite flours were prepared by partially replacing wheat flour with citrus peel powders; standardized baking procedures were applied to produce bread and cookie samples. The results revealed that citrus peel powders (orange, lemon, Malta) exhibited superior functional properties, including water absorption between 75 and 85 percent compared to 65 percent in Akij wheat flour, oil holding capacity ranging from 2.5 to 3.0 grams per gram compared to 1.8 grams per gram, and emulsion activity between 45 and 50 percent compared to 30 percent, indicating improved dough quality. Phytochemical analysis showed high levels of total phenols (120–135 mg GAE/g), flavonoids (85–95 mg QE/g), β-carotene (4.0–5.5 mg/100g), correlating with strong antioxidant activity (DPPH IC50 ~ 20–25 µg/mL). Proximate analysis revealed increased crude fiber (bread 0.8–1.6%, cookies 0.6–1.5%), minerals (ash: bread 1.3–2.1%, cookies 0.9–1.8%) with peel addition, while moisture, fat content remained stable, preserving texture. Anti-nutritional factors (phytate, oxalate, tannin, saponin, alkaloids) stayed within safe limits. Citrus peel enhanced antimicrobial activity, increasing inhibition zones against *Staphylococcus aureus* from 10 mm to 18 mm (8% orange peel) and moderately inhibiting *E. coli* and *Salmonella* (8–14 mm), suggesting improved food safety and shelf life. Collectively, these results highlight the functional, nutritional, and safety-enhancing benefits of citrus peel powders, outperforming standard commercial flour in key parameters. Sensory evaluation using 9-point Hedonic Scale showed that bread with 6–8% citrus peel scored highest for taste and appearance, while aroma and texture stayed consistent. For cookies, appearance, taste, aroma, and overall acceptability were rated highly, though texture varied more. Cookies with 8% Malta peel had especially better taste and acceptability. These results suggest that up to 8% citrus peel powder can be safely added to bread and cookies to improve their taste and quality. Overall, the study shows that citrus peel powders are useful ingredients that boost nutrition, flavor, safety, and help reduce food waste.

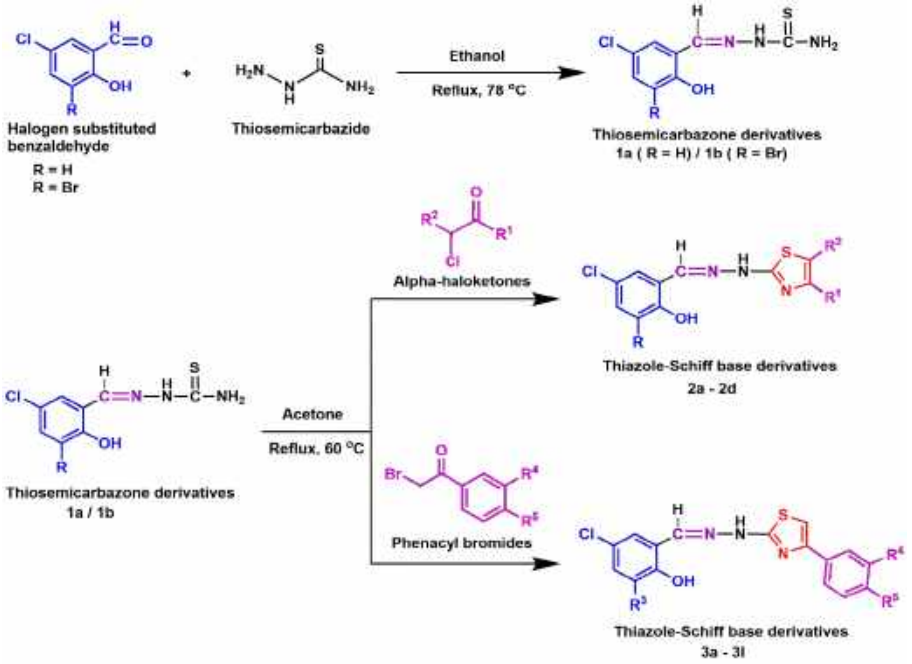
Paper ID: ICSHSD-463

Halogen Substituted Benzene Ring Containing Novel Thiazole-Schiff base Analogous: Synthesis, Antimicrobial and Antioxidant Evaluation as well as *in silico* ADMET properties prediction along with Molecular docking, MD simulation and Dynamics Study

Md. Shaon Islam[1], Shathi Bala[1], Mohammad Mostafizur Rahman[1], and Md. Aminul Haque[1,*]
[1]Department of Chemistry, Jagannath University, Dhaka-1100, Bangladesh
Corresponding email: amin2k12@chem.jnu.ac.bd

ABSTRACT

In this study, a series of sixteen thiazole-Schiff base derivatives were synthesized and characterized via spectral techniques including IR, ^{1}H NMR, and HRMS. Antimicrobial susceptibilities of the synthesized analogous were investigated via *in vitro* disc diffusion method, where compound **2a** and **2c** exhibited notable zone of inhibition against gram-positive bacteria *B. subtilis* (16.1 ± 0.3 mm) and gram-negative bacteria *E. coli (*16.0 ± 0.4). On the other hand, compound **3a** revealed outstanding activity against the fungal strains of *A. niger* (19.1 ± 0.7 mm). Furthermore, compound **3d** showed antioxidant activity with the value of IC_{50} = 53.77 ± 1.42, which is close to the standard ascorbic acid (IC_{50} = 49.67 ± 3.38). Oral bioavailability and toxicological parameters were considered, and most of the compounds satisfied Lipinski's rule of five and Veber's rule, except a few derivatives. The *in silico* molecular docking was performed against four protein co-crystals for the compounds that exhibited highest activity in the *in vitro* experiment, where compound **2a**, **2c**, **3a** and **3d** showed acceptable binding interactions with the selected proteins. The stability of the protein-ligand binding profiles was evaluated by molecular dynamic (MD) simulations and each compounds revealed stable binding interaction throughout the 30 ns trajectory along with marginal conformational changes of the complexes. Overall, compound **2a** appeared as most promising candidate, showing outstanding performance in both wet lab activities and *in silico* approaches.



Scheme 1. Synthesis halogen-substituted benzene containing Thiazole-Schiff base derivatives.

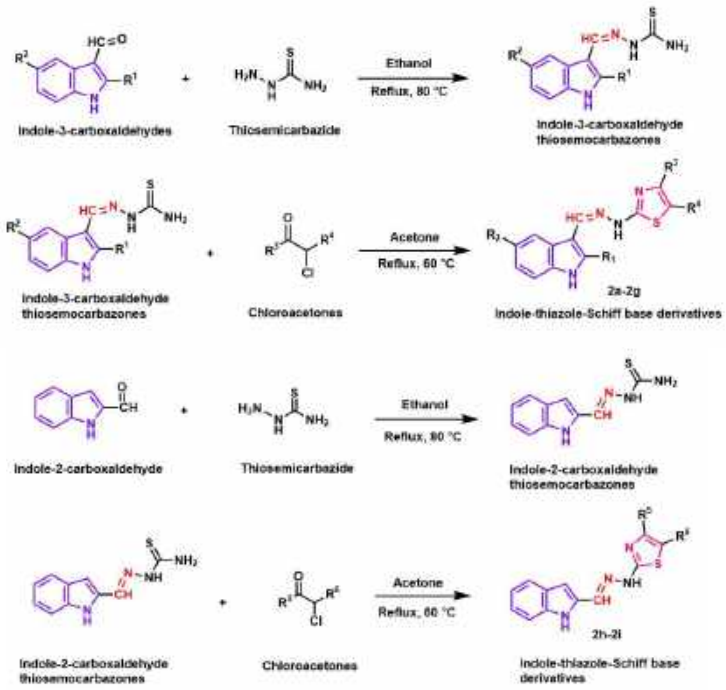
Paper ID: ICSHSD-464

Indole-Thiazole-Schiff Base Hybrids: Synthesis, Antimicrobial and Antioxidant Activity with ADMET Prediction, Molecular Docking and Dynamics Studies

Laila Jahan Nabila[1], Saima Rahman[1], Mohammad Mostafizur Rahman[1*], and Md. Aminul Haque[1,*]
[1]Department of Chemistry, Jagannath University, Dhaka-1100, Bangladesh
**Corresponding email: amin2k12@chem.jnu.ac.bd; mostafiz@chem.jnu.ac.bd*

ABSTRACT

A two-step conventional method was employed to synthesize nine indole-thiazole-Schiff base derivatives (**2a–2i**). The structures of the newly synthesized derivatives were confirmed and characterized by spectral analysis, namely ^{1}H NMR, IR, and HRMS. For in vitro analysis, the agar disc diffusion method was used to check the antimicrobial activity, and the DPPH scavenging assay was performed for antioxidant activity. Compound **2g** revealed the maximum antimicrobial activity, whereas compound **2d** (IC 50 of 33.40 ± 0.17 µg/mL) displayed excellent antioxidant capability compared to standard ascorbic acid (IC 50 of 41.31 ± 1.83 µg/mL). For in-silico analysis, ADMET properties were calculated to evaluate the oral bioavailability of the compounds as drugs. Compounds **2d** and **2g** were subjected to molecular docking for their high activity in antimicrobial and antioxidant assays, respectively. Moreover, molecular dynamics (MD) simulation was executed to assess the binding interactions and stability of the complexes.



Scheme: Synthetic route of indole-thiazole-Schiff base hybrids **2a-2i**

Paper ID: ICSHSD-467

Investigating Functional Properties of Several Binaphtholpyridyl Compounds and Substituted Schiff Base Derivatives

Md. Sadiqul Hasan[1], Bikash Dev Nath[1,*], Subarna Sandhani Dey[2], Abhijit Chowdhury[2], Md. Sharif Hossain[3], Md. Shahabuddin[1], and Ummey Rayhan[1]

[1]Department of Chemistry, Dhaka University of Engineering &Technology, Gazipur, Gazipur-1707, Bangladesh
[2]IFST, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka-1205, Bangladesh
[3]Department of Chemistry and Life Science, Yokohama National University, Yokohama, Kanagawa 240-0067, Japan
**Corresponding email: bikashchem@duet.ac.com*

ABSTRACT

Synthesis of multifunctional organic compounds is very challenging, but highly significant. Compounds with anti-microbial, anti-oxidant and metal chelating properties along with significant catalytic activities may find valuable applications in various industries due to their ability to combat various microorganisms, prevent oxidation in the body and control heavy metal ions in industrial waste water. In this study, three binaphthol-based substituted pyridyl compounds, **A**-**C** and the multinuclear Zn(II) and Ni(II) complexes, **D**-**E** of compound, **B** were evaluated for their anti-microbial and anti-oxidant properties. The catalytic activity of compound **A** in conversion of CO_2 and styrene oxide into cyclic carbonate was also studied. Metal complexes, **D**-**E** exhibited significant inhibition zone against all the bacterial and fungal strains tested. Zn(II) complex, **D** showed the highest anti-bacterial activity against Listeria monocytogenes ATCC 13932 with inhibition zone (IZ): 12.75 mm, whereas, Ni(II) complex, **E** showed the highest activity against Staphylococcus aureus ATCC 6538 with inhibition zone (IZ): 10.5 mm. Zn(II) complex, **D** and Ni(II) complex, **E** also exhibited significant antifungal activities against Candida albicans ATCC 10342 with inhibition zones of 12 mm and 11.5 mm respectively. Compound, **C** also showed significant antioxidant activity with the calculated IC50 value being 164.82 ppm. As a catalyst, compound **A** showed 41.0 % NMR conversion of cyclic carbonate from styrene oxide and CO_2 without any solvent and co-catalyst, the conversion reached to 55.0 % upon the addition of $Ni(OAc)_2.4H_2O$ alongside compound **A**. The compounds, **A**-**C** are also expected to exhibit significant metal chelating properties due to the presence of different chelating groups in their structural moieties and we will also investigate that. Moreover, we will also synthesize different substituted Schiff base derivatives by accommodating various important functional groups in their structural moieties. The synthesized Schiff-base derivatives due to the presence of their characteristic imine (>C=N-) groups along with various other important functional groups in their structural moieties are expected to be highly effective in exhibiting significant antimicrobial, antioxidant, anti-cancer, and metal chelating properties.

Paper ID: ICSHSD-468

Synthesis, Computational Studies and Biological Evaluation of Several 1,4-Diamino Benzene-based Schiff base Derivatives

Bikash Dev Nath[1], Md. Monarul Islam[2,*], Abhijit Chowdhury[3], Kabir M Uddin[4], Shofiur Rahman[5], Md. Sharif Hossain[6], and Paris E. Georghiou[7]

[1]Departmentof Chemistry, Dhaka University of Engineering &Technology, Gazipur, Gazipur-1707, Bangladesh
[2]Chemical Research Division, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka-1205, Bangladesh
[3]IFST, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka-1205, Bangladesh
[4]Department of Biochemistry and Microbiology, North South University, Dhaka-1229, Bangladesh
[5]Biological and Environmental Sensing Research Unit, King Saud University, Riyadh 11451, Saudi Arabia
[6]Department of Chemistry and Life Science, Yokohama National University, Yokohama, Kanagawa 240-0067, Japan
[7]Department of Chemistry, Memorial University of Newfoundland, St. John's, NL A1C 5S7, Canada
Corresponding email: mmipavel@yahoo.com

ABSTRACT

Schiff base derivatives exhibit important biological properties due to the presence of imine or azomethine (-C=N-) group in their structures. However, the biological activities of Schiff base derivatives may significantly be enhanced by introducing hydroxyl (-OH) and nitro (-NO_2) groups in their structures. Moreover, the presence of two imine or azomethine (-C=N-) groups in the structures of Schiff bases is expected to enhance their biologial properties even further. Keeping this in mind, we have synthesized several 1,4-diamine-based Schiff base derivatives, **A-D** containing hydroxyl (-OH) and nitro (-NO_2) groups. As expected, the synthesized compounds, **A-D** containing two imine or azomethine (-C=N-) groups along with the presence of hydroxyl (-OH) or nitro (-NO_2) group in their structures have shown enhanced biological activities which is also evident from the higher anti-bacterial activity of the synthesized Schiff base derivative, **B** than that of the conventional anti-bacterial drug, chloramphenicol against *Listeria monocytogenes* ATCC 13932. Schiff base derivative, **B** also showed comparable anti-fungal activity as the standard drug, azoxystrobin (AZ) against the fungal strain, *Candida albicans* ATCC 10342. All the Schiff base derivatives, **A-D** have also been tested for their cytotoxicity against a human lung cancer cell line (A549, CSL, Germany) which showed moderate cytotoxicity. DFT configurational studies of the compounds, A-D have confirmed that they exhibit interesting double bond geometry along with their different configurational arrangements. The structure-activity relationship of the compounds has been investigated through the extensive computational study of their different structural features. The compounds have also been docked to the crystal structures of the target proteins/enzymes to observe the binding modes of the compounds with the target proteins/enzymes. The computational studies of the compounds, **A-D** have perfectly complemented the experimental results obtained against different anti-microbial agents.

Paper ID: ICSHSD-471

AI-Driven Smart Irrigation and Crop Monitoring System for Empowering Rural Farmers

Rashidul Islam Sifat[1,*]

[1]Department of EEE, Dhaka University of Engineering & Technology, Gazipur, Gazipur-1707, Bangladesh
Corresponding email: sifatduet01@gmail.com

ABSTRACT

Water scarcity, inefficient irrigation, and climatic uncertainty are a few of the greatest concerns for small and medium-scale rural farmers. The present study proposes an AI-based smart irrigation and crop monitoring system that focuses on water optimization, improving the productivity of crops, and sustainable agriculture with particular reference to social impacts on rural farmers. The system integrates soil moisture sensors, humidity and temperature sensors, an ESP32 microcontroller, and solar-powered automation to facilitate data-driven decision-making in irrigation in real time. The collected data is processed through machine learning algorithms to predict crop water requirements, detect early signs of crop stress, and suggest optimal irrigation schedules to reduce water and manual labor wastage. In addition to technology, the system focuses on accessibility and ease of use for the local farmers. It incorporates mobile and web interfaces with simple dashboards, enabling farmers to monitor and control irrigation remotely. This approach promotes knowledge sharing, social inclusion, and community empowerment by providing rural farmers with decision support tools for farming. By leveraging IoT and AI, the system creates resilience to climate variability, ensures efficient resource management, and enables rural livelihood improvement. Field trials demonstrate that the system can reduce water consumption by a significant margin without reducing or even improving crop yields, making it an economical alternative for smallholder farming. The project demonstrates how the convergence of emerging technology and social interests can facilitate sustainable and socially responsible farming practices.

Paper ID: ICSHSD-480

A Novel Schiff Base Ligand As a Dual-functional Colorimetric Senor for Pb^{2+} Detection and Potential Antileishmanial Agent: Synthesis, Spectroscopic Characterization, DFT and Docking Studies

Joardar Gim[1], Zannatul Kowser[1,*], Most Tahera Khatun[1], Miss. Tasnim Jahan[1], Redika Sarmin Prieety[1], Dipa Debnath[1], Sahara Khatun Munni[1], and Rashedul Islam[1]
[1]Department of Chemistry, Jashore University of Science and Technology, Jashore-7408, Bangladesh
**Corresponding email: zannatulkowser_che@just.edu.bd*

ABSTRACT
The development of multifunctional molecular probes for selective heavy metal detection and biological applications has gained significant attention in recent years. In this study, a novel Schiff base moiety, *4-(((2-mercaptophenyl)imino)methyl)benzene-1,3-diol* (L), has been successfully synthesized and structurally confirmed by ATR-FTIR, UV–Vis, ^{1}H NMR, ^{13}C NMR, and FESEM analyses. The photophysical properties of L were systematically investigated, revealing a distinct and selective colorimetric response towards Pb^{2+} ions, visible to the naked eye, while showing excellent selectivity over competing cations such as Na^+, K^+, Li^+, Ag^+, Sn^{2+}, Cd^{2+}, Hg^{2+}, Zn^{2+}, Fe^{2+}, Co^{2+}, and Mg^{2+}. In its free state, L exhibits absorption bands at 204 nm and 298 nm. Upon complexation with Pb^{2+}, a new band appears at 236 nm, accompanied by a red shift of the 298 nm band to 324 nm, confirming strong ligand-to-metal charge transfer (LMCT). Job's plot analysis indicated a 2:1 ligand-to-metal binding stoichiometry, while the association constant (K_a) was calculated to be 5.39×10^8 M^{-1}. The detection limit (LOD) of 3.27 µM highlights the high sensitivity of L toward Pb^{2+} ions. The binding interaction was further supported by Density Functional Theory (DFT) calculations, which provides valuable insight into the electronic transitions and stabilization of the L–Pb^{2+} complex, consistent with experimental findings. In addition to its sensing performance, L also exhibited strong antioxidant potential, as evidenced by the DPPH free radical scavenging assay. To explore its potential biological relevance, in silico molecular docking studies were performed against a Leishmania target protein. The Schiff base L exhibits a notable binding energy of −7.7 kcal mol^{-1}, suggesting significant affinity and potential anti-leishmanial activity. Overall, this study demonstrates that the Schiff base ligand L functions as a dual-purpose compound, combining high-performance Pb^{2+} detection in aqueous medium with promising biological activity. These findings position L as a potential candidate for the development of multifunctional molecular systems with both environmental sensing and therapeutic applications.

