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Department of Basic Sciences
Manipur Technical University

Abstracts of International Conference on Advances in Multidisciplinary Sciences and Engineering 2026

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ICAMSE 2026
DEPARTMENT OF BASIC SCIENCES, MTU
JANUARY 21-23, 2026

Edited By

Anand Jyoti Sanasam
Rajkumar Kamaljit Singh
Ningombam Swapana
Moirangthem Dinesh Singh

MANIPUR TECHNICAL UNIVERSITY

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Abstracts of International Conference on Advances in Multidisciplinary Sciences and Engineering 2026

ICAMSE 2026 (21-23 January 2026)

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Abstracts of International Conference on Advances in Multidisciplinary Sciences and Engineering 2026
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राज्यपाल, मणिपुर

Ajay Kumar Bhalla
Governor of Manipur

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सत्यमेव जयते

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MESSAGE

I am glad to learn that the Department of Basic Sciences, Manipur Technical University is organizing the International Conference on Advances in Multidisciplinary Sciences and Engineering (ICAMSE 2026) during 21st-23rd January 2026.

In the present era, multidisciplinary research has become a key driver of innovation, sustainable development and technological advancement. Platforms such as ICAMSE will provide an invaluable opportunity for academicians, researchers, scientists, engineers and industry professionals to come together, exchange ideas and deliberate on emerging trends and challenges across diverse domains of science and engineering.

I am confident that this conference will foster meaningful academic interactions, encourage collaborative research and inspire young scholars to pursue excellence in scientific inquiry and innovation. The publication of the Abstract Book of ICAMSE 2026 will serve as a valuable academic resource, reflecting contemporary research contributions and promoting knowledge dissemination.

(Ajay Kumar Bhalla)

NINGTHOUJAM GEOFFREY, IAS
COMMISSIONER-CUM-SECRETARY
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Imphal, the 8th January, 2026

MESSAGE

I extend my warm greetings to the delegates, researchers, academicians, scientists, industry professionals, and students participating in the *International Conference on Advances in Multidisciplinary Sciences and Engineering (ICAMSE-2026)*, organised by the Department of Basic Sciences, Manipur Technical University. It gives me great satisfaction to be associated with this Abstract Book, which represents the collective scholarly efforts of researchers from diverse disciplines.

In the present knowledge-driven era, multidisciplinary research plays a pivotal role in addressing complex societal, technological, and environmental challenges. Conferences such as ICAMSE-2026 provide an important platform for the exchange of ideas, dissemination of innovative research, and promotion of interdisciplinary collaboration among experts. The abstracts compiled in this volume reflect the depth, diversity, and relevance of contemporary research aligned with national and global priorities.

I appreciate the initiative taken by Manipur Technical University, particularly the Department of Basic Sciences, in organising this international conference. I commend the Organising Committee for their academic vision and dedicated efforts in bringing together eminent scholars and young researchers on a common platform. I also congratulate all contributors whose abstracts have been selected for presentation and publication in this book.

I am confident that ICAMSE-2026 will contribute significantly in strengthening research culture, fostering interdisciplinary collaboration, and enhancing the academic standing of the State in the field of higher and technical education. I wish the conference great success and hope that all participants will find the deliberations intellectually stimulating and professionally rewarding.

With best wishes,

(Ningthoujam Geoffrey)

L. Radhakanta, MCS
DIRECTOR OF UNIVERSITY & HR EDUCATION,
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Ref. No……..

Date:……..

MESSAGE

Imphal, the 7th January , 2026

I am pleased to extend my greetings to all participants, organisers, and contributors to the International Conference on Advances in Multidisciplinary Sciences and Engineering (ICAMSE 2026), scheduled in hybrid mode from 21–23 January 2026 at Manipur Technical University, Imphal.

Multidisciplinary integration is increasingly vital for addressing contemporary global challenges. ICAMSE 2026 provides a valuable forum for researchers, academicians, and professionals to exchange innovative ideas, promote collaboration, and advance interdisciplinary solutions in sciences and engineering.

I commend the Department of Basic Sciences, Manipur Technical University, for organising this significant international event, which will undoubtedly stimulate scholarly discourse and contribute to regional and global knowledge advancement.

I wish the conference every success and anticipate productive deliberations.

(L. Radhakanta, MCS)

OFFICE OF THE VICE-CHANCELLOR
MANIPUR TECHNICAL UNIVERSITY, IMPHAL
(A University established under the Manipur Technical University Act, 2016)
www.mtu.ac.in, www.mtuonline.in

It is a matter of great pleasure and pride for me to extend my warm greetings to all the participants of the *International Conference on Advances in Multidisciplinary Sciences and Engineering (ICAMSE-2026)*, organised by the Department of Basic Sciences, Manipur Technical University. I am delighted to present this Abstract Book, which showcases the diverse and insightful research contributions of scholars from various disciplines.