Paper ID: ICSHSD-481

Design, Synthesis, In-Vitro Evaluation, Molecular Docking, and Admet Studies of Novel Functionalized Coumarin-Thiazole Hybrids

Fahmida Kamal[1], Md. Sakhaoyat Hossain[1], and A. H. Rashadul Hossain[1,*]
[1]Department of Chemistry, Chittagong University of Engineering & Technology, Chattogram-4349, Bangladesh
**Corresponding email: rashad@cuet.ac.bd*

ABSTRACT
Coumarin-thiazole hybrids represent a significant class of heterocyclic compounds that display a variety of pharmacological activities, including anticancer, antioxidant, and antibacterial effects. The incorporation of these two desirable scaffolds into a unified framework presents a promising strategy for the development of heterocyclic drugs and the enhancement of therapeutic efficacy. A novel coumarin–thiazole hybrid has been synthesized through a three-step reaction sequence. The synthetic pathway commenced with a Knoevenagel condensation between a substituted benzaldehyde and a *β*-keto ester, leading to the formation of a coumarin derivative (**1**). This derivative was then reacted with hydrazine carbothioamide to yield a hydrazone intermediate (**2**). The final step involved cyclization with *α*-bromoacetophenone, resulting in the desired coumarin–thiazole scaffold (**3**). This reaction pathway, which encompasses Knoevenagel condensation, Schiff base formation, and Hantzsch-type thiazole cyclization, illustrates a promising strategy for the construction of bioactive heterocyclic frameworks, thereby providing optimism regarding their potential bioactivity. The synthesized compounds were characterized using FT-IR, ^{1}H NMR, ^{13}C NMR, COSY, HSQC, and HMBC. Antibacterial screening assessed their effectiveness against *E. coli, P. aeruginosa, S. aureus*, and S. pyogenes, while antifungal activity was evaluated against *C. albicans, A. niger*, and *A. clavatus* strains. Furthermore, the results were validated via molecular docking studies. Drug likeness properties were predicted at the end via ADMET analysis, to support the investigations. The comprehensive experimental and computational analyses supported the conclusion that the synthesized hybrid compounds possess the potential to act as inhibitors for the development of new anti-microbial drugs.

Paper ID: ICSHSD-486

Cellulose-based Colorimetric Sensor Film for Rapid and Efficient Detection of Formaldehyde in Food Samples

Md. Ariful Islam[1], Israt Jahan Riya Moni[1], and Abu Bin Imran[1,*]
[1]Department of Chemistry, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
**Corresponding email: abimran@chem.buet.ac.bd*

ABSTRACT
Formaldehyde is a hazardous aldehyde frequently employed in industrial and domestic environments and is sometimes inappropriately used as a food preservative, posing significant health risks, including carcinogenicity, respiratory complications, and immune system impairment. Monitoring its presence in food is important for ensuring consumer safety. Although traditional analytical techniques such as chromatography and spectrophotometry offer high accuracy and sensitivity, they require sophisticated equipment, complex sample preparation, and are not suitable for rapid on-site testing. To address this limitation, the development of portable, sensitive, and environmentally sustainable sensing materials remains a challenge. This study involved the development of a novel biodegradable hybrid polymer film for the quantitative detection of formaldehyde in food samples. Cellulose was used as the supporting natural polymer to encapsulate Nash colorimetric reagents, resulting in biodegradable films designed for formaldehyde detection. Under optimal conditions, the film demonstrated excellent linearity across the concentration range of 0–100 ppm, with limits of detection (LOD) established at 1 ppm. The cellulose-derived film exhibited a rapid response time (≤5 min). Testing on actual food samples confirmed its reliability, yielding results consistent with conventional colorimetric methods. This eco-friendly platform highlights the potential of cellulose films combined with digital image analysis for cost-effective, portable, and accurate on-site formaldehyde detection in food safety monitoring and broader applications in environmental and biomedical sensing.

Paper ID: ICSHSD-492

Sustainability in Tradition: Vernacular Mud Architecture Practices of Gazipur

Nusrat Jahan Fariha[1,*], and Iqbal Hossen[1]
[1]Department of Architecture, Dhaka University of Engineering & Technology, Gazipur, Gazipur-1707, Bangladesh
**Corresponding email: njfariha99@gmail.com*

ABSTRACT
Traditional mud architecture in Bangladesh represents an indigenous and contextually responsive approach to sustainability, particularly within climate-vulnerable rural regions such as Gazipur. Mud, as a locally abundant, low-energy material, has historically been central to vernacular construction, offering inherent thermal comfort, resilience to climatic variability, and minimal environmental footprint. However, these practices are increasingly marginalized by rapid urbanization, the dominance of industrialized materials, and socio-cultural perceptions that undervalue sustainable heritage construction. This study examines how Gazipur's mud-building techniques embody sustainable principles such as resource efficiency, material circularity, and community participation. Analyses of wall-building methods, spatial configurations, and material cycles demonstrate their alignment with contemporary sustainability frameworks and climate-adaptive design strategies. Methodologically, the research adopts a multi-method approach, combining field documentation, semi-structured interviews with local builders and residents, and comparative evaluation against established green building parameters. Findings indicate that Gazipur's mud architecture is not merely a cultural artifact but a practical and replicable model for low-carbon, climate-resilient, and socially inclusive rural housing. The study underscores the value of integrating vernacular knowledge into modern architectural discourse, illustrating how traditional techniques can inform policy, sustainable housing strategies, and community-centered interventions. By linking heritage conservation with environmental performance, this research contributes to the discourse on sustainable architecture in developing regions, offering insights for resilient and culturally attuned rural development in Banglades

Paper ID: ICSHSD-493

Coumarin–Thioamide Hybrids as Antioxidant and Enzyme-targeting Agents: Synthesis, DFT, ADMET, and Molecular Docking Studies

Afia Imrad Tahasin[1], and Md. Sakhaoyat Hossain[1,*]
[1]Department of Chemistry, Chittagong University of Engineering & Technology, Chattogram-4349, Bangladesh
**Corresponding email: sakhaoyat.chem@gmail.com*

ABSTRACT

Elevated blood glucose levels are a common occurrence in Type-2 Diabetes Mellitus (T2DM), a metabolic condition that can be effectively controlled with α-glucosidase inhibitors. In this study, a series of novel coumarin-based thiosemicarbazone derivatives (**1-3**) were created and assessed for their capacity to inhibit *α*-glucosidase. This study presents the synthesis of a series of novel coumarin-hydrazone-thioamide hybrids utilizing a two-step protocol. The initial step involved the condensation of substituted benzaldehyde derivatives with ethyl acetoacetate through a Knoevenagel reaction, followed by intramolecular lactonization to produce chromen-*2*-one intermediates. The second step comprised the acid-catalyzed condensation of these intermediates with *N*-phenylhydrazinecarbothioamide in a methanol and glacial acetic acid mixture, yielding three final hydrazone-thioamide conjugates. The reaction mechanism for the first step entailed enolate formation, electrophilic substitution, and subsequent lactone ring closure, while the second step involved nucleophilic addition and elimination. Structural elucidation of the synthesized compounds was achieved through IR, ^{1}H, ^{13}C NMR, COSY, HSQC and HMBC. Furthermore, *in vitro* antioxidant assays revealed that all synthesized compounds exhibited significant free radical scavenging (DPPH and ABTS) activity in comparison to ascorbic acid, which served as a standard. Furthermore, the computational analyses were conducted with utmost thoroughness to investigate the properties of the compounds. Density functional theory (DFT) calculations provided comprehensive insights into frontier molecular orbitals, charge distribution, and electronic stability. The molecular docking studies against two α-glucosidase proteins (PDB ID: 3A4A and 3TOP) revealed a wealth of important interactions, including π-π interactions and hydrogen bonds, between the compounds and ligand attachment to the critical residues of *α*-glucosidase. The binding interactions, alignment, stability, and structural arrangement of the prepared molecules within the catalytic pocket of *α*-glucosidase were explored with meticulous attention to detail using in silico strategies, including docking studies and pharmacokinetic analysis.

Humanities and Social Sciences

Invited Papers

Invited -01

Livelihood Vulnerability Index: An application to Evaluate the State of Climate Vulnerability for Small-Scale, Inland Fishing Livelihoods

Md Nazmus Sadekin[1]
[1]Professor, Department of Economics, Mawlana Bhashani Science and Technology University, Santosh, Tangail-1902, Bangladesh.
**Corresponding Email*: sadekin@mbstu.ac.bd

ABSTRACT
These days, "vulnerability" is regarded as an essential topic in the study of climate change and global change. Vulnerability in various communities has resulted from climate change's unprecedented effects on human and ecological systems, which are expected to increase in the future. Nonetheless, fishing is regarded as one of the high-risk lifestyle pursuits because of several unique features. The livelihood of small-scale fishing (SSF) populations in inland closed water areas is being negatively impacted by climate change, which is having an unequal global impact on the fisheries industry. This is why comprehensive research on vulnerability is needed. Thus, this paper proposes: 1) a conceptual framework for creating an approach to evaluating the climate vulnerability status of SSF communities of inland closed water areas; 2) the problems and ideas associated with the impact of climate change on SSFs of inland closed water areas from a vulnerability perspective.

Invited -02

The Interdisciplinary Nexus: Language and Communication as Connectors

Dr. Waliul Islam
Supernumerary Professor of English, Institute of Modern Languages, University of Dhaka
**Corresponding Email*: waliul.islam@du.ac.bd

ABSTRACT
The presentation makes an attempt to explore how humanities studies, in general, and language teaching, in particular, can integrate science studies, irrespective of branches like engineering, medical, technical, and contribute to inclusive efforts to address global issues and promote sustainable development. There is nothing denying that at the heart of integrating science, technology, and humanities lies the need for effective communication. Language teaching, often rooted in humanities, equips individuals with tools to articulate complex ideas across disciplinary boundaries. Any scientific research if published purely with technical jargon is likely to alienate non-experts, but communication skills training—such as rhetoric and discourse analysis—helps translate findings into actionable insights for policymakers and communities. While global challenges require collective action and the United Nations Sustainable Development Goals (SDGs) emphasize partnerships (SDG 17), which rely on clear, culturally sensitive communication to bridge gaps between scientists developing green technologies and humanists advocating for ethical implementations. Communication skills extend beyond mere transmission of information; they involve active listening, empathy, and persuasion—elements honed through language education. Research indicates that bilingual or multilingual individuals exhibit enhanced cognitive flexibility, aiding problem-solving in interdisciplinary teams. This cognitive advantage supports sustainable development by enabling adaptive responses to dynamic global issues. Whilst the presentation will identify some impediments to comprehensive inclusiveness in resolving global crisis, it will suggest some realistic strategies that can be implemented through language teaching and learning.

Invited -03

AI for Learning and Teaching EFL: Exploring Undergraduates' Perspectives

Professor Dr. M. Maniruzzaman*
Department of English, Jahangirnagar University, Savar, Dhaka, Bangladesh
**Corresponding author: mmz71@juniv.edu*

ABSTRACT

It is assumed that learning and teaching a second/foreign language with the support of artificial intelligence (AI) revolutionize education for both learners and instructors. The present study was planned to explore the prospect of the application of AI technology (AIT) to learning and teaching English as a foreign language (EFL) at the undergraduate level and to ascertain the undergraduates' perspectives on the practicability of exploiting AIT. The study was carried out in the departments of English at two public and two private universities in Bangladesh. The respondents selected through simple random sampling consisted of 80 undergraduates studying English language and literature in English, 20 students from each of the four universities. This study employed a student questionnaire to collect data from the participants. Additionally, semi-structured interviews were conducted with the subjects to gather relevant information and ensure triangulation. The study revealed that the subjects had strongly positive attitudes to the appropriate techniques for exploiting AIT, the viability of employing AIT in learning and teaching EFL, the effectiveness of using AIT for enhancing the processes and achieving outcomes of learning and teaching EFL, and the requirements for applying AIT to learning and teaching EFL. Based on the findings, the researcher recommends integrating AIT with the curriculum, materials, instruction, and assessment, and training both teachers and students in AI applications, AI-powered tools, software, and apps, enhancing the learning and teaching of the EFL skills – listening, speaking, reading and writing, and components – vocabulary, pronunciation and grammar.

Invited -04

Mainstreaming government development projects towards sustainability: case study of climate change an disaster risk assessment

Dr. Md. Sirajul Islam[1*], Dr. Nurun Nahar[2]
[1]Department of Civil and Environmental Engineering, North South University
[2]Ministry of Planning, Bangladesh Government
**Corresponding author:* sirajul.islam@northsouth.edu

ABSTRACT

As a developing country, Bangladesh undertakes a large number of development projects under its Annual Development Programme (ADP). Most of these projects are for infrastructure development like road, bridge, hydraulic structure or buildings. However, considering its geographical location and the resulting vulnerability to climate change and natural disasters, it becomes a burning question, how to safeguard this development effort to be sustainable in the long run. In view of this, government as a timely step has taken a number of initiatives like refining the Development Project Proposal (DPP) proforma to ask question about the environmental impact, climate change relation and disaster risk involved to any of such projects. Some changes are made in preparing feasibility study of big development projects, emphasizing the environmental sustainability, climate risk and disaster relevance of the projects to evaluate as well. The latest development was to develop a comprehensive risk screening tool as Climate Risk Screening (CSR) followed by detailed Climate Risk Vulnerability Assessment (CRVA). In a web-based platform, disaster risk score of a development project, in relation to a particular hazard can be calculated. Depending on the risk score, provisions are there to propose appropriate adaptation measures to minimize the impact. The original idea was generated from an Asian Development Bank (ADB) project on mainstreaming government development project towards sustainability. In its final stage, a web-based platform Disaster and Climate Risk Information Platform (DRIP) has been launched already for the purposes. It is expected that the developed tool can serve as an important means to ensure sustainability of government development projects, addressing the future impact of climate change and disaster risk.

Invited -05

Sustainable Dairy-based Agribusiness in Bangladesh Through Disruptive Innovation

Dr. Md. Rahat Khan
Army Institute of Business Administration, Savar
Bangladesh University of Professionals
Savar Cantonment, Dhaka- 1344, Bangladesh
**Corresponding author: rahat@aibasavar.edu.bd*

ABSTRACT
Bangladesh's dairy agribusiness is undergoing a silent transformation driven by the principles of disruptive innovation (DI)—a radical shift that challenges traditional production and value systems. Building on multiple empirical investigations across in-land open and closed dairy ecosystems, this research addresses how Bangladesh's dairy enterprises can evolve toward sustainability through innovation-led disruption. Findings from my four integrated PhD studies—ranging from the Central Cattle Breeding and Dairy Farm (CCBDF) in Savar, in-land open dairy farming operations in Pabna and Sirajganj, and in-land closed dairy clusters in Dhaka, Tangail, Manikganj, and Gazipur—reveal that business sustainability depends on seven pivotal enablers: entrepreneurial initiation, essential skill development, institutional-to-state support, strategic enablers, business action stages, business outcomes, and entrepreneurial challenges. The study develops the Disruptive Dairy Business Process Innovation (DDBPI) model, extending the Disruptive Production Process Innovation (DPPI) framework by integrating social inclusion, digital adaptation, and process efficiency in resource-constrained contexts. The aggregate model aligns with SDGs 2, 8, and 12, emphasizing inclusive growth, decent employment, and responsible production. By adopting AI-enabled monitoring, cooperative business models, and precision breeding technologies, Bangladesh can transition its dairy economy from fragmented local operations to an integrated, innovation-driven ecosystem. The research underscores that disruptive innovation in dairy is not merely technological; it is also entrepreneurial, institutional, and societal, providing a blueprint for sustainable agribusiness in emerging economies.

Invited -06

Towards sustainable and just climate adaptation: insights from coastal Bangladesh

Md. Masud-All-Kamal
Department of Sociology, University of Chittagong
**Corresponding author:*

ABSTRACT
This paper explores the factors shaping the sustainability of climate change adaptation interventions in coastal Bangladesh. It particularly examines the institutional and governance dynamics that mediate adaptation outcomes. Despite the proliferation of national policies and programs, adaptation in Bangladesh remains dominated by technocratic and short-term approaches that often fail to secure sustained benefits for vulnerable communities. Drawing on insights from local adaptation practices, the study argues that sustainable adaptation must be understood as a socially transformative process that enhances equity, participation and local agency. Three interlinked drivers are identified as central to this process: meaningful community engagement, the reconfiguration of institutional power relations, and meaningful collaboration between local actors. The analysis reveals that hierarchical and externally imposed interventions undermine local knowledge and innovation. The paper concludes that advancing sustainable adaptation in coastal Bangladesh requires not only technical measures but also institutional transformation that embed local knowledge and priorities at its core.

Invited -07

Dilemmas and Challenges in Qualitative Fieldwork with Climate-Vulnerable Communities

Masud Kamal, S. M. Monirul Hasan, Nasir Uddin
Department of Sociology, University of Chittagong
**Corresponding author:* monirul.hassan@cu.ac.bd

ABSTRACT

Research with groups prone to multiple vulnerabilities places academic researchers in a wide range of ethical dilemmas both methodologically and epistemologically. Drawing on our long-term research engagement with climate-vulnerable communities in coastal Bangladesh, this chapter presents dilemmas and challenges that a qualitative researcher faces while undertaking fieldwork. We find that dilemmas and risks arise from listening to distress stories, knowing participants' problems, balancing demands made by the participants, and benefits available to the participants during fieldwork. A researcher takes from the communities in the form of information but gives nothing material which is deeply needed for the climate-vulnerable communities in the global south. Research is not essentially a task of 'give and take', yet a researcher needs to be aware of the ethical challenges and find out strategies to deal with them. We suggest broadening the purview of formalised research ethics to minimise researchers' dilemmas in qualitative research.

Contributed Papers

Sub-theme: Innovative Business Technology for Sustainable Development

Paper ID: ICSHSD-421

Exploring factors driving Online Impulsive Buying Behavior: An S-O-R Approach with Green Trust as Mediator and Price Consideration as Moderator

Rasheda Akter Rupa[1], Afruza Haque[2]*, Most. Sadia Akter[1], Md. Faisal-E-Alam[3], Nahida Sultana[1]
[1] Lecturer, Department of Management Information Systems (MIS), Faculty of Business Studies, University of Dhaka
[2] Assistant Professor, Department of Humanities and Social Sciences, Dhaka University of Engineering & Technology (DUET), Gazipur, 1707, Bangladesh
[3] Assistant Professor, Department of Management Studies, Begum Rokeya University, Rangpur-5404, Bangladesh
Corresponding author: afruza@duet.ac.bd

ABSTRACT

In digital marketplace, impulsive buying behavior has become increasingly prevalent, shaped by emotional and situational triggers and instant purchasing decisions. This study aims at exploring the stimuli that lead to shopping engagement and thereby, impulsive buying behavior (IBB) through the mediation of Green Trust (GT) and moderation of Price Considerations (PC). Grounded on Stimulus-Organism-Response (S-O-R) model, constructs such as Perceived Utilitarian Value (PUV), Perceived Enjoyment (PE), Product Innovation (PI) and Escapism (ESC) are hypothesized to influence consumers' shopping engagement resulting in IBB. Data were collected from 813 respondents and the conceptual model was analyzed using Structural Equation Modeling Partial Least Squares SEM (PLS-SEM). Findings reveal that PUV, PE, PI, and ESC have direct impact on SE. GT partially mediates the relationship of PUV, PE, and PI with SE. It was also found that PC moderates the relationship between SE and IBB. This study enriches the existing literature, particularly emphasizing on the sustainable consumer behavior by establishing green trust as mediator and price consideration as moderator. The insights gained from this study practically guide the marketers in developing customized strategies that capitalize on intrinsic and extrinsic psychological triggers in engaging consumers in shopping activities and subsequent impulsive buying behavior. This study addresses a significant gap in consumer behavior literature by investigating the mediating role of green trust in understanding the psychological underpinnings of consumer behavior in a digital market context.

Paper ID: ICSHSD-513

Integrating Informal Culinary Economics in Rural Tourism through an Implemented Cloud-based Digital Platform

Md. Musfiqur Rahman Akib[1], Habibur Rahaman[2]*
[1]Chittagong Independent University.
[2]Chittagong Independent University.
Corresponding author: habibcuetcse@ciu.edu.bd

ABSTRACT

Homemade food presents a significant opportunity for advancing sustainable business innovation in developing economies, particularly in rural areas where local entrepreneurship and traditional culinary skills are often underrepresented in formal markets. In Bangladesh, rural regions attracting domestic and international tourists seek authentic rural culinary experiences, yet the integration of home-cooked cuisine into the tourism value chain is hindered by the absence of structured digital platforms, standardized safety protocols, and reliable market linkages. This study introduces a framework that connects rural homemade food providers with the tourism economy through a secure and adaptable cloud-based digital platform. The system incorporates validated provider profiles, rigorous hygiene and safety assessments, escrow-secured payments, transparent reviews, and structured dispute resolution, ensuring operational reliability and cultural authenticity. By enabling informal family kitchens, particularly those operated by women micro entrepreneurs in rural tourism communities, to transition into formally recognized, income generating enterprises, the platform preserves affordability while safeguarding heritage culinary practices. A pilot implementation involving 50 simulated users and 15 rural providers demonstrated strong adoption, achieving a 92% service acceptance rate, an average booking completion time of 2.5 minutes, and a satisfaction score of 4.6 out of 5. Beyond these operational outcomes, the model generated measurable community-level benefits, including increased household income, expanded participation of women entrepreneurs, preservation of traditional cuisine, and adherence to safety standards. These results align with SDG 5, SDG 8, and SDG 11, highlighting the framework's potential for broad implementation in similar rural economies. By integrating cloud-based technology with local entrepreneurship, the framework provides a practical and flexible approach to formalize informal food markets in rural areas while promoting sustainable tourism and inclusive economic development.

Paper ID: ICSHSD-516

Training Essential Business Skills to Homemakers

Abid Hossain[1*]
[1]Department of Computer Science and Engineering, East West University, Dhaka,5200, Bangladesh.
**Corresponding author: abidhossa9@gmail.com*

ABSTRACT

Smartphones have become an essential tool for communication, gathering information, and managing daily tasks of life. Homemakers spend most of their time looking after homes. With the recent burst of online entrepreneurship opportunities; specially after COVID-19, working from home or creating and managing a business is one of the most popular ways of working. Many of them have the skills and different ideas for a startup, but most often they have no clue about how the digital tools of smartphones can turn ideas into real business. A training-based pilot study was performed from 12th to 19th August 2025 with 20 homemakers who either own or have access to a smartphone. Two survey questionnaires were constructed to assess the change in skills in pre- and post-training. Data collection and analysis were performed by using Google Forms and Google Sheets respectively. The objective of this research was to observe the effectiveness of the training on homemakers' performance in their business initiatives. Significant improvement was observed among them in terms of basic smartphone operation, internet browsing, emailing, using messaging & social media apps and online transaction management. Learning business skills through smartphones can help them to become successful entrepreneurs alongside being a housewife.

Sub-theme: Driving Economic Sustainability Public Policy

Paper ID: ICSHSD-022

Religious Ethics and Economic Development: Revisiting Max Weber's Protestant Ethic and the Spirit of Capitalism

Taslima Mohsina Mimi[1*]
[1]Military Institute of Science and Technology, Dhaka, Bangladesh.
**Corresponding author: taslimamohsinamimi@gmail.com*

ABSTRACT
This paper revisits Max Weber's influential thesis in The Protestant Ethic and the Spirit of Capitalism (1904/1905) through the lens of sustainable economic development. Weber proposed that Protestant religious values—particularly those associated with Calvinism—introduced a disciplined work ethic, rational economic behavior, and value-driven consumption that laid the foundation for the rise of capitalism in Western Europe. This paper critically explores how these religiously inspired ethical systems contributed to a form of early economic rationality that fostered long-term development, contrasting it with structural and ideological barriers to capitalist growth in the Eastern world. Using an extensive literature review and theoretical analysis, the study highlights how non-Western societies, such as India and China, were shaped by belief systems like the caste structure, reincarnation, Confucianism, and Taoism, which emphasized tradition and collectivism over individual economic advancement. The paper argues that understanding these historical roots is vital for framing contemporary discussions on inclusive and sustainable economic models. It raises questions about how ethical frameworks like religion can support responsible capitalism and long-term development in diverse global contexts.

Paper ID: ICSHSD-092

Fintech and Sustainability: The Economic Role of AI, Blockchain, and IoT in Business Innovation and Green Finance

Samiha Mamun[1]*, and Md. Rahat Khan[1]
[1]Army Institute of Business Administration (Army IBA), Savar (An Affiliated Institute of Bangladesh University of Professionals), Savar Cantonment, Dhaka 1344, Bangladesh.
**Corresponding author: samihamamunmeem@gmail.com*

ABSTRACT
In this research paper, a conceptual framework that provides an informative perspective of the economic role of AI, blockchain, and IoT within fintech as a business innovation and a sustainable green finance is developed. Through this analysis using sixteen expert interviews and secondary data, such as industry reports, recent news articles, the paper discusses how such convergent technologies lead to organizational agility, transparency, and decision-making based on data in the volatile financial markets. In the paper, the Authors explain the aspects of technological integration, strategic alignment, cross-functional collaboration, continuous stakeholder engagement, ethical governance, and many others, which help fintech companies to develop innovative and sustainable financial solutions. Such technologies now enable companies to increase financial inclusion, improve the management of ESG risks, and drive the shift towards low-carbon economies with new business models, such as autonomous financial agents and decentralized finance. The evidence identifies decisive implications of fintech trends on the economic sustainability and environmental risks, as well as providing demarcations of ways forward beyond empirical studies on a sustainable, fair, and broadened digital finance system.

Paper ID: ICSHSD-098

The Role of Microfinance in Reducing Income Inequality and Promoting Social Mobility

Samiha Mamun[1]*, and Dr. Most. Tahura Pervin[2]
[1]Army Institute of Business Administration (Army IBA), Savar (An Affiliated Institute of Bangladesh University of Professionals), Savar Cantonment, Dhaka 1344, Bangladesh.
[2]Department of Humanities and Social Sciences, Dhaka University of Engineering & Technology, Gazipur, 1707, Bangladesh.
**Corresponding author: samihamamunmeem@gmail.com*

ABSTRACT
In the research paper, the goal is to prepare a conceptual framework towards comprehending the use of microfinance to curb income inequality and enhance social mobility in developing countries. Examining the relevant secondary data sources (including the expert interviews, published reports, and economic data), the study investigates the role of the microfinance implementation of financial inclusion, economic empowerment, and social progress among the marginalized groups of the population. It discusses how microfinance can open access to capital, capacity building, and development of social capital and allow clients, especially women and rural dwellers, to surmount structural economic barriers. The paper provides an overview of the multidimensional effects of microfinance on income distribution and social mobility and pits these effects against some broader development paradigms. It also covers such issues as limitations to financial outreach and the hope of digital financial innovations. The study offers useful insights into the transformational impacts of microfinance in emerging economies, as it proposes areas of both empirical and policy-oriented research in the future.

Paper ID: ICSHSD-101

Incorporating Waste-To-Wealth Model into Microfinance: A Gateway to Fostering Sustainable Economic Growth in Bangladesh

Rokaiya Jahan Banna[1]*, Faiza Farha[1], Masum Billah[1], Afsana Mahmud[1], and Humayra Kabir[1]
[1]World Linkup, 2nd Floor, Software Technology Park, Kawran Bazar, Dhaka, Bangladesh.
**Corresponding author: rokaiyajahan29@gmail.com*

ABSTRACT
Microfinance has become the cornerstone of poverty alleviation in Bangladesh. It was introduced as the way of rural community empowerment, especially women, by providing them the capital. However, the dream of those rural communities burns into ashes when they feel pressure of the loan repayment. This turns into the vicious cycle of debt trap and severe socio-economic distress. This current study proposes a paradigm shift of the microfinance concept to "wealth-to-wealth" model, here the rural communities are not given loan to repay rather new path to a micro industry with the overlooked yet high potential underutilized local resources. The model focuses on empowering the rural communities to generate income by transforming abundant bio materials such as guava leaves, moringa or banana fiber into a consumer product. This approach aims not only to reduce the risk of loan repayment but also foster a sustainable, green economy at the grassroots level. We used a mixed method approach for conducting the research by collecting data from Rajshahi and Noakhali divisions and the existing researches on this topic to assess the model's feasibility and impact. The findings are expected to offer a replicable framework for enhancing microindustry directly contributing to SDG 1 (No Poverty) and SDG 8 (Decent Work and Economic Growth).

Paper ID: ICSHSD-144

Energy-Efficient IoT Network for Smart Alternate Wetting and Drying (AWD) Irrigation in Sustainable Precision Rice Farming in Bangladesh

Md Zakir Hossen[1*], M.A. Rob[1], Fazlul Hasan Siddiqui[1], and Debjit Roy[2]
[1]Department of Computer Science and Engineering at Dhaka University of Engineering & Technology, Gazipur.
[2]Irrigation and Water Management Division at Bangladesh Rice Research Institute, Gazipur.
Corresponding author: cse.zakirhossain@gmail.com

ABSTRACT

Innovation in rice irrigation systems has become a critical research focus for water conservation globally. Numerous IoT-based automatic irrigation systems have been proposed in the literature, with most relying on cellular or Wi-Fi networks for communication between nodes and remote monitoring and control. However, establishing Wi-Fi networks is both challenging and costly in remote areas, particularly in large rice field regions. Additionally, cellular networks require a Subscriber Identity Module (SIM) for each IoT device, and in regions where SIM cards are limited, scaling up the number of IoT devices becomes problematic. To address these limitations, an IoT-based irrigation system using LoRaWAN in Bangladesh was explored as a sustainable alternative. The 915 MHz frequency LoRa network for device communication and cloud-based monitoring were utilized for the system. The system demonstrated excellent precision in controlling devices and smooth operation during the testing phase. The results were promising with a low-cost setup and an IoT network without relying on cellular or Wi-Fi infrastructure in remote regions was successfully established. The network enabled efficient operation of a smart irrigation system aimed at optimizing the application of water. The irrigation process was effectively operated through mobile apps, allowing for remote control and monitoring, which significantly reduced human effort and time. Wi-Fi networks have limited coverage, and expanding the coverage area requires additional devices and increased maintenance complexity. In contrast, a 10 km range for omnidirectional communication with LoRaWAN technology was achieved by using inexpensive network devices, minimizing both costs and maintenance complexity. Additionally, field devices sent packets to the server via the gateway, with a delay of approximately 4 seconds (1 second for the device to send the packet to the gateway, 1 second for the gateway to forward the packet to the server, and 1 second for the server to send the action back to the field device). The gateway, which usually supports up to 8 devices and is priced around $200, had been developed in our system with no limitations on the number of connected devices, and at a significantly lower cost of approximately $10. This cost-effective solution connected 100 devices in rural areas without any issues, providing a scalable and affordable solution for smart irrigation. By deploying 100 devices, 100 SIM cards and data packages could be saved. This experiment represents a significant advancement in rice irrigation in Bangladesh, offering a new precision approach to overcoming water scarcity challenges in agriculture.

Paper ID: ICSHSD-171

Balancing Employment and Human Values in The Digital Age: The Challenges for Freelancers in Bangladesh's Professional and Social Life

Mohammad Kawsar Ahammed[1*], and Ziaul Hoque[2]
[1]Department of Humanities and Social Sciences, DUET.
[2]University of Dhaka.
**Corresponding author: kawsarhss@duet.ac.bd*

ABSTRACT

The rise of the digital economy has fundamentally reshaped the global workforce, with freelancing emerging as a significant source of employment and economic opportunity, particularly in developing nations like Bangladesh. This shift, while empowering individuals with flexibility and independence, presents a unique set of non-economic challenges that require a critical, humanistic examination. Traditional analyses often focus on the financial benefits of freelancing, overlooking the profound social and psychological impacts that a digitized, independent work model can have on an individual's well-being and social integration. This research argues that true economic sustainability is inextricably linked to human well-being and social harmony, a perspective often marginalized in technology-centric discourse. This study aims to investigate the complex interplay between professional autonomy and human values for freelancers in Bangladesh, a country with a rapidly expanding pool of remote workers. It seeks to understand how the absence of a traditional office environment, coupled with the demands of a gig economy, influences their social life, mental health, and the establishment of a healthy work-life balance. Using a qualitative research approach, the study will employ in-depth, semi-structured interviews with a diverse group of freelancers across various sectors and age groups in Bangladesh. The data collection will focus on personal narratives, lived experiences, and subjective perceptions of their work and its impact on their professional and social identities. The anticipated findings of this research will provide a detailed account of the key challenges faced by Bangladeshi freelancers. These are expected to include, but are not limited to, the experience of social isolation, the difficulty in disconnecting from work, heightened levels of stress and anxiety, and the erosion of traditional community support systems. The study will also explore the strategies and coping mechanisms that freelancers develop to mitigate these issues. The results will contribute to a deeper understanding of how the digital gig economy is reshaping social structures and individual well-being. This research makes a significant contribution to both the humanities and social sciences by bridging the gap between technological advancement and humanistic inquiry. It provides valuable insights for policymakers, educational institutions, and community organizations to develop targeted interventions that can better support the freelance community. By shedding light on the human costs of the digital age, this study ultimately advocates for a more balanced and sustainable future where technology serves humanity without compromising our essential values and social connections.

Paper ID: ICSHSD-274

Balancing Economic Growth and Environmental Sustainability in Bangladesh: A Data-Driven Analysis

Zeba Farzana[1*]
[1]Centre for Entrepreneurship Development, BRAC University (CED-BRACU).
Corresponding author: zeba.farzana@bracu.ac.bd

ABSTRACT

Bangladesh acts as an interesting case study where there is a complex relationship between rapid economic growth and environmental sustainability. Despite being one of the top ten densely populated countries in the world, the country has achieved significant socio-economic development. However, this accelerated growth has come with its own set of environmental costs. Bangladesh is one of the most vulnerable to climate change, facing threats from rising sea levels and severe flooding. Additionally, industrialization and urbanization has been taking place at an unprecedented rate in an unsustainable manner that results in environmental degradation, including severe air, water, and land pollution. The country has consistently ranked second or third place in terms of worst air pollution in 2024 and is also one of the biggest plastic polluters in the world. As such, a comprehensive understanding of the intersection between environmental and economic aspects in Bangladesh is required for devising policies to balance the economic gains with environmental costs, thereby ensuring a sustainable future. Extant literature has highlighted these issues individually but there are not enough studies integrating these two domains with a data-driven approach. This study is guided by the sustainable development theory which posits that developmental needs must be met in a way that does not compromise the ability of future generations to meet their demands. It uses a quantitative research design to investigate the connection between economic development and environmental quality in Bangladesh from 1990 to 2024 using information from World Bank Open Data. The study has tested the Environmental Kuznets Curve (EKC) hypothesis which states that as countries progress economically, their rate of environmental degradation will at first increase and then decrease, resulting in a U-like curve. It has found that different pollutants, such as greenhouse gases, are increasing over time, indicating that Bangladesh is still on the "rising" part of the curve. The study has also evidenced a decreasing trend in the percentage of renewable energy consumed, hinting that non-renewable energies are still the dominant energy sources, especially in the rural areas. By integrating these analyses, this research has demonstrated that a sustainable development model for Bangladesh requires an integrated policy approach that promotes both economic growth and environmental upgradation. There is a need for targeted policies that enhance energy efficiency, invest in clean technologies, increase awareness towards the use of renewable energies, and manage natural resources sustainably to ensure that the nation's economic progress does not come at the expense of its environment and the well-being of future generations. Future studies can deploy a mixed method approach to fill in the gaps of the current research.

Paper ID: ICSHSD-341

Evaluating Human-Environment Sustainability Barometer: Host–Tourist Perceptions in River-Based Communities of Rajshahi

Md Mainul Islam[1], Soumitro Kumar Das[2*], Md Ole Ullah[1], Md.Shojeb Rahman, Md. Mahfuz Islam Nayon, and Md. Riwon[1]
[1]Department of Tourism and Hospitality Management, University of Rajshahi, Rajshahi-6205, Bangladesh.
[2]Department of Applied Mathematics, University of Rajshahi, Rajshahi-6205, Bangladesh.
Corresponding author: sdasshuvro@gmail.com

ABSTRACT

The multidimensional effect of tourism on sustainability demands a profound and intricate measurement especially in terms of equilibrium of complexity of perceptions among stakeholders that arise within communities that depend on tourism. This paper systematically evaluates core differences in the sustainability perceptions held by tourists and local residents (hosts) in Rajshahi, and at the same time seeks to help establish a comprehensive barometer of sustainability which will take into account these multi-faceted perceptions. In this quantitative study, a survey of 200 well-selected respondents (100 tourists and 100 hosts) was carried out that evaluated 39 specific variables. SPSS version 27 was used to analyze the responses to have Independent samples t-test, and chi square test. The detailed results reveal critical differences in perceptions: the tourists expressed much greater worries about environmental degradation ($M=3.44$ vs. $M=2.82$, $p=0.011$), local pollution ($M=3.78$ vs. $M=2.90$, $p<0.001$), and damage to resources ($M=3.62$ vs. $M=2.86$, $p=0.001$), hosts had more community ties ($M=4.24$ vs. $M=3.80$, $p=0.040$) Tourists also had the perception of higher livelihood gains ($M=3.74$ vs. $M=2.96$, $p=0.001$) indicating not the same level of optimism towards the economy than the hosts do. The results reiterate the dire necessity to conduct focused interventions to ensure a large-scale alignment of perceptions of the involved stakeholders. The findings are important in giving a contribution towards interdisciplinary sustainability models, and further provide good data to policymakers and tourism developers in ensuring balanced environmental protection, social integration as well as economic equity in tourism-intensive areas.

Paper ID: ICSHSD-352

Islamic Financial Literacy and Its Impact on Financial Well-Being among Bangladeshi Muslims

Mohammad Faizul Haque[1*], and Mamunur Rashid[1]
[1]Department of Humanities and Social Sciences, Dhaka University of Engineering and Technology, Gazipur.
Corresponding author: mdfaizulhaque@duet.ac.bd

ABSTRACT
This study conducts quantitative research on the Islamic financial literacy and financial well-being among Bangladeshi Muslims. Bangladesh is a Muslim majority country where conventional banking is more prominent than the Islamic banking system. Therefore, the knowledge about the Islamic financial system is not so widespread. This research tries to figure out the relationship between the Islamic financial literacy among Bangladeshi Muslims and its impact on their financial well-being from a statistical point of view. The finding is expected to provide meaningful insights for scholars, financial institutions, and policymakers to develop practical strategies to widen the application and utilization of the Islamic financial system and expand the Muslim population's participation.

Paper ID: ICSHSD-412

Unveiling the Path From Women's Entrepreneurial Intention to Women's Empowerment in Bangladesh: The Moderating Role of Family Support

Tanha Akter[1*], Most. Sadia Akter[1], Rasheda Akter Rupa[1], Md. Tashriful Islam[2]
[1]Department of Management Information Systems (MIS), Faculty of Business Studies, University of Dhaka.
[2]Materials Technologist, WIP Sourcing Asia Limited, Bangladesh Liaison Office.
Corresponding author: tanha-14-2018121131@mis.du.ac.bd

ABSTRACT
Women's entrepreneurship is increasingly seen as a pathway to empowerment and inclusive growth, yet in Bangladesh many women still struggle with limited resources, cultural barriers, and a lack of confidence in their abilities. This study draws on the Theory of Planned Behavior (TPB)and Empowerment Theory to understand how Motivation (MOT), Self-Efficacy (SE), Access and Control over Resources (ACR), and Perceived Behavioral Control (PBC) influence Women's Entrepreneurial Intention (WEI), and how these intentions lead to greater Women's Empowerment(WE). It also considers the role of Family Support (FS) in strengthening these relationships. Using a purposive sampling technique to select the women who are actively involved in or actively planning to start a business, survey data were gathered from 281 women entrepreneurs in Dhaka between April and June 2025 and analyzed with PLS-SEM. The results show that SE, ACR, and PBC strongly encourage entrepreneurial intention, while motivation alone is not enough without supportive conditions. WEI itself is a powerful driver of empowerment, enhancing economic independence, social recognition, and psychological confidence. FS further helps women translate motivation into intention, while WEI mediates the link between resources and empowerment. These insights highlight the need for confidence-building, better access to resources, and family-inclusive interventions, offering managerial implications for training, mentoring, and financial design, and theoretical contributions by adapting TPB to collectivist contexts such as Bangladesh.

Paper ID: ICSHSD-465

AI in Service Sector: Necessities and Effects

Sumaiya Jahan Nusrat[1], and Jerin Atiya Ibnat[1*]
[1]Department of Genetic Engineering and Biotechnology, East West University, Dhaka, Bangladesh.
Corresponding author: atiyaibnat11@gmail.com

ABSTRACT
The purpose of this research is to examine the necessity and effects of Artificial Intelligence or AI in the service sector. As AI is predominant in our everyday lives, there is a scope to explore the rapid adoption of AI technologies in areas such as banking, private company, customer support, healthcare, education, and the significant impact these changes have on efficiency, customer satisfaction and employment. This study investigates the benefits, challenges, and ethical considerations of AI implementation in the service sectors of Bangladesh. Individuals working in various job sectors, and postgraduate students participated in this study. This study applied a mixed-method approach that included survey questionnaire and interview as tools for data collection. In total, responses were received from 63 participants. Participants represented different age groups and various job sectors, providing diverse perspectives on AI's role in their professional and personal lives. Findings indicate that AI enhances speed, saves time, improves customer satisfaction, boosts work efficiency, and accuracy but it also raises concerns over job displacement and data privacy. This study concludes that while AI has become essential for competitiveness in the service sectors, balanced implementation with human oversight is crucial for sustainable growth.

Paper ID: ICSHSD-519

Migration and the Informal Sector: Sustainability Challenges for Marginalized Groups in Chattogram City

Md Mozzammel Masum[1*]
[1]Department of Sociology, University of Chittagong, Chattogram - 4331.
*Corresponding author: contact.mozzammelmasum@gmail.com

ABSTRACT

Port City Chattogram faces a range of challenges linked to globalization, but one of the most significant issues is the tension between migration, the informal sector, and sustainability. As a crucial urban hub of Bangladesh, one of the fastest-growing developing countries with rapid population growth, migration has become a natural process, where surplus rural people go to cities in search of work. However, the limited growth of the urban job market often fails to absorb labor due to skill mismatches, lack of job security, and inadequate wages. In this gap, the informal sector emerges as the only shelter for these migrants. Most of these people are compelled to reside in urban slums, where they remain marginalized. Restricted mobility and weak policy support further reinforce their exclusion. But these same groups play an outstanding role in sustaining urban life by providing essential services that fuel globalization, also. This study aims to explore how such marginalized groups simultaneously contribute to urban development while also posing sustainability challenges in terms of livelihoods and social inclusion. The research will adopt a qualitative approach, focusing on several informal communal occupations within Chattogram and examining their linkages to the city's central economic activities. Particular attention will be given to the dynamics of exclusion and the structural constraints that prevent them from accessing proper recognition and advantages. It is expected that the findings will highlight both the policy gaps and the overlooked contributions of the informal sector to Chattogram's economy. By bringing these issues to light, the study prioritizes reframing marginalized migrants not only as service providers but also as one of the most significant stakeholders in urban development. In conclusion, it argues for the need to incorporate their realities into public policy, making them a priority for economic sustainability and inclusive growth.

Sub-theme: Economic and Public Policy for Sustainable Development

Paper ID: ICSHSD-252

A Cross-Sectional Analysis of Dietary Habits and Lifestyle Factors Influencing Glycemic Control in the Context of an Adherence Crisis among Type 2 Diabetes Patients in Rajshahi City

Tithy Saha[1] & Soumitro Kumar Das[2*]
[1]Department of Food and Nutritional Science, University of Rajshahi, Rajshahi-6205, Bangladesh.
[2]Department of Applied Mathematics, University of Rajshahi, Rajshahi-6205, Bangladesh.
Corresponding author: sdasshuvro@gmail.com

ABSTRACT

The management Type 2 diabetes remains a critical concern in terms of public health that requires the need to understand the associated dietary and lifestyle factors. This paper examined the correlation between dietary pattern and physical levels of activity with glycemic control in 150 patients with type 2 diabetes at Rajshahi Diabetic Association General Hospital. We collected data through structured surveys and clinical measurements, and to analyze data, we applied various statistical methods, such as Pearson correlations, t-tests, chi-square tests, Mann-Whitney U, and Kruskal-Wallis tests with SPSS 27. Using a cross-sectional approach, we evaluated the relationship between the Total Daily Energy Expenditure (TDEE), calorie intake, and metabolic health. The result showed significant calorie overconsumption, which strongly correlated with pre-meal blood glucose spikes ($r = 0.335$, $p < 0.01$), while higher physical activity demonstrated the reverse effect with glucose spikes after meals ($r = -0.174$, $p = 0.033$). Gender-based analysis indicated females have more relative overconsumption (52.51% versus 36.79% in males, $p = 0.093$), potentially due to their sitting roles, and as age increased, physical activity involvement was also diminished ($r = -0.243$, $p < 0.01$), hence indirectly influencing glucose management. Though the hospital took dietary awareness classes, we found 92% of participants did not comply with the calorie intake guidelines, addressing a critical knowledge-practice gap. These findings underline the importance of specific interventions in dietary compliance and physical exercise, especially in females and older people, and provide insights on healthcare policy to address the diabetes management crisis in both clinical and community settings for sustainable development.

Paper ID: ICSHSD-15

AI's Role in Bangladesh's Economic Growth: A Comprehensive Sectoral and Policy Analysis

Nazmus Sakib Apurba[1] and Sadiya Afrin Reba[2]
[1]Department of Computer Science and Engineering, International University of Business Agriculture and Technology, Dhaka, Bangladesh
[2]Department of Economics, International University of Business Agriculture and Technology, Dhaka, Bangladesh
Corresponding author: nazmussakibapurbo@gmail.com

ABSTRACT

Artificial intelligence has become an important part of Bangladesh's economic shift towards a digital economy. In this study we collected and analyzed 500 data points from various sectors using a structured questionnaire to examine AI's effects on Information technology, agriculture, textiles, pharmaceuticals, fintech, manufacturing, healthcare, education, disaster management etc. We have observed the highest impact score in Agriculture (54.5%) as our country is an agricultural country. Agriculture plays an important role in our economy. Our key findings suggest a potential productivity boost and improvements in economy. Here we have also identified challenges like- skill shortages and ethical concerns that need attention. Our recommendations emphasize partnerships, education, infrastructure and reskilling. By analyzing the primary data, we have proposed a formula to determine the AI impact on different economic sectors of Bangladesh.

Paper ID: ICSHSD-156

Assessing Preparedness of Educational Institutions for Future Pandemics: Lessons from COVID-19

Farha Tanzin[1*]
[1]Assistant Professor, Dhaka University of Engineering & Technology (DUET), Gazipur.
[*]*Corresponding author: farhanodee@duet.ac.bd*

ABSTRACT

The COVID-19 pandemic exposed critical vulnerabilities in educational institutions worldwide, revealing how unprepared campuses were to address large-scale health emergencies. This study aims to evaluate pandemic preparedness within educational institutions, with a specific focus on the Dhaka University of Engineering & Technology (DUET), as a representative case. The research investigates the existing condition of institutional infrastructure and services regarding pandemic preparedness for future pandemic. The research follows qualitative research method including literature review, systematic field observation and structured questionnaire survey. The combination of the methods was selected to ensure the deep spatial analysis. Questionnaire administered to students, faculty members, and healthcare professionals associated with DUET. Field observations examined space configuration, circulation patterns, and the availability of infection-control facilities, while questionnaires captured experiences, perceptions, and preparedness gaps as reported by the university community. Together, these approaches provided a comprehensive assessment of institutional preparedness.The results show that DUET has inadequate preparedness to manage pandemic related challenges. Observations and questionnaire revealed that there is limited infrastructure for physical distancing, insufficient ventilation measures, and inadequate isolation facilities. This research would emphasize shortcomings in the COVID-19 response by DUET and identify the necessity of preparedness plans, which should combine spatial planning, healthcare infra-structure, and operational resilience. The coronavirus pandemic teaches policy experts how to safeguard well-being, maintain schooling continuity, and resilience on the system level. The results can be appealing to policymakers, administrators and planners who are serious about providing safe, sustainable learning environments.

Paper ID: ICSHSD-88

Socio-Economic And Environmental Determinants of Migration in The Haor Basin of Bangladesh: A Statistical Analysis

Amit Das[1] Anupoma Das Poly[2] Susmita Das[3]
[1]Department of Business Administration, Shahjalal University of Science and Technology, Sylhet, Bangladesh.
[2]Department of Sociology, Shahjalal University of Science and Technology, Sylhet, Bangladesh.
[3]Department of Sociology, Shahjalal University of Science and Technology, Sylhet, Bangladesh. **Corresponding author: amitdas.info2@gmail.com*

ABSTRACT

This study examines the patterns of labor migration using a case of the Haor Basin, Bangladesh, highlighting the socio-economic and environmental determinants of large-scale labor migration in this area. This paper examines the drivers and linkages by which improved living conditions, migration networks, and livelihood strategies increasingly pull urban migrants, and how natural disasters act as a push factor, thereby amplifying out-migration from vulnerable areas. The study also examines the socio-economic impact of migration on the households in the localities with respect to change in income, family structure, community, and gender relations. Such analysis is essential to informing social welfare and economic development policies in the regions potentially impacted by migration. This study uses a survey-based, quantitative approach to assess migration patterns in the Haor Basin, Bangladesh. Push and pull factors were evaluated by a structured questionnaire with only closed-ended questions on a 5-point Likert scale. Hypotheses were tested using statistical methods: principal component analysis (PCA), reliability analysis (Cronbach's alpha), and regression analysis. Results suitable for reliable and generalizable use were obtained, and the sample size was calculated using Cochran`s formula. Migration causes and duration are the focus of the study, and regression analysis is used to examine the relationship between relevant variables. The study finds that the economic push factors, such as unemployment, income disparity, poverty, and economic inequality, are the main drivers of migration from the Haor basin. Factors also include environmental challenges, such as climate and extreme weather, and socio-cultural factors, such as social stratification and migration networks. PCA and regression models reveal that these push factors are the main determinants. Also, other demographic variables like age, marital status, and education are important in migration choices as migrants in host countries seek out better jobs and wider living conditions.

Practical Implications: The study points out that for climate-affected communities to stay in their localities, it is necessary to create jobs, provide basic facilities, and offer social services to make them more resilient against the effects of climate change, which in many cases has forced people to leave their areas of residence. The limitations of the study includes non-response bias, limited representation of socio-cultural diversity, and difficulties capturing seasonal migration and undocumented patterns of mobility.

Paper ID: ICSHSD-251

Spatio-Temporal Analysis of Meghna Riverbank Dynamics for Sustainable Policy in Bhola (1990–2035)

Muhammad Sajibul Islam[1], Md. Rashel Morshed[2], Jitu Mohajan [3]*
[1,2,3] Department of civil Engineering, Dhaka University of Engineering & Technology, Gazipur
**Corresponding author: 201057@student.duet.ac.bd*

ABSTRACT

The Meghna River, a big component of the Ganges-Brahmaputra-Meghna (GBM) system, is drastically changing morphologically with intense the riverbank erosion causing immense social-economic and environmental challenges on the communities of the Bhola District. The paper has used remote sensing and GIS in analyzing bank erosions in the rivers between 1990 and 2025. The Landsat imagery was used to process the ArcGIS with MNDWI identifying the water bodies and DSAS was used to calculate the erosion and accretion on the use of End Point Rate (EPR) and Net Shoreline Movement (NSM). The analysis shows dynamism in the river bank activities with extensive economic impact. The net accretion rate of the study area was calculated to be 4.56 meters/ year over the 35 years (1990-2025), equivalent to about 13.03 percent change on annual basis as compared to baseline conditions. Temporal disaggregation however indicates contrasting results: 1990-2005, slow rates of erosion of only -0.42 meters/year (-1.20% annually) but 2010-2025, the erosion rates were severe at -27.51 meters/year (-78.60% annually), indicating a significant acceleration in the bank retreat with significant economic implications. The district of Bhola has witnessed extreme effects of riverbank erosion with 74.73 percent of its population being affected to migrate. There has been a considerable reduction in agricultural productivity of 38 percent cropland in three decades. These findings clearly indicate that there is a dire need to have evidence-based economic planning and policies to guide the sustainable management of rivers and riverbanks. Spatial planning, early-warning systems and erosion mitigation policies have the potential to protect livelihoods and maximize land-use strategies, minimize loss of financial resources in flood susceptible regions. Incorporation of predictive modeling in policy frameworks is one of the best ways to improve resilience, so that, communities who experience fluvial hazards continue to maintain sustainable development.

Paper ID: ICSHSD-263

Role of Social Media and Mainstream Media During the July Uprising in Bangladesh: A Comparative Analysis

***Md. Hasan Al Azad[1], and Mohammad Kawsar Ahammed[2]**
[1]Lecturer, Department of Humanities and Social Sciences, Dhaka University of Engineering & Technology, Gazipur
[2]Lecturer, Department of Humanities and Social Sciences, Dhaka University of Engineering & Technology, Gazipur
**Corresponding Author: md.hasan.al.azad@gmail.com*

ABSTRACT

Although media is a cornerstone for democratic countries, aberration from its normal role can yield significant repercussions in societies. The July uprising in Bangladesh, which led to the overthrow of the authoritarian Awami League regime on August 05, 2024, revealed divergent roles of media platforms during this critical period. In fact, it highlighted sharply contrasting roles of social media and mainstream media, which shaped the course of the movement in various ways. Therefore, the objective of this research is to assess and compare how social media and mainstream media shaped public opinion and mobilization during the July uprising. Using the comparative case study approach, two cases, namely social media platforms and mainstream media, are selected based on the most similar systems design. The research employed the qualitative research method to conduct the study. For data collection, media frames are identified using the framing theory, and secondary data were collected from social media and mainstream media platforms. Finally, the collected data were analyzed employing the thematic analysis technique. This research concludes that social media played a more significant role in the real-time mobilization of the movement than mainstream media. Moreover, mainstream media showed greater self-censorship and framing aligned with state narratives. Finally, this study suggests the government make balanced regulations regarding digital media and ensure transparency and accountability in mainstream media operations in Bangladesh.

Paper ID: ICSHSD-282

Expansion of Cities: Analyzing Urban Expansion and Sustainability Challenges in Chattogram

Tanjiha Binte Kabir[1]
[1]Department of Sociology, University of Chittagong
**Corresponding Author: tanjihakabir89@gmail.com*

ABSTRACT

Urbanization and industrialization are key drivers of city expansion in Bangladesh. As the country's commercial capital Chattogram city centered around the Karnaphuli River and its industrial growth has experienced rapid migration from rural areas due to employment opportunities in garment factories and other industries. However, unplanned urbanization led to various challenges including the rise of slum areas, waterlogging, traffic congestion, gas shortages, electricity shortages, informal housing, inadequate infrastructure, poor waste management, hill-cutting and loss of biodiversity now characterize the urban fabric of the city resulting in numerous socio-economic and ecological challenges. Sustainable urban planning therefore emerges as a necessary framework to balance economic growth, environmental resilience, and social equity. The focus of the study is to identify urban patterns, major factors of city expansion, urban challenges and the proposal of sustainable urban growth for next generation.

Paper ID: ICSHSD-281

Public Policy and Its Importance to Achieve Sustainable Development: With Special Reference to Sri Lanka

[1]Nisanka Sanjeewani Ariyarathne
[1]Department of Public Policy, Faculty of Humanities& Social Sciences, University of Ruhuna Marata, Sri Lanka
**Corresponding Author: nisanariyarathne@yahoo.com*

ABSTRACT

Sri Lanka gained independence from British colonial rule in 1948. The process of state formation and nation-building in Sri Lanka has presented significant challenges. The first three Sri Lankan leaders were strongly pro-British and lacked a comprehensive perspective on sustainable state-building aligned with national interests. They applied a British Westminster-type constitution and continued British public policies after independence. Subsequently, Sri Lanka changed its constitution in 1972 and 1978, respectively, in accordance with the ruling political parties' interests rather than sustainable development in the country. In later years, leaders formulated public policies based on the IBRD or IMF suggestions, and the popular political agendas of leaders. It is obvious that they adopted Western public policy models without proper analysis. The main objective of this research is to examine why Sri Lanka lags in implementing public policies related to sustainable development. This research mainly employs a qualitative research methodology. Most of the collected data are non-numerical, and the gathered data are analyzed through content analysis. In this research, the following steps were implemented for data analysis. In the initial stage, the researcher defines the research question and selects data sources (including policy documents, books, and government reports). Subsequently, a coding scheme was developed by categorizing policies under themes such as incentives and subsidies, education, environment, economic, social welfare, research and innovation, and external affairs. In the next stage of this study, the researcher analyzed patterns and trends and finally came to conclusions. The findings of the study indicate that, Sri Lanka economy is highly dependent on international financial institutions and that it is still in a debt trap. By and large, Public policies since independence have been far behind in addressing sustainability and have not gained expected outcomes due to the lack of accountability of rulers. In the post-war period, introduced mega development projects to achieve rapid development; however, there were several policy implementation issues, and the expected optimistic consequences were not realized due to fiscal mismanagement, impractical political decisions and heavy state-centered welfare policies. The country is further victim of the financial dominance of other countries and has lost its external sovereignty. In conclusion, there is little and short-term sustainability implementation in Sri Lankan public policy. Public policies have shifted with changes of government power. A considerable number of public policies is driven by the ruling political party, focusing more on consolidating its power than on sustainability.

Paper ID: ICSHSD-283

District-Level Dynamics of Tree Cover Change in Bangladesh: Policy Implications for Sustainable Development

Atiqur Rahman[1*], Akramul Haque[2] Md Alamgir Hossin[3], Ovi Ranjan Saha[4]
[1]Department of Civil Engineering, Dhaka University of Engineering & Technology, Gazipur, Bangladesh.
[2]Institute of Water and Environment (IWE), Dhaka University of Engineering & Technology, Gazipur, Bangladesh.
[3]Institute of Water and Environment (IWE), Dhaka University of Engineering & Technology, Gazipur, Bangladesh.
[4]Department of Water Resources Engineering, Bangladesh University of Engineering and Technology, Bangladesh.
Corresponding Author: akramul@duet.ac.bd

ABSTRACT
This study evaluates district-level dynamics of tree cover change in Bangladesh over the period 2017–2023 using GIS and remote sensing, providing understandings for sustainable development policy and natural resource ascendency. The analysis reveals significant heterogeneity across districts: while some regions such as Bhola, Lakshmipur, Noakhali experienced gains in tree cover, most districts recorded consistent declines. The magnitude of losses was particularly pronounced in densely populated or agriculturally intensive areas such as Bogra, Dhaka, Dinajpur, Jaipurhat, Jessore, Jhenaidah, Kishoreganj, Kurigram, Lalmonirhat, Manikgonj, Naogaon, Narayangonj, Nasirabad, Netrakona, Nilphamari, Panchagarh, Rongpur, Thakurgaon where reductions exceeded 40% in certain districts. Overall, Bangladesh recorded a net decline in tree cover between 2017 and 2023, with sharper contractions observed in the 2017–2020 period compared to 2020–2023. These patterns underscore the combined pressures of urban expansion, agricultural escalation, and inadequate conservation incentives. The findings highlight critical trade-offs between economic growth and ecological resilience, pointing to the need for cohesive policy frameworks that balance livelihood demands with ecosystem sustainability. Strengthening afforestation programs, promoting community-based forest management, and line up local land-use planning with national sustainability goals are essential strategies to reverse ongoing declines. By providing district-level evidence, this study contributes to the broader address on sustainable resource governance and supports data-driven policymaking for climate-resilient development pathways.

Paper ID: ICSHSD-290

Predictive Statistical Analysis of Under-5 Child Mortality and SDG Targets in Bangladesh, India, and The Maldives (2000–2023)

Anika Nawar Jahan[1], Manjur-E-Elahi Shimul[2]
[1]Department of Statistics, University of Chittagong, Chittagong-4331, Bangladesh,
[2]Department of Statistics, University of Chittagong, Chittagong-4331, Bangladesh
**Corresponding author: anikastatcu@gmail.com*

ABSTRACT
Child mortality in South Asia remains a major public health concern despite global efforts to achieve SDG 3.2, which aims to reduce under-five deaths to less than 25 per 1,000 live births by 2030. This paper predicts the under-five mortality rate of 2030 in Bangladesh, India, and the Maldives using data from 2000 to 2023, considering key factors such as malnutrition, pneumonia, diarrhoea, breastfeeding practices, health expenditures, and access to essential services. In particular, malnutrition, especially stunting and wasting, weakens immunity and makes children more vulnerable to infections, while pneumonia and diarrhoea remain major causes of mortality in Bangladesh and India (Khan et al., 2006; Salam et al., 2015; Perin et al., 2022). To address data gaps, multiple imputation with the Markov Chain Monte Carlo method was applied to handle missing data and obtain reliable estimates. Subsequently, exponential smoothing was then used to forecast independent variables for 2024-2030, as it captures recent trends in health indicators. Moreover, the estimated values were fitted into a multivariable linear regression model to assess predictors of under-five mortality, providing an evidence-based analysis of progress towards SDG 3.2 (Acheampong et al., 2017). The regression models show strong fits in all three countries with R^2 values above 80 percent. Specifically, in Bangladesh, stunting emerges as the most significant factor, highlighting the role of child nutrition. In India, health spending shows a positive association with mortality, indicating inefficient resource allocation, while health support and wasting show comparatively smaller impacts. In contrast, the Maldives has strong negative coefficients for health support services, driving reductions in mortality, underscoring the importance of accessible and quality healthcare. Regarding multicollinearity, it is not an issue, as indicated by low Variance Inflation Factor (VIF) values; and the imputed datasets are statistically reliable, with Fraction of Missing Information (FMI) within acceptable limits. These diagnostics confirm the robustness of the models and reliability of the results. Overall, this study applies careful data handling, forecasting, and regression analysis to identify key causes of child mortality and provide a model for predicting future trends. The findings emphasize the need to improve child nutrition and healthcare services to sustain reductions in under-five mortality and guide policymakers in achieving SDG 3.2 by 2030.

Paper ID: ICSHSD-291

Decoding the Triple-Force Commitment of Accounting Educators in Curriculum Change: Bangladesh Perspective

Rehana Fowzia[1*]
[1]Associate Professor, Department of Business Administration, Stamford University Bangladesh.
Corresponding author: rehana.fowzia@gmail.com

ABSTRACT

Faculty members play a major role in the success of any curriculum reform in higher education. This study sought to examine the factors influencing the commitment of accounting educators toward the continuous change of the curriculum by testing a three-component model of commitment. This model comprises three components of commitment: affective commitment, continuance commitment, and normative commitment. This research employed a quantitative survey method to collect data from accounting faculties in a purposively selected sample of universities in Bangladesh. A sample of forty participants completed a five-point Likert scale measuring agreement with statements based on the three-component model of commitment. Faculty attitudes and agreements were tested with one-sample t-tests to ascertain if they significantly differed from neutral levels. This analysis sought to assess the relative strength of various types of commitment to the curriculum change. The analysis showed that commitment based on emotional attachment and identification was the strongest contributor to supporting the reform. Faculty members supporting the curriculum reforms were those who strongly perceived the changes to be congruent with their values and professional aspirations. Faculty members who strongly endorsed the reform exhibited a strong continuance commitment. Continuance commitment led faculty to support reforms to avoid negative outcomes, such as administrative penalties or professional stagnation. Normative commitment also played a role. Some faculty members felt pressured to comply due to institutional expectations or peer pressure. In summary, the findings suggest that faculty support comes from a mix of internal motivation and external pressure. The research showed that building affective commitment is crucial for sustainability. Academic leaders and policymakers should focus on clear communication, shared decision-making, and training opportunities to foster affective commitment and improve faculty engagement in curriculum change. By removing institutional barriers and reducing fear-based compliance, faculty can engage more fully in meaningful reform processes with lasting commitment. This study adds to the literature on change management in higher education by providing research on the psychological and institutional factors that shape faculty responses to curriculum change. By applying the three-component model of commitment to accounting education in Bangladesh, the study gives practical insights for academic leaders looking to move faculty from simple compliance to true and lasting commitment to curriculum change.

Paper ID: ICSHSD-310

Exploring the Dual Impact of FDI and Trade Openness on Renewable Energy Consumption in RCEP Countries Focusing on Sustainable Energy

Anika Tasneem[1*], Dr. Md Nazmus Sadekin[1,2], Md Mazadul Hoque[2], Farhana Yeasmin[2,3], Ashiqur Rahman[1], and Md. Tuhin Ahmed[1]
[1]Department of Economics, Mawlana Bhashani Science and Technology University, Santosh, Tangail-1902, Bangladesh.
[2]Policy Think & Economic Research Center (PTERC), Bangladesh.
[3]Department of Development Studies, University of Chittagong, Chittagong-4331, Bangladesh.
Corresponding author: anikatasneem7303@gmail.com

ABSTRACT

This study examines the impact of trade openness and foreign direct investment (FDI) on the adoption of sustainable energy in Regional Comprehensive Economic Partnership (RCEP) countries, using panel data from 1998 to 2022. The Pesaran (IPS) and Phillips-Perron tests confirm the stationarity of the data, while the Pedroni cointegration test reveals a long-term relationship between the variables, confirming the theoretical relationship between economic factors and renewable energy adoption. The paper employs Dynamic Ordinary Least Squares (DOLS), Fully Modified Ordinary Least Squares (FMOLS), and Pooled Ordinary Least Squares (POLS) to analyze these relationships, with Canonical Cointegration Regression (CCR) ensuring the robustness of the results. Findings indicate that FDI positively influences sustainable energy use, highlighting its role in promoting renewable energy transitions through capital investment and technology transfer. However, trade openness negatively impacts sustainable energy consumption, suggesting that trade liberalization in RCEP countries might increase reliance on non-renewable energy sources or environmental trade-offs. These results have significant policy implications, underscoring the need for RCEP nations to attract sustainable FDI, implement trade policies that prioritize the environment, and strengthen financial systems to support renewable energy adoption. This research contributes to the broader conversation on sustainable development and energy policy, providing valuable insights into the economic drivers of renewable energy consumption in developing countries.

Paper ID: ICSHSD-320

Assessment of Women's Contributions in the Livestock Sector of Bangladesh

Dr. Most. Mahfuja Khatun[1], Dr. A.S.M. Ashab Uddin[1], Md. Razibul Hassan[1*], Farzana Yasmin[1], Dr. Shahana Nazneen[1], Md. Bakhtiar Kakee[1], and Dr. Sadek Ahmed[1,2]

[1] Training, Planning and Technology Testing Division, BLRI, Savar, Dhaka

[1,2] Training, Planning, and Technology Testing Division and Goat Production Research Division, BLRI, Savar, Dhaka

**Corresponding author: razibulhassan@blri.gov.bd*

ABSTRACT

Livestock constitutes a vital subsector of agriculture and a key driver of Bangladesh's rural economy, engaging both men and women in diverse roles. Despite women's significant participation, their contributions have often been undervalued or overlooked. This study was conducted to assess women's contributions to livestock production across different farm sizes and livestock types, identify determinants of women's empowerment in the sector, and explore associated challenges and opportunities for strengthening women-led livestock farming. A mixed-methods approach was adopted, combining quantitative and qualitative tools. Farm size was categorized based on herd size: small (1–3 cattle), medium (4–5), and large (5+). The study purposively selected 208 smallholder women livestock farmers from 12 villages in Shahjadpur Upazila, Sirajganj district. Data were collected through structured interviews and analyzed using Microsoft Excel 2019 and R Studio 4.5.0. Descriptive statistics and the Women's Empowerment in Livestock Index (WELI) were employed to evaluate empowerment levels. The findings indicate that the respondents' mean age was 40.68 ± 0.70 years, with 68.75 % aged between 31 and 50 years. Literacy rates varied significantly by age group ($p < 0.01$), being highest among women aged 51+ (88 %), moderate among those aged ≤ 30 (45 %), and lowest in the 31–50 age group (5 %). Most respondents were married (96.2 %), with a mean household size of 4.03 ± 0.07 members. On average, households owned 2.7 ± 0.23 indigenous and 5.95 ± 0.29 crossbred cattle, totaling 5.74 ± 0.26 animals. The mean livestock asset value per household was approximately Tk. 698,702 ± 37,121.31. Dairy farming emerged as the dominant enterprise (39.5 %), followed by combined farming (36.5 %) and beef fattening (24 %). In terms of experience, 43.8 % of respondents reported dairy farming, 38.5 % combined farming, and 28.4 % beef fattening. Larger farms (39.9 %) were most prevalent. Men were slightly more involved than women in livestock activities (1.23 vs 1.11 participants per household), and only 23.08 % of women belonged to farmers' organizations. Farm income was significantly higher than non-farm income ($p < 0.001$). WELI score distribution showed that empowerment levels were generally high: 54.33 % of respondents scored between 0.6 and 0.8, while 33.17 % scored between 0.8 and 1.0. Only 12.5 % fell in the 0.4–0.6 range, and none were found in the lowest empowerment categories. These findings highlight a predominantly empowered population, though targeted interventions are needed to elevate the moderately empowered group to higher levels.

Paper ID: ICSHSD-351

Community-based Tourism and Empowering the Santal Community in Bangladesh: Challenges and Opportunities

Muhammad Mahmudur Rahman[1], and Md. Alomgir Hossan[2*]
[1]Professor, Department of Political Science, University of Rajshahi, Rajshahi 6205, Bangladesh.
[2]Department of Political Science, University of Rajshahi, Rajshahi 6205, Bangladesh.
Corresponding author: alomgirhossan101@gmail.com

ABSTRACT
Community-Based Tourism (CBT) has become an important sustainable approach for poverty reduction, cultural presentation, and community empowerment. This research examined the involvement of the Santal Community in community-based tourism (CBT), the most disadvantaged group in Bangladesh. In this study, we have utilized a mixed methods (Qualitative and Quantitative) approach to analyze the opportunities and constraints of the Santal Villages in Bangladesh. Our study area was Rajshahi and Naogaon, which represent the Santal community. We have built a Structured Questionnaire for primary data collection and a simple random sampling technique. Secondary data were also collected from different sources such as published journal articles, news articles, and government documents. We have analyzed our data using R Studio. Our major findings suggest that CBT contributes to alternative income sources, enhancing women's participation in decision making, interacting with cultural identities, and interest in preserving indigenous cultural heritage. In this study, we have also focused on the United Nations Sustainable Development Goals (SDGs), especially SDG 1(No Poverty), SDG 5(Gender Equity), SDG 8(Decent Work and Economic Growth), and SDG 10(Reduced Inequalities), which reveal that Santal does not contribute to fulfill the SDGs properly. They feel uneasy and uncomfortable with others. To meet these SDGs and to bridge coexistence with them, we need to overcome challenges, including insufficient infrastructure, weak policy support, exploitative practices, and the risk of cultural commodification. This study argues that the implementation of CBT not only provides potential for sustainable tourism management but also contributes to Bangladesh's commitment to achieving the 2030 Agenda for Sustainable Development and protecting environmental issues. Proper training, communication, cultural diversification, and building a local market could provide economic and environmental improvement in the Santal Community, as well as other communities. This study suggests improving collaboration among the government, NGOs, and the private sector to create a supportive environment for achieving sustainable community-based tourism in Bangladesh.

Paper ID: ICSHSD-408

Migrants' experiences of vulnerability and coping in the context of Community-Based Disaster Risk Management: A study of urban slums in Chattogram

Rifat Hossen[1*]
[1]Department of Sociology, University of Chittagong, Hathazari, 4330, Chattogram.
Corresponding author: rhossen2352@gmail.com

ABSTRACT
Chattogram is known as a commercial hub in Bangladesh and the fastest-growing city that attracts many migrants, particularly from rural areas affected by climate change. As Chattogram is a coastal city, many people face disaster problems and often remain excluded from Community-Based Disaster Risk Management (CBDRM) initiatives. The study explores the barriers migrants face in accessing CBDRM support during and after disasters. The study employs qualitative methods of data collection, including in-depth interviews, key informant interviews, and focus group discussions, to gain insight into the lived experiences, perceptions, and challenges of the most affected migrants in the city, as well as their involvement in CBDRM activities. The findings indicate that migrants face unstable housing, insufficient drainage, and risks of flooding, with women expressing concerns regarding safety and sanitation during disasters. They frequently face exclusion from formal urban disaster governance planning, early warning systems, and relief distributions, and are often regarded as "outsiders." As a result, they rely on informal coping strategies, such as borrowing money and food from neighbors, building temporary shelters, engaging in religious and youth-led support, and utilizing family networks. The study emphasizes the necessity of adopting migrant-inclusive CBDRM policies and localized support systems to promote equitable disaster resilience in urban slums.

Paper ID: ICSHSD-461

Unplanned Urbanization and Its Impact on City Life: An Empirical Study on Chattogram Metropolitan City

Afia Anzum[1*]
[1]University of Chittagong, Hathazari, 4330, Chattogram.
Corresponding author: anzumafia@gmail.com

ABSTRACT

Unplanned urbanization is one of the biggest threats for Chattogram metropolitan city and the people living here. Urbanization here is happening in a totally unplanned way, so the urban dwellers are facing troubles in different aspects of city life. This study focuses on the impact of unplanned urbanization on city life in Chattogram metropolitan city. It also investigates the reasons behind unplanned urbanization and finds out some appropriate solutions to mitigate the problem. This study uses qualitative research techniques and uses in depth interviews, content analysis, observation and FGD as data collection methods. Muradpur, Chawk Bazar, Halishahar and Bahaddarhat have been chosen as the study area and the people who are currently living in Chattogram metropolitan city are the study population. By using purposive sampling technique,34 samples have been selected. Thirty in depth interviews and a FGD with four participants have been performed to collect necessary information. Relevant news articles about Chattogram city have been used for the content analysis and for data analysis thematic analysis is used. The findings revealed that unplanned urbanization has a very negative impact on city life. Social, economical, environmental, physiological and psychological effects of unplanned urbanization is seen on city life. The main reasons which are responsible for this phenomenon includes migration, unequal distribution of wealth, corruption and negligence of government authorities, lack of consciousness among common people, influence of political leaders, non implementation of laws etc. Lastly, the study proposed some policy recommendations to mitigate the problems related to unplanned urbanization and also suggested some ideas about future development.

Paper ID: ICSHSD-469

Community Perceptions of Femicide in Bangladesh: A Sociological Analysis of Jobra Village

Bristy Rani Sarker [1*]
[1]Department of Sociology, University of Chittagong, Bangladesh.
Corresponding author: bristyranisarker556@gmail.com

ABSTRACT

Femicide is the term which essentially means being violent towards women with the intent of killing them. It is the most extreme act of violence towards women. Femicide is becoming a global abuse issue with each passing moment. Misogynistic mentality happens to be one of the most crucial, if not the most crucial, reasons for such an inhumane act. This monograph focuses on the people of the Jobra village near Chittagong University, and how they perceive this act of extreme violence. The research also tries to find out the way the village people think of femicide culture, religion, society, and socio-economic aspects. The research used both qualitative and quantitative methods to collect data. Both closed and open-ended survey questions were provided for the interviewees. According to the people interviewed, the findings show that the main reasons for femicide are mostly dowry, romantic relationships against parents' wish, patriarchal practices, religious extremism, and extra marital affairs. However, the study recommends that femicide can be prevented if the law works strictly with women who are abused and punishment is strictly placed for the abuser/killer, and with the right and strong awareness against femicide. Overall, this research gives valuable insight into the community's perception of femicide in a specific rural context in Bangladesh.

Paper ID: ICSHSD-473

Sustainable Livelihood Strategies for Local Communities: An Empirical Study in the Coastal Sundarbans of Bangladesh

Maruf Ahmmed[1*], and Sadrul Alam Kanok[2]
[1]Lecturer, Department of Sociology, University of Chittagong, Chittagong-4331, Bangladesh.
[2] Lecturer, Department of Sociology, University of Chittagong, Chittagong-4331, Bangladesh.
Corresponding author: marufahmmed@cu.ac.bd

ABSTRACT
The Sundarbans Delta, spanning coastal India and Bangladesh, commands a vast expanse over the northern Bay of Bengal, encompassing 10,000 km2 of which 62% of this magnificent mangrove forest lies in Bangladesh. The Sundarbans mangrove forest in Bangladesh is a crucial resource with numerous significances for the residents' livelihood and the national economy. Approximately one million people are directly or indirectly dependent on the resources of the Sundarbans for their livelihoods, yet their dependency is under pressure due to the impacts of climate change, dwindling resources and misgovernance. In this backdrop, this study aims to shed light on the livelihood vulnerability and resilience of forest-dependent communities of Sundarbans. More specifically, we will examine how forest-dependent individuals manage their livelihoods, what are their livelihood threats and how do they overcome those challenges. Findings suggest that sustainable livelihood solutions ensure the economic well-being of the local population without jeopardizing the delicate mangrove ecosystem. In this mixed-method field research, necessary data will be collected from the target population by conducting a survey using a structured questionnaire and FGDs case study methods. By applying all of this a new model should prioritize the probable impacts of climate change, ecological reliability, supportability in gathering, and the continuity of environmental services for future generations of both human sustainable livelihood and the ecosystem itself. Additionally, we will investigate the communities assets, the challenges they face, and their efforts to diversify sustainable livelihood strategies.

Paper ID: ICSHSD-478

The Role of Islamic Banking in Achieving Sustainable Development Goals (SDGs) in Bangladesh: An Empirical Insight

Mamunur Rashid[1*], Mohammad Faizul Haque[1], and Muhammad Salah Uddin[2]
[1]Department of Humanities & Social Sciences, Dhaka University of Engineering and Technology, Gazipur
[2]Researcher, University of Foggia, Italy
Corresponding author: mrashid@duet.ac.bd

ABSTRACT
The banking system in Bangladesh has been transitioning gradually to an ethical and sustainable financial system through Islamic banking. This research examines the relationship between Islamic banking and the sustainable development goals of Bangladesh, particularly by measuring the impact of Islamic banking in achieving SDGs. The Islamic banking system is based on risk sharing, equity, and ethical finance, all of which support sustainable development, and this study provides empirical justification for this relation. This study uses time series data for the period of 2000-2024 and employs ARDL models and dynamic regressions to investigate both short-run and long-run relationships. GDP per capita, inflows of FDI, Trade openness, and Education are used as control variables. This quantitative research investigates the overall impact of Islamic banking on achieving sustainable development using the sustainability indicators of SDGs. This study is expected to provide insights for the policy makers and financial regulators to find effective pathways for the inclusive and sustainable development of Bangladesh through strengthening the Islamic banking sector.

Paper ID: ICSHSD-482

Expansion of Cities: Analyzing Urban Expansion and Sustainability Challenges in Chattogram

Tanjiha Binte Kabir[1*]
[1]MSS (Sociology), University of Chittagong.
*Corresponding author: tanjihakabir89@gmail.com

ABSTRACT
Urbanization and industrialization are key drivers of city expansion in Bangladesh. As the country's commercial capital Chattogram city centered around the Karnaphuli River and its industrial growth has experienced rapid migration from rural areas due to employment opportunities in garment factories and other industries. However, unplanned urbanization led to various challenges including the rise of slum areas, waterlogging, traffic congestion, gas shortages, electricity shortages, informal housing, inadequate infrastructure, poor waste management, hill-cutting and loss of biodiversity now characterize the urban fabric of the city resulting in numerous socio-economic and ecological challenges. Sustainable urban planning therefore emerges as a necessary framework to balance economic growth, environmental resilience, and social equity. The focus of the study is to identify urban patterns, major factors of city expansion ,urban challenges and the proposal of sustainable urban growth for next generation.

Paper ID: ICSHSD-496

From Global Trade to Local Scars: Understanding Current Circumstances and Environmental Consequences of the Ship-Breaking Industry in Bangladesh

Istiak Ahmed[1*]
[1]MS Student, Department of Sociology, University of Chittagong, Chattogram-4331, Bangladesh.
*Corresponding author: Istiakahmed555@gmail.com

ABSTRACT
The shipbreaking industry is critical for the nation's economy since it generates employment opportunities, contributes to GDP, and supports the shipbuilding, steel, furniture, construction, machinery, and electrical industries. Even though the country is one of the biggest shipbreakers in the world, this activity was not officially recognized as an industry in Bangladesh until 2006. Despite its profitability and income generation, this industry has dramatically expanded in Bangladesh, and has encountered multiple hurdles due to different detrimental environmental and social impacts that hinder the sustainable growth of this burgeoning field. This research intends to analyze the effects of shipbreaking activities in Bangladesh on the local environment, worker health and safety, and management strategies for industry sustainability. To conduct this research, the study used a qualitative approach to document comprehensive overview of the shipbreaking sector. Primary data has been gathered through conducting 3 FGDs and 9 KIIs. This study concludes that ineffective implementation mechanisms impede the enforcement of shipbreaking regulations in Bangladesh, the economic interests of yard owners, insufficient inter-agency coordination, and inadequate training and awareness among workers, all of which exacerbate environmental degradation and pose health risks to the workers. Adherence to international standards, use of ecologically sound shipbuilding and recycling techniques, and integration of sustainable management practices are essential to alleviating the environmental and health impacts of shipbreaking activities in Bangladesh. Finally, this paper frames some policy implications to safeguard the marine environment and the workers' health rights without damaging the industry's overall competitiveness.

Paper ID: ICSHSD-497

Women in the Mosque: A Socio-Architectural Comparison Between the Early Islamic Period and Contemporary Bangladesh

Md. Sawgat Khan[1], and Nusrat Jahan Fariha[2*]
[1]Assistant Professor, Department of Humanities & Social Sciences, DUET, Gazipur, Bangladesh
[2]Undergraduate Student, Department of Architecture, Dhaka University of Engineering & Technology, Gazipur, Bangladesh
Corresponding author: njfariha99@gmail.com

ABSTRACT

Women's access to religious spaces in Bangladesh remains constrained by deeply rooted invisible boundaries shaped by cultural practices, infrastructural deficiencies, and prevailing social norms. In contrast, when examining the early Islamic period and contemporary Muslim societies, women's access to religious spaces manifests in diverse ways. The Bangladeshi context, however, presents a distinct set of challenges and limitations. This study adopted an interdisciplinary mixed-method approach, integrating both sociological and architectural perspectives. Primary data collection involved semi-structured questionnaires and interviews, combined with case studies and on-site observations. Secondary data included historical Islamic texts, archival mosque records, and international scholarly literature, accessed through online databases, to establish comparative frameworks. Furthermore, GIS mapping was employed to analyze the spatial distribution and accessibility of mosques in relation to residential density and mobility patterns. Findings reveal a persistent absence of dedicated prayer spaces and segregated entrances for women, compounded by strong social prohibitions that collectively restrict female participation in mosque-based religious practices and communal activities, particularly congregational prayers. A historical perspective indicates that during the early Islamic period—most notably in the Mosque of the Prophet at Madinah and other mosques frequented by the Sahaba (the companions of Prophet)—women's participation in congregational worship was both spatially accommodated and socially recognized. These precedents illustrate an architectural and cultural inclusivity that contrasts sharply with contemporary Bangladeshi mosques, where subsequent cultural shifts and design practices have contributed to the marginalization of women from mosque spaces. Such exclusion generates emotional and spiritual consequences with broader implications for social equity and gender inclusion. The research further contrasts mosque design practices in urban Bangladesh with inclusive models observed in other Muslim contexts, emphasizing the critical role of architecture in shaping equitable religious participation. By proposing design and policy interventions such as women-friendly mosque layouts, safe circulation routes, and inclusive facilities, this study contributes to urban planning strategies that integrate spatial justice and social inclusion for women. Ultimately, this research aligns with sustainable development goals by addressing gender inequality and promoting culturally sensitive, inclusive public spaces in Bangladesh's rapidly urbanizing environment.

Paper ID: ICSHSD-508

Farmer-centric AI System for Socially Inclusive Smart Irrigation and Crop Monitoring

Rashidul Islam Sifat[1*], and Md. Sawgat Khan[2]
[1] Department of EEE, Dhaka University of Engineering & Technology, Gazipur.
[2]Assistant Professor, Department of Humanities & Social Sciences, Dhaka University of Engineering & Technology, Gazipur.
**Corresponding author: sifatduet01@gmail.com*

ABSTRACT

Water scarcity, inefficient irrigation, and climatic uncertainty are a few of the greatest concerns for small and medium-scale rural farmers. The present study proposes an AI-based smart irrigation and crop monitoring system that focuses on water optimization, improving the productivity of crops, and sustainable agriculture with particular reference to social impacts on rural farmers. The system integrates soil moisture sensors, humidity and temperature sensors, an ESP32 microcontroller, and solar-powered automation to facilitate data-driven decision-making in irrigation in real time. This study adopted an interdisciplinary mixed-method approach, integrating both sociological and technological perspectives. Lab based experiment, semi-structured interview and case study methods used for both Technical and social data collections. The collected data is processed through machine learning algorithms to predict crop water requirements, detect early signs of crop stress, and suggest optimal irrigation schedules to reduce water and manual labor wastage. In addition to technology, the system focuses on accessibility and ease of use for the local farmers. It incorporates mobile and web interfaces with simple dashboards, enabling farmers to monitor and control irrigation remotely. This approach promotes knowledge sharing, social inclusion, and community empowerment by providing rural farmers with decision support tools for farming. By leveraging IoT and AI, the system creates resilience to climate variability, ensures efficient resource management, and enables rural livelihood improvement. Field trials demonstrate that the system can reduce water consumption by a significant margin without reducing or even improving crop yields, making it an economical alternative for smallholder farming. The project demonstrates how the convergence of emerging technology and social interests can facilitate sustainable and socially responsible farming practices.

Paper ID: ICSHSD-509

Autism Awareness and Special Education in Bangladesh: Pathways to Social Integration

Rohana Afroz[1], and Md. Sawgat Khan[2*]
[1] Department of Sociology, University of Brahmanbaria, Bangladesh.
[2] Department of Humanities & Social Sciences, Dhaka University of Engineering & Technology, Gazipur.
**Corresponding author: sawgatkhan@duet.ac.bd*

ABSTRACT

As a neurological disorder, autism is widely recognized in academic discourse; however, awareness of this issue remains a subject of concern in the context of Bangladesh. This study aims to examine the social integration process of children with autism, focusing on mass awareness and the role of a specialized education system. To assess autism awareness and examine the role of special education, interview schedules were organized for the family members and teachers of children with autism. Using the purposive sampling method, 11 case studies were conducted to understand how the special education system integrates these gifted children. Various statistical methods, including descriptive statistics, are employed to analyze the data. The result showed that parents with higher levels of education (64.6%) are more likely than parents with lower levels of schooling (35.4%) to take proactive actions after they diagnose autism in their children. There are some issues regarding financial difficulties, proper training sessions, and a lack of therapy. 63.6% of parents argued that the government's initiatives were insufficient, and only 54.5% received training. Besides this, it is encouraging to see that 90% of teachers are well-trained, but they should also put pressure on increasing training and awareness of autism. Although 70% of teachers reported not receiving proper feedback on their tasks from family members, 82% of parents observed some positive changes in their children after enrolling them in the special schooling system. This study underscores the importance of early diagnosis, inclusive education models, and strong collaboration between families, educators, and policymakers in enhancing the social integration of ASD children. Increased government support, targeted training for parents and teachers, and broader public awareness campaigns are essential to creating a more inclusive and supportive environment for children with autism in Bangladesh.

Paper ID: ICSHSD-511

How Architects Are Involved in Preventing Crime in a Community

Md Habibur Rahman[1*], Md. Sawgat Khan[2], and Most Roksana Khatun[1]
[1] Department of Architecture, Dhaka University of Engineering & Technology, Gazipur.
[2]Assistant Professor, Department of Humanities & Social Sciences, Dhaka University of Engineering & Technology, Gazipur.
Corresponding author: arha.2160@gmail.com

ABSTRACT

In Medellín, Colombia, when new community spaces like library parks and public plazas were built and actively used by residents, the city saw homicide rates fall by almost 80% over ten years. This shows how giving people welcoming and shared places can help transform even high-crime neighbourhoods into safer communities. This study investigates the question: How can architects contribute to crime prevention within communities through urban and architectural design? The research seeks to examine the extent to which design strategies can reduce opportunities for criminal activity and promote safer environments. Adopting a mixed-methods research resources—drawing on literature reviews, case studies, and questionnaire survey analysis of urban neighborhoods—the study emphasizes the application of Crime Prevention Through Environmental Design (CPTED) principles as a central framework. Preliminary findings indicate that architectural features such as natural surveillance, territorial reinforcement, controlled access, and active community participation play a critical role in deterring crime. The research further suggests that embedding these strategies in architectural and urban planning practices not only lowers crime rates but also enhances residents' sense of ownership, cohesion, and safety. For example, Zinda Park in Narayanganj, Bangladesh, demonstrates how community-driven design and management of open space can create a safe and vibrant environment where crime and antisocial activities remain minimal due to constant community use and oversight. The study concludes that architects, working collaboratively with urban planners, policymakers, and law enforcement, can significantly influence crime prevention outcomes. Probable contributions include the integration of CPTED principles into architectural education, the adoption of urban planning policies that prioritize safety, and the development of community-driven design processes that strengthen resilience and sustainability.

Paper ID: ICSHSD-513

Integrating Informal Culinary Economies in Rural Tourism through an Implemented Cloud-Based Digital Platform

Md. Musfiqur Rahman Akib[1], Habibur Rahaman [1]*
[1]Chittagong Independent University
Corresponding author: habibcuetcse@ciu.edu.bd

ABSTRACT

Homemade food presents a significant opportunity for advancing sustainable business innovation in developing economies, particularly in rural areas where local entrepreneurship and traditional culinary skills are often underrepresented in formal markets. In Bangladesh, rural regions attracting domestic and international tourists seek authentic rural culinary experiences, yet the integration of home-cooked cuisine into the tourism value chain is hindered by the absence of structured digital platforms, standardized safety protocols, and reliable market linkages. This study introduces a framework that connects rural homemade food providers with the tourism economy through a secure and adaptable cloud-based digital platform. The system incorporates validated provider profiles, rigorous hygiene and safety assessments, escrow-secured payments, transparent reviews, and structured dispute resolution, ensuring operational reliability and cultural authenticity. By enabling informal family kitchens, particularly those operated by women microentrepreneurs in rural tourism communities, to transition into formally recognized, income generating enterprises, the platform preserves affordability while safeguarding heritage culinary practices. A pilot implementation involving 50 simulated users and 15 rural providers demonstrated strong adoption, achieving a 92% service acceptance rate, an average booking completion time of 2.5 minutes, and a satisfaction score of 4.6 out of 5. Beyond these operational outcomes, the model generated measurable community-level benefits, including increased household income, expanded participation of women entrepreneurs, preservation of traditional cuisine, and adherence to safety standards. These results align with SDG 5, SDG 8, and SDG 11, highlighting the framework's potential for broad implementation in similar rural economies. By integrating cloud-based technology with local entrepreneurship, the framework provides a practical and flexible approach to formalize informal food markets in rural areas while promoting sustainable tourism and inclusive economic development.

Paper ID: ICSHSD-514

Unequal Access: Water Scarcity and Vulnerability among Marginalized Communities in Chattogram

Istiak Ahmed[1*], Tanjiha Binte Kabir[1] and Mozzammel Masum[1]
[1]Department of Sociology, University of Chittagong, Bangladesh
**Corresponding author:Istiakahmed555@gmail.com*

ABSTRACT

Chattogram, the city of diversity, is facing an escalating water crisis, which disproportionately affects the most vulnerable populations. Equal access to safe and adequate water is recognized as a fundamental human right globally and is essential for community well-being and fulfilling daily needs, including drinking, sanitation, and hygiene. However, most of the low-income communities in Chattogram lack access to clean water, which is further worsened by structural inequality and insufficient resource allocation, increasing the existing vulnerabilities of these communities. This study investigates the root causes behind this pervasive water scarcity in Chattogram, including infrastructural limitations, socio-economic disparities, environmental pressures, and systemic neglect. Through a sociological lens, the study reveals how poverty and inequitable access to water intensify current vulnerabilities and shape adaptive responses and coping strategies to escalating water crises. This report also emphasizes how chronic water shortages, exacerbated by inadequate infrastructure, growing salinity, and groundwater depletion, drive many people to rely on hazardous sources, threatening their health and overall social equality. The study concludes with tailored policy recommendations to strengthen water governance and provide equitable water rights for Chattogram's disadvantaged communities, hence contributing to more inclusive urban sustainability and promoting social justice.

Paper ID: ICSHSD-515

Technological Intervention and the Changing Norms of University Students: A Multidisciplinary Approach to Cultural Adaptation

Md. Sawgat Khan[1*], Rohana Afroz[2], Md. Rezaul Karim[3], Md Mufijur Rahman[4], Arifur Hoque Rana[4] and Md Mainul Islam[5]
[1]Assistant Professor of Sociology, University of Engineering & Technology, Gazipur
[2]Lecturer in Sociology, University of Brahamanbaria
[3]Lecturer in Sociology, Chittagong College, Chattogram.
[4]M.S.S. in Sociology, University of Chittagong
.[5]B.SC. in Botany, Bhola College
**Corresponding author: sawgatkhan@duet.ac.bd*

ABSTRACT

In Bangladesh, university students' cultural norms have been significantly impacted by the rapid integration of modern technologies, including artificial intelligence, automation, mobile devices, social media, and digital education platforms. These norms, historically shaped by families, peer groups, education, religion, and societal values, are undergoing transformative shifts due to the pervasive influence of technology. This multidisciplinary mixed-methods study explores the interplay between technological advancements and cultural adaptation among university students in Bangladesh. This study examines how technology-driven changes affect students' behaviors, communication styles, ethical considerations, and cultural values. Furthermore, the research assesses the socio-cultural and ethical implications of these shifts, identifying both challenges and opportunities for preserving cultural heritage. Qualitative and quantitative data are collected through questionnaires, interviews, and case studies. Advanced data analysis tools and sociological theories were used to analyze the findings. By adopting a holistic approach, the study aims to provide actionable policy recommendations and strategies for students, educators, and policymakers to navigate these changes effectively. Additionally, the research highlights the importance of interdisciplinary collaboration among the humanities, social sciences, and ICT in addressing complex socio-cultural and technological challenges faced by university students. This study contributes to the growing body of knowledge on technology and cultural studies. It offers insights into fostering cultural resilience while embracing innovation in Bangladeshi higher education.

Paper ID: ICSHSD-533

Invisible Citizens: Challenges and Solutions for Social Integration of Bihari Adolescents in Bangladesh

Rubaia Tasneem[1*], Supravo Chowdhury Nipu[2]
[1]Research Manager, Datascape Research and Consultancy Ltd, MA (History), MSS (Peace, Conflict and Human Rights Studies), Bangladesh University of Professionals.
[2]Lecturer Research Manager, Waste Bangladesh. MSS Sociology, Bangladesh University of Professionals.
**Corresponding author: rubaia@datascape-bd.com*

ABSTRACT
The Bihari community in Bangladesh, particularly its adolescent population, continues to face persistent socio-political and cultural marginalization. This study explores the structural, social, and institutional barriers that hinder the social integration of Bihari adolescents, especially in urban refugee camp settings. Using a mixed-methods approach, household surveys, key informant interviews, including in-depth interviews, focus group discussions, and a review of policy frameworks, the research highlights the role of identity, legal recognition, language barriers, and discrimination in shaping their exclusion. The study also identifies local and national strategies ranging from community-based initiatives to inclusive education and policy reforms that can enable more effective integration. By centering the voices of Bihari youth, this research aims to contribute to inclusive development discourse and offer actionable recommendations for stakeholders working on minority rights, youth development, and social cohesion in Bangladesh.

Paper ID: ICSHSD-501

Food and Society- The Social Dimensions of Eating Habits in Bangladesh

Umma Habiba Kakuly[1*], Razia Sultana[1], Md.Naimur Rahman[1], Md.Saidur Rahman[1], Md.Mominul Islam[1], Md. Sawgat Khan[2]
[1]Department of Food Engineering at Dhaka University of Engineering & Technology,Gazipur
[2]Assistant Professor, Department of Humanities & Social Science at Dhaka University of Engineering & Technology,Gazipur.
**Corresponding author: uhkkakoli3388@gmail.com*

ABSTRACT
This study explores the social dimensions of eating habits in Bangladesh, with a focus on generational shifts between traditional foods and modern fast foods. While older generations continue to value traditional meals such as rice, fish, lentils, and handmade dishes, younger generations increasingly prefer fast foods like burgers, pizza, and fried snacks. The shift is influenced by factors including time constraints, social media exposure, peer pressure, and the pursuit of modern lifestyles. Such changes not only pose health risks like obesity and diabetes but also weaken family dining practices and threaten the preservation of cultural food traditions. A case study comparing grandmother and grandson highlights the contrast in preferences within a single household. The findings emphasize the need to encourage nutritious traditional foods, promote healthy eating through schools, and create a balance between modern and traditional dietary practices. This balance is essential for safeguarding both public health and cultural identity in the context of rapid social transformation.

Paper ID: ICSHSD-534

Effect of Social Media and Lifestyle – The Social Dimensions of Modern Living

Md Azmul Haque[1]*, Zubayer Islam[1], Sottojit[1], Sontos[1], Shubroto[1], Md Sawgat Khan[2]
[1]Department of Social Science, Dhaka University of Engineering & Technology
[2]Assistant Professor, Department of Humanities & Social Science, Dhaka University of Engineering & Technology
**Corresponding author: azmulhaque15@gmail.com*

ABSTRACT
This study explores the social dimensions of social media and lifestyle changes in modern society, with a focus on generational shifts between traditional lifestyles and digital-driven habits. While older generations continue to value face-to-face communication, physical activities, and community gatherings, younger generations increasingly rely on social media for interaction, entertainment, and self-identity. The shift is influenced by factors including technological advancement, peer pressure, global connectivity, and the pursuit of modern lifestyles. Such changes not only pose health challenges such as anxiety, depression, and sedentary-related problems but also weaken family interactions and reshape cultural values. A case study comparing parents and children highlights the contrast in lifestyle choices within a single household. The findings emphasize the need to encourage mindful use of social media, promote balanced offline activities through schools and families, and create harmony between digital and traditional lifestyles. This balance is essential for safeguarding both mental health and cultural identity in the context of rapid social transformation.

Sub-theme: Graduate Employability and Language Education

Paper ID: ICSHSD-34

Building Pathways to Employability by Using Transmedia Storytelling Approach: A Case Study in an EFL Classroom

Eshita Khanam Karu[1], Fariza Puteh-Behak[2], Hayati Ismail[3], Muhammad Azizul Hoque[4]
[1]University of Science and Technology Chittagong, Chittagong, Bangladesh
[2]Universiti Sains Islam Malaysia, Nilai, Malaysia
[3]Universiti Sains Islam Malaysia, Nilai, Malaysia
[4]International Islamic University Chittagong, Chittagong, Bangladesh
**Corresponding author: eshitakaru95@gmail.com*

ABSTRACT

Graduate unemployment in Bangladesh is a significant issue, which illustrates the importance of employability skills. One of the primary obstacles that limits progress in Bangladesh is the escalating issue of unemployment among individuals who have graduated (Miah, 2022). With the rapid advancement of technology, the realm of employment has evolved, and graduates need to possess specific skills to get employed (Alam et al., 2022; Kovács & Keresztes, 2022; Caingcoy, 2021), consisting of communication, collaboration, problem solving, critical thinking, leadership, digital literacy, and adaptability (Soproni, 2023; Rai &Likhitkar, 2023; Tushar &Sooraska, 2023; Caingcoy, 2021; Briones et al., 2021; Kenayathulla et al., 2019). This research aims to address this issue by using transmedia storytelling as a pedagogical approach, which uses multiple platforms to expand the storyworld, and the combination of all the platforms makes a unified whole (Serrat, 2008), thereby building employability skills among learners in Bangladesh. This study is qualitative by nature. Data have been collected from a first-semester university classroom. There have been thirty-five students enrolled in the course Four Skills of English Language. A short film titled (PLASTIK) - A Wake-Up Call to End Plastic Pollution has been chosen to use in the classroom for the pursuit of using transmedia storytelling approach. Students have enhanced this short video by employing many media, including a short story, discussions, a digital storyboard with visuals, and a social media platform. Semi-structured interviews from fifteen students selected through purposive sampling and classroom observation have yielded data. Interviews have been conducted in Banglish, a blend of Bangla and English together, as Bangla is the official language of Bangladesh. Collected data have been analyzed by following a critical narrativist approach. Results indicate that the use of transmedia storytelling has increased students' employability-related skill sets. In order to expand the storyworld of (PLASTIK): A Wake-Up Call to End Plastic Pollution, students have collaborated in groups and conducted intensive brainstorming sessions with their peers. They have collaborated on brainstorming sessions to create a compelling narrative and expanded the plot, which has helped them improve their critical thinking and problem-solving skills. They have gone through numerous trial-and-error procedures to keep the tale on track. They have created visuals and have been familiar with a variety of digital technologies. They have become more flexible and have learned to respect each other's viewpoints because of their collaboration. In a nutshell, the acquisition of employability skills by students has been significantly enhanced by the transmedia storytelling approach. This research may have implications for researchers, policymakers, and other stakeholders for instilling employability skills among students.

Paper ID: ICSHSD-254

Role of English Language Proficiency in the Graduate Employability in Bangladesh

Mohammad Rukanuddin[1]
[1]Department of A&S, Ahsanullah University of Science and Technology
**Corresponding author: rukan.as@aust.edu*

ABSTRACT

This paper offers a critical analysis of the central role of English language abilities in graduate employability within Bangladesh. The paper examines how English fluency has evolved from a useful soft skill to a mandatory prerequisite for achieving lucrative and career-defining employment, particularly in the nation's thriving private sector, multinational corporations, and globalized industries. The study synthesizes a wide spectrum of literature from scholarly research, business analysis, and government policy in order to present an all-encompassing picture of the scenario. We argue that English language proficiency serves as a sort of linguistic capital, a valuable asset that confers significant economic and social benefits upon its possessors. This capital is not dispersed evenly; the paper will demonstrate how the quality of English language teaching in schools, socioeconomic status, and location create a significant skills gap between graduates. The review will address in a systematic way three key aspects. It will first address the specific English language skills—e.g., business writing, negotiation, and writing reports— on which employers expect their emphasis to go beyond mere conversational proficiency. It will indicate that a significant proportion of graduates, as degree-holders as they are, lack the functional communication competence demanded of the professional environment. Secondly, the paper will discuss problems behind this skills gap, including outdated curricula, excessive dependence on rote memory, teachers with inadequate training, and little exposure to English outside of academia. Finally, the discussion will refer to the social consequences of this mismatch in skills, arguing how it generates a dual labor market where a small English-literate elite becomes the recipient of high-paying jobs and the majority of the graduates are relegated to low-paying or casual work. The paper concludes by providing a package of policy recommendations and pedagogical interventions for the re-designing of English language education in Bangladesh. These include embracing communicative language teaching approaches, encouraging academe industry cooperation to align curricula with market needs, and creating a national English proficiency test standard and widely adopted by employers.

Paper ID: ICSHSD- 337

Possibilities and Challenges in Professional Responsibilities: Voices of a Bangladeshi Private University English Graduates

Kaniz Fatema[1], **Shanjida Akter**[2], **Owafia Sadika**[2], **Sadiaqua Mahmood Aunue**[2]
[1]Senior Lecturer, Department of English, East West University
[2]Undergraduate student, Department of English, East West University
**Corresponding author: kaniz@ewubd.edu*

ABSTRACT

This era of the fourth industrial revolution demands a workforce with inclusive skills for its sustainable development. The invasion of artificial intelligence (AI) makes it more challenging for the English graduates of Bangladesh as they face difficulties not only in their academic context but also in their professional platform. This skill gap mainly occurs due to the difference between a graduate's skills obtained through higher education (HE) and the employers' expectations, which often results in expatriates holding positions instead of local candidates (Chowdhury & Habib, 2024; Amin & Sheikh, 2021). Monir (2022) also states that every graduate is required to have 'employability skills' to tackle the challenges of the ever-growing competitive job market. This research aims to investigate the professional experience of fifty-eight English alumni of a private university of Bangladesh. For that reason, the researchers attempt to answer (i) what types of skills English graduates require in their professional fields, (ii) to what extent English graduates face challenges to fulfil their professional needs, and (iii) how they evaluate the sets of skills the existing curriculum offers. The mixed data are collected through a Google Form, which includes four major sections to elicit both open-ended and closed-ended questions from the participants. It statistically measures the difference between the graduates' existing skills and the required set of skills in their job fields. The quantitative data is analysed with R statistical software. The mean differences directly indicate the differences. Moreover, a chi-square test shows the significant difference with a contingency table. To triangulate, the qualitative data is thematically analysed which reveals the professional challenges they faced/have been facing due to the lack of skills. Based on the differences and challenges, they also suggest the additional skills which should be included in the English Undergraduate program of that particular university. The result draws attention of both the classroom facilitators and the policy makers. The suggestions involve the potential extension of the existing curriculum to align with the extended needs of program achievement milestones.

Paper ID: ICSHSD- 357

English Language Education and Employability: Perspectives from Engineering Students in Bangladesh

Maisha Afsar[1], Nahida Jannat Oishe[2], and Jannatul Ferdous Fariha[3]*
[1] WINGS Learning Centre (affiliated with the British Council), Dhaka, Bangladesh
[2] Independent English Instructor, Dhaka, Bangladesh
[3] Department of English and Humanities, BRAC University, Dhaka, Bangladesh
**Corresponding email: maisha.afsar98@gmail.com*

ABSTRACT

English as a language of imperialism has established its charm in colonized countries like Bangladesh. This language acts as a bridge for education, communication as well as for career pathways. Bangladesh, having an ESL context, demands a good command of English for students to build their careers either nationally or internationally. Similarly, it is also required for engineering students to have a good command of English to excel in this competitive job market. Consequently, it is crucial to understand the students' perception regarding the effectiveness of the English language that they learn in their respective fields. However, there is a void of research on how students from technical subjects, such as Engineering, perceive their current language learning practices, despite the growing need for English both as a global language and a way of gaining specific technical knowledge to cater to their preparation in the competitive job market. This comes with the potential learning strategies they might follow to enhance their English language learnability or the basic English they need to excel in their studies and shape career goals. Therefore, the study aims to explore the Engineering students' perceptions about the effectiveness of the current English classroom practices in job employability, the existing gaps between the learned skills and required skills, and the language learning strategies they use autonomously to overcome the gap. The study encompasses a qualitative approach followed by semi-structured interviews with engineering students from different universities in Bangladesh. After collecting data from the students, thematic analysis was conducted to find out the recurring patterns, the gap between the theoretical and practical knowledge, and the strategies they employ independently in terms of learning appropriate English suited to the engineering job field. The findings suggest a lack of stream-specific English language learning in most of the universities, along with the majority of the students' tendency to rely on classroom instructions more than using language learning strategies to learn independently to elevate their English skills. The insights from the data offer useful direction for the language practitioners and stakeholders including teachers not only to employ English language learning skills suitable to the engineering students in classroom instructions but also to provide them with appropriate guidance to boost their job employability.

Paper ID: ICSHSD-523

Graduate Employability and English Language Education: A Critical Examination of Tertiary Practices in Bangladesh

Dr. Sadia Afrin Shorna[1], Marzia Hossain Chaity[2*]
[1]University of Asia Pacific.
[2]University of Asia Pacific.
**Corresponding author: sadia@uap-bd.edu, marzia@uap-bd.edu*

ABSTRACT

The employability of graduates has become a significant concern in the context of Bangladesh's expanding tertiary education sector, with a focus on English language proficiency as a prerequisite of workplace readiness. Employers often observe a disconnect between graduates' language proficiency and the communicative demands of the job market, despite English being compulsory in all university curricula. The relevant research emphasized how grammar-based and exam-driven teaching methods still predominate in education, with little incorporation of workplace-oriented skills like business correspondence, report writing, business communication, and presentations. To address this gap, the current study adopts a qualitative research approach based on semi-structured interviews. A total of 20 respondents from English departments at 3 Bangladeshi universities provided their insights into learning strategies and perceptions of employability. Along with them, 5 employers from different sectors have shared their perspectives and experiences regarding the employability skills. Their viewpoints shed light on how English language learning is currently structured, the problems of integrating curricula with workplace requirements, and the extent to which students are prepared for professional settings. The findings indicate that the existing paradigm of teaching the English language does not adequately address soft skills, critical thinking, and intercultural communication, all of which are required for employability in both the local and global contexts. They advocate a change towards competency-based, task-oriented pedagogies that include English instruction, employability training, internships, and industry partnerships. Universities can better match their curricula with national development goals and job market expectations by refocusing English instruction on transferable workplace skills. The study also recommends the need for collaborative efforts among policymakers, educators, and employers to bridge the gap between academic instruction and professional realities.

Sub-theme: Language Education and Technology for Learner Autonomy

Paper ID: ICSHSD-11

Promoting Learner Autonomy among Students with Visual Impairments through Assistive Language Learning Technologies in Urban Bangladesh

Farheen Akter Bhuian
Lecturer, Department of Science & Humanities, Military Institute of Science & Technology, Dhaka 1216, Bangladesh
Corresponding author: Farheen@sh.mist.ac.bd

ABSTRACT

In the age of AI and informationalism, the incorporation of technology in education has ushered novel approaches for enabling learner autonomy. However, limited research has been conducted on how such assistive tools impacts students with disabilities in Bangladesh. This study aims to identify the gap and investigate the role assistive technologies play in earning autonomy among students with visual impairments. A qualitative research design with participant observation approach, employing semi-structured interviews and content analysis was implied in the study adopting a network sampling method. Ten young women and five men with visual impairment, a total of fifteen PWDs were involved in the study. Their age ranged between 18-25 studying at tertiary institutions. This study, grounded in the social model of disability, focused on exploring how students with visual impairments engage with digital tools such as screen readers, speech-to-text apps, google voice reader, alternative and augmentative communication (AAC) systems, and AI-driven platforms such as Chat-GPT for learning purposes. The research aims to understand the accessibilities of these technologies to the students, how effectively these tools are integrated into their learning environments, and how they enhance self-efficacy and autonomous learning in the learners with disabilities. It also attempts to identify the structural, social and pedagogical barriers that impedes inclusivity and autonomous learning process. Preliminary findings highlights that assistive technologies empower students with disabilities by diversifying and aiding in learning empowers them, but challenges includes absence of localized contents, insufficient teacher training and the socio-economic inequalities. This is an interdisciplinary study contributing both in disability studies and pedagogical strategies aiming to promote autonomous learning in diverse students.

Paper ID: ICSHSD-30

Employing ICT in English Language Clubs in Rural Regions to Bridge the Digital Divide and Promote a Sustainable Future

Kakoly Talokder*[1], Md Jashim Uddin Bhuiyan*[2], Jakir Hossan[3]
[1]President, e-Commerce Development Center (A research-based organization), Bangladesh.
[2]Faculty of Management Science & Engineering, Kunming University of Science & Technology, Kunming 650500, China
[3]Faculty of Ethnology and History, Yunnan University of Nationalities, Yunnan 650500, China.
*Corresponding author: Kakoly Talokder: president@edcbn.com
Md Jashim Uddin Bhuiyan: dr_jashimbhuiyan@outlook.com*

ABSTRACT

A significant disparity has persisted between urban and rural schools in Bangladesh concerning educational possibilities for a long time. Following the emergence of ICT, this disparity has intensified, resulting in rural pupils lagging behind. Students in rural areas lack opportunities to practice English beyond the classroom. Efforts have been undertaken to address this issue and to enhance the four English language skills for rural children through ICT in the English Language Clubs of select rural schools in the Narsingdi area. WhatsApp groups have been established, and some English assignments have been assigned to pupils therein. Students have the chance to practice speaking, listening, reading, and writing entirely free of charge. This initiative started in January 2025, and this article examines the subject comprehensively. To achieve balanced national development, it is essential to facilitate English language practice for rural school children, which can only be accomplished through the utilization of ICT. This essay examines the connection between Sustainable Future and ICT technology in English education. Proficiency in English is a crucial component of Bangladesh's educational system. Proficiency in the English language significantly influences the GDP of neighbouring India, particularly in the IT exporting sector. The significance of the English language in Bangladesh's economy is indisputable. Contributing to economic growth through the application of ICT in English language education is feasible, necessitating considerable attention in rural schools.

Paper ID: ICSHSD-182

Exploring Tertiary Students' Perceptions Regarding the Use of AI Chatbots in the Development of Speaking Fluency

Jubaed Zauhar Nishat
Department of English and Modern Languages, North South University
Corresponding author: jubaednish@gmail.com

ABSTRACT

AI chatbots are being increasingly integrated into higher education, yet their role in fostering speaking fluency remains unclear. This research examines how university students perceive chatbots in developing oral skills in linguistic, cognitive, and emotional areas. The study used a mixed-methods approach, incorporating a survey with open-ended questions from students at private universities in Bangladesh. Research clearly shows that students are familiar with AI chatbots, with many having already utilized them for speaking practice. In general, the learners used chatbots as helping tools that facilitated communication and offered constructive feedback. However, they also noted ongoing issues, a notable decline in motivation, and technical interruptions that need to be addressed. Although the students did not consider chatbots as substitutes for human classmates or instructors, they strongly endorsed their use as supplementary practice aids. Qualitative insights further emphasized the need for more comprehensive feedback to enhance understanding, systems to track progress, gamified elements to maintain interest, voice-enabled interactions, adaptive personalization, and enhanced technical reliability. The study concludes that AI chatbots are flexible, available, and nonjudgmental avenues for language practice, but they cannot replace the human interactions needed to communicate. This study is not without limitations; indeed, it is based on self-reported data, reveals no demographic variables, and has lasted a short period of time, which limits its applicability outside of the context of the study. Despite these limitations, the results offer significant pedagogical and design insights: chatbots can be utilized as a means of preparation, reinforcement, and post-class activities to enhance speaking opportunities. Future studies should employ longitudinal course designs, performance indicators, and critical demographic indicators, whereas developers need to maximize voice and feedback features, as well as contextual aspects.

Paper ID: ICSHSD-212

The Impact of AI-Powered Autonomous English Language Learning on Student Motivation and Academic Performance in Tertiary Education

Naiem Al Amin
Lecturer, Institute of Skills Development and Continuing Education (ISDCE), State University of Bangladesh
Corresponding author: naim.alamin1@gmail.com

ABSTRACT

This study examines the influence AI-driven autonomous learning practices on student motivation and academic achievement within tertiary-level English language education in Bangladesh. While AI-powered language learning systems offer personalized instruction to address the limitations of traditional teaching methods, their specific influence on the crucial educational variables of student motivation and academic performance within structured tertiary environments remains unclear and under-researched. The research aimed to investigate the effects of AI-powered autonomous learning on student motivation, assess its impact on academic performance in English language courses, and compare perceived student engagement between AI-powered systems and traditional learning methods. A mixed-method explanatory design was employed. Quantitative data were collected via a survey of 100 undergraduates from public and private universities. This was followed by qualitative semi-structured interviews with 20 graduate students. The study utilized a mixed-methods analytical approach, applying statistical techniques to the quantitative data and thematic analysis to the qualitative data. Quantitative results revealed strongly positive dispositions, with high mean scores for perceived usefulness (M=4.2) and ease of use (M=3.9) on a 5-point scale. A significant, moderate positive correlation was found between intrinsic motivation and self-reported academic performance ($r=0.45$, $p<0.01$). Disaggregated analysis showed that students from private universities reported significantly higher satisfaction and self-efficacy than their public university counterparts. Qualitative interviews with graduates substantiated the quantitative findings and provided critical nuance. Thematic analysis confirmed the paramount advantage of personalization, but also uncovered significant unintended consequences: a majority of participants described a "motivation paradox" where tool efficiency diminished deep learning engagement and reported feelings of isolation from reduced peer interaction. Synthesizing these results, a prevailing consensus emerged advocating for a hybrid pedagogical model. Participants conceptualized AI not as a substitute, but as a supplemental instrument within a blended approach that strategically leverages algorithmic personalization while preserving essential human elements of mentorship and collaborative discourse. The study provides a nuanced understanding of AI's dual role in enhancing personalized learning while potentially undermining motivation through isolation, offering critical insights for developing effective blended pedagogical models. It recommends integrating AI as a supplementary tool within a structured framework that prioritizes human interaction and scaffolds student autonomy to mitigate psychological drawbacks and maximize educational outcomes.

Paper ID: ICSHSD-305

Are Teachers Ready to Turn the Tables? A Study Exploring Tertiary Level EFL Teachers' Perceptions and Readiness for Flipped Classrooms in the Context of Bangladesh

MD Nahid Hasan[1*], and Khadija Akter Onee[2]
[1]Lecturer, Gazipur Digital University
[2]Assistant Professor, Bangladesh University of Professional
[*]*Corresponding email: nahid0001@bdu.ac.bd*

ABSTRACT

Flipped classrooms provide the opportunity to use class time for active learning, promoting student autonomy and fostering higher-order thinking skills. Although flipped classrooms for ELT have received significant attention in various parts of the world, their potential in the context of Bangladesh remains underexplored. Hence, this study aims to shed light on the perceptions and preparedness of tertiary-level Bangladeshi EFL teachers regarding flipped classrooms. Adopting a mixed-methods approach, data for the study were collected from fifty EFL teachers across the different universities in Bangladesh through surveys and semi-structured interviews. The findings of the research revealed teachers' perceptions and readiness for flipped classroom teaching by exploring their familiarity, technological competence, instructional design skills, and professional training experiences.

Paper ID: ICSHSD- 319

Blended Learning Approaches: Content-based Syllabus in ESL Classroom, Approaches and Techniques

S. M. Shawlin
Lecturer in English, German University Bangladesh
Corresponding email: smshawlin888@gmail.com

ABSTRACT

Blended learning is an approach of learning activities where offline and online learning activities used to teach learner in the ESL classroom. This research explores how content-based instruction (CBI) is applied in the classrooms from the perspective of blended learning. The paper starts with the introductory analysis of CBI and blended learning, its use and the framework of certain scholars who create the impacts on this field of CBI and the approaches as well as the techniques. The researcher will analyze the techniques and approaches used in blended learning, like, if the learner used the apps, Duolingo, Quizzes or wall words. Does the learner used Google forms and docs or any other necessary documents in classroom learning. In Blended learning activities like YouTube videos or other activities used in the classroom. The researcher used mixed method where online survey and real-life teaching experience used in the paper. The researcher used English department student's learning activities and teaching techniques to use the data analysis. The researcher mostly prioritizes if the learner, learners more effectively from the video lessons or any digital tools that is used by the facilitator. The researcher used online survey as a tool of blended learning techniques and approach used in the CBI instruction. The approach used in the data analysis as a tool to create more effectively in the video lesson as an interaction with the learners and other peer learners. The structure used in the classroom to enhance more activities to initiate active learners. The researcher will investigate the learners used activities in digital tools like quizlet app or other platforms, whether they use any AI tools to learn the English language or any other language. The blended learning approach is one of the most influential learning activities in today's world where CBI is the most used technique to enhance that learning.

Paper ID: ICSHSD- 372

Google Classroom as an E-Portfolio to Enhance Receptive Language Skills: User Reflections at Tertiary Level in Bangladesh

Dr. Mir Md. Fazle Rabbi[1]
[1]Assistant Professor, Department of Humanities and Social Sciences,
Dhaka University of Engineering & Technology, Gazipur
Corresponding email: mfrabbi2000@duet.ac.bd

ABSTRACT

Technological advancements highly influence Generation Z and Generation Alpha; therefore, educational institutions prioritise digital literacy over traditional modes of learning. Bangladeshi educational institutions, especially universities, are also adopting technology in education. Using an e-portfolio for language learning is a relatively new trend in academia that engages learners outside the classroom in their comfortable environment. Google Classroom can be used as a platform for an e-portfolio where teachers can upload teaching materials and students can keep a record of their learning. This article focuses on the teachers' and students' reflections on using Google Classroom as an e-portfolio to improve receptive English language skills (listening and reading skills). A mixed-methods approach was employed in conducting this research. Data were collected through a survey questionnaire, interviews, and an observation checklist. Six (6) teachers and 140 engineering students from a reputed private university in Bangladesh participated in the study. The study was conducted in three co-taught ESP courses, utilizing carefully designed course materials. The findings suggest that an e-portfolio encourages participants to be more active in the teaching-learning process. The majority of the participants prefer using Google Classroom for the listening e-portfolio over using it for the reading e-portfolio. The study also suggests that integrating face-to-face classroom activities and e-portfolios in Google Classroom is preferred by most participants.

Paper ID: ICSHSD- 386

Self-Assessment as a Pedagogical Tool for Monitoring English Learning Progress and Learner Autonomy: Insights from Bangladeshi Engineering Students

Fatema Sultana[1] and Mir Md. Fazle Rabbi [2*]
[1]Associate Professor, Department of Humanities and Social Sciences, DUET, Gazipur
[2]Assistant Professor, Department of Humanities and Social Sciences, DUET, Gazipur
[*]*Corresponding email: mfrabbi2000@duet.ac.bd*

ABSTRACT

Assessment is widely recognised as a fundamental component for evaluating and ensuring the development of students' English language proficiency. While formative and summative assessments remain the most commonly employed approaches, English language teaching (ELT) practitioners are increasingly prioritizing formative assessment and seeking alternative methods that foster deeper learner engagement. Among these, self-assessment has been identified as a promising tool to enhance learner autonomy. This study examines the implementation of self-assessment in English language learning among Bangladeshi engineering students. Specifically, it explores the efficacy of three self-assessment steps proposed by Yan and Carless (2022), their impact on learners' motivation and confidence, and the challenges associated with implementing these steps in assessing grammar and writing tasks within a tertiary-level EAP course. The study also highlights its implications for curriculum design and language pedagogy in English as a Foreign Language (EFL) settings. Adopting a mixed-methods approach, data were collected through surveys from 40 engineering students and complemented by interviews from 15 randomly selected survey participants and two teachers who taught the course. The quantitative data were analyzed using MS Excel and SPSS, and the qualitative data were analyzed through thematic coding. The findings were presented through graphical representations. Results suggest that the self-assessment steps suggested by Yan and Carless (2022) can serve as an effective pedagogical strategy to strengthen learner autonomy and improve language proficiency. However, their implementation requires careful scaffolding and teacher guidance. The study contributes to the growing body of literature on alternative assessment in EFL contexts by offering practical insights for ELT practitioners. It also provides prescriptive recommendations for incorporating self-assessment into English language instruction, thereby equipping educators with strategies to enhance learner engagement and language outcomes in higher education.

Paper ID: ICSHSD-333

Integrating Animated Lessons into Tertiary Level English Language Teaching: Teacher Agency and Sustainable Practices

Gazi Mohd Shakil Imtiaz Fahad[1]
[1]Tenured Lecturer, Department of English, Mawlana Bhashani Science and Technology University
**Corresponding author: fahad@mbstu.ac.bd*

ABSTRACT

This proposal investigates the integration of animated multimedia lessons into university-level English courses, focusing on how teacher agency enables sustainable pedagogical innovation. Using a mixed-methods design, I will compare student outcomes in animation-rich versus traditional classes and gather teacher reflections on implementation. Prior studies show that animated videos significantly boost vocabulary learning and learner engagement. I anticipate finding that teachers who actively shape these lessons will report greater autonomy and that students in the animated-lesson group will achieve higher comprehension and retention. The study aims to demonstrate that empowering teachers to lead such innovations yields lasting, sustainable improvements in tertiary ELT.

Paper ID: ICSHSD- 460

Bangladeshi Undergraduate Students' Perceptions towards the Use of AI Technology in Developing English Speaking Skills

Tashrifa Fairuz[1]
[1]Lecturer, Department of English, Presidency University
Corresponding author: tashrifa.fr@gmail.com

ABSTRACT
The present study investigates the perceptions of undergraduate students of Bangladesh regarding their use of different AI tools in developing English speaking skills. Using a mixed-methods approach, data were collected from 117 participants from various universities of Bangladesh through survey questionnaires. With the help of descriptive and thematic analysis, the findings reveal that AI platforms enhance learners' speaking skills through personalised learning environment, individualised feedback and its flexibility and accessibility. Learners preferred AI over traditional methods, such as public speaking, due to its impartial assessment features. This not only motivated students to learn, but also made them more confident; hence, contributing towards their improved proficiency. However, certain challenges of AI applications were also identified by the respondents, for instance, the lack of human emotions, irrelevant context generation and issues with translations. Based on the findings the research indicated that AI could potentially revolutionise the language learning pedagogy of Bangladesh with the integration of relevant AI instructions taken by the learners under the supervision of a human teacher. The study suggests that policy-makers of Bangladesh should reform the existing curricula to incorporate AI literacy training and AI-based courses in the existing field of education.

Paper ID: ICSHSD- 474

Empowering Learner Autonomy of Engineering Students through Digital Pedagogies in EFL Context

Nur Mohammad Khan[1], **AKM Zakaria** [2]
[1]Dhaka University of Engineering and Technology, Gazipur-1707, Dhaka, Bangladesh
[2]Dhaka University of Engineering and Technology, Gazipur-1707, Dhaka, Bangladesh
[*]Corresponding email: nurkhan@duet.ac.bd

ABSTRACT
The study examines the integration of digital pedagogies that foster autonomy among engineering students in English in an EFL context. The study aims to determine how interactive and technology-based learning methods can enable students to take responsibility for their own education, thereby enhancing language proficiency and promoting learner autonomy. The consequences show that digital pedagogy has a positive effect on learners' motivation and self-directed learning. A mixed-methods approach was employed to evaluate the influence of digital pedagogies on learner autonomy. A quantitative survey of 120 engineering students from BUET, DUET, AUST, and EWU assessed self-reported autonomy in learning English as a foreign language before and after using digital resources, including language applications, online discussions, and e-learning modules. In-depth interviews provided qualitative insights into the learning experiences of 20 students. The data were examined using both descriptive and inferential statistics. The findings suggest that students who used digital tools became more autonomous in their language learning. A notable increase in self-directed learning behaviors was observed, with students showing greater motivation to engage in independent practice. The data also indicated that digital tools influenced learning more accessible for engineering students, helping them learn at their own pace. Consequently, student feedback on the impact of digital tools on motivation was very positive. The study concludes that digital pedagogies effectively promote learner autonomy in the EFL context. This is clear from the fact that students can learn English better with the help of technology and digital tools. As a result, it encourages independent learning practices. Therefore, employing technology plays a crucial role in enhancing language learning outcomes.

Paper ID: ICSHSD-489

The Perceptions of the Bangladeshi Undergraduate Students of the Use of Grammarly in Enhancing English Writing Skills

Purbita Das [1]
[1]Department of English Language and Literature, University of Science & Technology Chattogram (USTC)
Corresponding author: purbitadas18@gmail.com

ABSTRACT

This small-scale study aims to examine the perceptions of the Bangladeshi undergraduate students' of using Grammarly to enhance their English writing skills. In a country like Bangladesh, where English is taught as a second language, academic writing in English poses significant challenges for the learners coming from different educational backgrounds. In this regard, there has not been considerable studies regarding the use of Grammarly from the perspectives of the Bangladeshi undergraduate students. By adopting a mixed-method approach that include a survey and semi structured interviews with 51 Bangladeshi undergraduate students; the study reveals that most of the participants view Grammarly as a beneficial tool in improving their grammar and vocabulary, thus, boosts their confidence and independence in the L2 writing process. However, the findings from the interviews highlight some issues like over-reliance, contextual inconsistencies as well as limited support for fostering critical thinking and creativity. Overall, the study emphasizes integrating Grammarly as a tool to cultivate holistic writing skills of the undergraduate students.

Paper ID: ICSHSD-517

Philosophy of Language and Artificial Intelligence: Philosophical Perspectives on Meaning, Communication, and Sustainable Development

Shakil Mia[1*]
Corresponding author: shakil444920@gmail.com

ABSTRACT

The rapid advancement of artificial intelligence (AI) in the modern era, including large language models (LLMs), has brought to the fore philosophical questions about the nature, meaning, and communication of language. While AI is now capable of using, analyzing, and communicating language in a similar way to humans, there is a deep debate about whether this language ability actually produces understanding. This study will analyze the fundamental differences between the mechanical nature of AI's language processing and actual human comprehension and communication. The main objective of this research is to compare the eternal questions of philosophy of language "What is meaning?" and "How is communication possible?" with AI's language processing methods, identify the qualitative differences between them, and explore how these differences affect practical areas such as education, employment, and policymaking. This study uses a critical-analytical approach. It compares a statistically-based language processing model of AI with John Searle's 'Chinese Room' thought experiment and classical concepts in the philosophy of language (e.g., meaning and communication). Real-world examples will be used alongside theoretical frameworks. Artificial intelligence models that successfully simulate language patterns do not produce real philosophical or epistemological 'meaning'. AI produces language by following statistical patterns. Which then depend onhe next token prediction. AI is completely disconnected from consciousness, experience, or free will. This is important to understand because AI is having a profound impact on education, employment, and public policy. Blindly accepting AI as intelligent beings like humans can lead to ethical confusion. Therefore, this study proposes a coherent philosophical framework for the use of AI in the context of sustainable development. This research is primarily a theoretical and philosophical inquiry; therefore, it has limited empirical data. As AI technology is evolving rapidly, the emergence of new models in the future may challenge some of the analyses of this research.

Sub-theme: Communication Skills for ESP and Engineering Graduates

Paper ID: ICSHSD-96

The Role of Krashen's Affective Filter Hypothesis in Attaining Sustainable SLA (Second Language Acquisition) Leading to Socioeconomic Development in the Tertiary Students in Bangladesh

Kishan Saha
Lecturer, Department of English & Assistant Proctor, Southern University Bangladesh.
Corresponding author: kishansaha246@gmail.com

ABSTRACT

Second Language Acquisition is a primary target for tertiary students in Bangladesh. The tertiary students in Bangladesh belonging to the Department of English and ELT aim to master English as a Second Language. Krashen's Affective Filter Hypothesis of the Monitor model plays an important role in second language acquisition. The hypothesis focuses on the emotional and mental attributes of the students concerned by using certain filters. These filters can either advocate for SLA or obstruct SLA. The author used a mixed methodology in the study. The author visited 16 universities in Bangladesh to collect the primary data from 160 participants belonging to the Department of English. The secondary data has been collected from relevant existing studies. Questionnaires were provided for the collection of data from the participants. The participants were divided into focus groups for the discussion on the open-ended questions. It exposes the teaching methodology, pedagogical standards and the curriculum too. The contents in the graduate and postgraduate studies are based on various branches of Applied Linguistics and genres of English Literature as a part of the curriculum and OBE. The filters based on emotional and mental mindset get activated during the study of these texts, and the acquisition of language takes place accordingly. The study has shown that positive filters facilitate Second Language Acquisition, whereas negative filters discourage second language acquisition, as these discourage understanding the comprehensible input. The study has shown that most of the students claimed that the positive filters trigger Second language Acquisition in the EFL classrooms by using the LAD effectively. The educators can use the filters to create a favorable condition for the students concerned to ensure sustainable second language education, leading to the socio-economic development of the students by generating employability in diverse professional cultures.

Paper ID: ICSHSD-233

Fostering Learner Autonomy through Integrated Language Learning Approaches

Samia Islam
Lecturer, Department of English, German University Bangladesh, Gazipur, Bangladesh
Corresponding author: samia.helloteen@gmail.com

ABSTRACT

This paper explores how integrated learning can empower students to become self-motivated learners. Educators provide learners with greater control over the pace, content, and methods of their learning by incorporating digital platforms, interactive tools, and blended activities into classroom instruction. Such strategies are encouraged active engagement, personalized learning paths, and continuous reflection. And it enables student to take ownership of their educational journey. In the 21st century, integrated learning promotes critical thinking and creativity as well as essential skills for career capability and perpetual learning. Fostering autonomous language learners has become an essential purpose of language education in today's educational landscape. Independent learners are self-motivated, capable of regulating their own learning process. They can be proficient at critical thinking and problem-solving. Integrated learning approaches is one of the most effective ways to nurture such learners. The study highlights effective methods for implementing blended learning in language education. These include task-based learning, collaborative online tasks and real-time feedback mechanisms. Such strategies are not only improving language proficiency but also cultivate autonomy, motivation, and self-assurance among learners. Students learn to evaluate their progress through this holistic approach. They set their goals and adapt learning strategies according to individual needs to fostering the independence and endurance. Learners who can utilize technology effectively are better prepared to engage in continuous professional development. And they keep a meaningful contribution in society and may adjust themselves in global personnel demands. Integrated learning system keeps balance between AI based education and traditional pedagogy. It also supports personal growth and the long-term development of humanity by equipping students with digital skills. In conclusion, serving integrated learning approaches can be the transformative method to foster independent language learners. This approach not only enhances employability and academic outcomes but also contributes to the sustainable development of individuals and several societies at large.

Paper ID: ICSHSD-239

The Status of English Language in CSE Classrooms: Challenges and Perspectives presented based on two sample universities- Bangladesh University & Canadian University of Bangladesh

Dr. Md. Nesar Uddin[1*], Rezina Sultana[2]
[1]Assistant Professor, Department of English, Bangladesh University
[2] Head and Assistant Professor, Department of English, Canadian University of Bangladesh
Corresponding author: nesar.uddin@bu.edu.bd

ABSTRACT

Being able to communicate in English has become essential for national development in the increasingly interconnected world, especially for developing nations like Bangladesh. English has become the de facto language for international business, education, research, and communication as globalization picks up speed. Seeing this trend, Bangladesh recognizes how important it is to communicate effectively in English to promote international cooperation, draw in foreign capital, and provide its people the ability to compete on a global scale. Thus, being able to communicate in English is crucial for both scholastic and professional success, particularly in occupations that require international interaction. Because of its intrinsic worldwide nature and reliance on English-language materials, Computer Science and Engineering (CSE) stands out among these fields. Strong English language proficiency is necessary for CSE professionals to interact with worldwide teams, obtain technical documents, stay current on global developments, and pursue higher education or employment overseas. Although postsecondary education in Bangladesh places a strong emphasis on English proficiency, many CSE students find it difficult to reach that level. Various educational backgrounds, poor teaching strategies, and little exposure to English outside of the classroom are frequently the causes of this lack. Bangladesh University and the Canadian University of Bangladesh are the two sample institutions that are the subject of this research paper's qualitative investigation of the state of English language competency in CSE classrooms. It investigates the difficulties that both students and teachers encounter while assessing students' proficiency in the four fundamental skills of speaking, listening, reading, and writing. The efficacy of English teaching, curriculum integration, and students' views on the value of English in their academic and professional lives are important research topics. The study's justification stems from the increasing need for CSE graduates to be proficient in English for both academic and employment purposes. Despite its significance, there is still a lack of focused, systematic research on Bangladeshi CSE students' English language requirements. By filling this knowledge gap, the study hopes to advance knowledge of the linguistic difficulties in engineering education and offer suggestions for more efficient English teaching that is appropriate for this setting. In order to help CSE students in Bangladesh succeed academically and professionally in a globalized world, this study ultimately seeks to highlight the state of English in CSE education today, pinpoint proficiency barriers, and offer workable solutions to improve English teaching and learning.

Paper ID: ICSHSD-247

Exploring English Language Learning Strategies among the Learners of Northern Bangladesh: A Case Study on Nilphamari District

Md.Al-Amin[1]
[1]Bangladesh Army University of Science and Technology (BAUST), Saidpur
Corresponding author: mdalamin@baust.edu.bd

ABSTRACT

This study is going to investigate the English language learning strategies employed by learners in the northern region of Bangladesh, specifically focusing on the Nilphamari district. As English language proficiency is gradually recognizing as a vital skill in global communication and economic progression, understanding the strategies adopted by the learners of English language in this region is crucial. The study will adopt a qualitative case study approach. It will employ interviews, surveys, and observations to gather comprehensive data. Through purposive sampling, learners from diverse socioeconomic backgrounds and educational levels will be included to ensure a representative sample. This study aims to identify the common strategies which are employed by the learners to acquire and increase their English language skills, as well as the factors influencing their choice of strategies. Additionally, the study will investigate the challenges and difficulties faced by learners in the Nilphamari district in their pursuit of English language proficiency. Findings and result from this study will provide valuable perception for educators, policymakers, and stakeholders involved in English language education in Bangladesh, particularly in rural areas. By understanding the effective strategies and addressing the challenges encountered by learners, necessary efforts can be directed to improve English language learning outcomes and promote socio-economic development in the region. This study will contribute to the existing body of knowledge on English language learning strategies in Bangladesh and offers practical recommendations for enhancing English language education in similar contexts.

Paper ID: ICSHSD- 397

Remote Area Second Language Learners' Problems and Solutions in Listening Comprehension

Podile Ramanaiah[1]
[1] Ph.D. Scholar, SR University

ABSTRACT

Listening is an important skill in learning another language, yet students living in remote areas often find it challenging. This study examines their hearing difficulties and suggests ways to improve understanding. A mixed-method approach was used, including learner surveys, teacher interviews and class observation in many rural areas. Conclusions suggest that there are major obstacles such as quality audio materials, poor digital infrastructure, frequent class disruptions, and a lack of trained teachers in effective hearing instructions. To address these issues, paper recommends the use of mobile-assisted language learning (mall) tools, providing attractive and optimal hearing resources for ongoing teacher's professional development as well as low-resources settings.

Paper ID: ICSHSD-499

The Role of Age in Second Language Development: Insights from Tertiary Level Students of the English Department

Sultanul Arefin[1], Sheikh Md. Rokonul Islam[2]*
[1]IUBAT – International University of Business, Agriculture and Technology.
[2]Dhaka University of Engineering and Technology, Gazipur (DUET).
**Corresponding author: rokonul@duet.ac.bd*

ABSTRACT

This article examines the impact of age on the L2 development of tertiary-level university students in an English department in Bangladesh. A mixed-methods design was employed, with data collected from 68 students and 19 faculty members across three universities using survey instruments that contained both closed-ended and open-ended items. The quantitative findings indicate that younger learners excel in pronunciation, fluency, and spontaneous interaction, whereas older learners demonstrate stronger performance in grammar, vocabulary, and metacognitive strategies. Thematic analysis of the qualitative data (Braun and Clarke, 2006) identified three main themes: the benefits of early exposure, psychological and affective barriers, and compensatory strategies that extend beyond the age constraint. Teachers stressed that whilst age conditions the process and modality of learning, motivation, exposure, and support can moderate the constraints of age. These results run counter to deterministic interpretations of the Critical Period Hypothesis, emphasizing the complex interplay between age, cognition, and motivation. This has implications for pedagogy, which needs to be differentiated, and for institutional policies that encourage lifelong learning.

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