In today's rapidly evolving scientific and technological landscape, multidisciplinary approaches play a vital role in addressing complex global challenges. ICAMSE-2026 serves as an excellent platform for academicians, researchers, scientists, industry experts, and students to exchange ideas, share innovative research findings, and explore emerging trends across the broad spectrum of sciences and engineering. The abstracts compiled in this volume reflect the quality, originality, and relevance of contemporary research aligned with societal and technological needs.

I commend the Department of Basic Sciences and the Organising Committee for their sincere efforts, academic vision, and meticulous planning in successfully conceptualising and organising this international conference. I also congratulate all the authors whose abstracts have been selected for presentation and inclusion in this book, and I am confident that their work will contribute significantly to the advancement of knowledge and interdisciplinary research.

I sincerely hope that ICAMSE-2026 will foster meaningful academic interactions, encourage collaborative research, and inspire young researchers to pursue excellence in their respective fields. I wish the conference great success and extend my best wishes to all the delegates for a fruitful and enriching academic experience.

With best wishes.

(Prof. W. Chandbabu Singh)
Vice-Chancellor
Manipur Technical University

Ramananda Nongmeikapam
Registrar
Manipur Technical University

MESSAGE

Imphal

I am very pleased to note that the Department of Basic Sciences, Manipur Technical University is organizing the International Conference on Advances in Multidisciplinary Sciences and Engineering (ICAMSE-2026). The publication of this abstract book marks an important academic milestone and reflects the collective scholarly efforts of researchers and academicians from diverse disciplines.

In the present era of rapid scientific and technological advancement, multidisciplinary research plays a pivotal role in addressing complex real-world challenges. ICAMSE-2026 provides a valuable platform for interaction, exchange of ideas, and dissemination of contemporary research outcomes in the fields of science, engineering, and allied areas. The abstracts compiled in this volume showcase innovative research contributions and emerging trends that will enrich academic and professional discourse.

I commend the organizing committee and the Department of Basic Sciences for their initiative, dedication, and meticulous planning in bringing together this international academic forum. I also extend my appreciation to the authors, reviewers, and participants for their valuable contributions and enthusiastic participation, which have significantly enhanced the quality of this conference.

I am confident that ICAMSE-2026 will contribute meaningfully to the advancement of knowledge and foster collaborative research among institutions and researchers. I wish the conference a grand success and hope that the deliberations will be both insightful and productive.

With best wishes,

(Ramananda Nongmeikapam)
Registrar, Manipur Technical University

Dr. Ksh. Imokanta Singh
Chief Finance Officer
Manipur Technical University

MESSAGE

I am delighted to learn that the Department of Basic Sciences, Manipur Technical University, Imphal is organizing an International Conference on Advances in Multidisciplinary Sciences and engineering (ICAMSE — 2026) from 21st to 23rd January, 2026 at MTU campus. I also congratulate the team from the Department of Basic Sciences, MTU for this maiden initiative.

A University is meant for free flow of knowledge, both from within and without, in order for it to grow. In this era of high connectivity, an institution ought not to remain isolated from the currents flowing around it and also it cannot remain so. It has to absorb the best practices from around the world and also it is also to share its best to others. Convergence of minds and practices are the demands of the time. I hope this International conference will serve this purpose and enrich the knowledge bank of MTU. I also ardently hope that this conference shall open unprecedented avenues to both our teachers and students alike so that the relationship established will remain long lasting.

I am sure this conference is going to deliberate on various issues and advancements in the field of science and technology. Such deliberation may not be human-centric only but may also address the whole ecosystem running the planet earth, including the network of flora and fauna, climate issues etc. Advancement of technology for the sake of advancement should not be detrimental to others who cannot express their views and prowess. The scientific community, in particular and humans, in general, must always remember that there is no Planet B where the whole humanity can be transported after destroying this very Earth with callous hands and minds.

Hope this conference will lit the way for a better and livable Planet earth where personal ambitions of bright minds may not interfere with the course of goodness.

I wish the team a grand success in this endeavor.

(Dr. Ksh. Imokanta Singh)
Chief Finance Officer, Manipur Technical University

Dr. Ningombam Swapana
Chairman, ICAMSE–2026
Department of Basic Sciences
Manipur Technical University, Imphal

MESSAGE

It is my great pleasure to extend a warm welcome to all participants of the International Conference on Advances in Multidisciplinary Sciences and Engineering (ICAMSE–2026). This conference is envisioned as a global forum that brings together leading researchers, scientists, engineers, academics, industry professionals, and policymakers to deliberate on interdisciplinary research, emerging trends, and innovative solutions that address contemporary challenges.

ICAMSE–2026 aims to foster a meaningful exchange of ideas across diverse domains of science and engineering, encouraging collaboration that transcends traditional disciplinary boundaries. The conference program includes plenary lectures, invited talks, and oral and poster presentations, offering participants an excellent opportunity to share their research findings, gain new perspectives, and engage in constructive academic dialogue.

I am confident that ICAMSE–2026 will serve as a vibrant platform for knowledge dissemination, professional networking, and the initiation of future collaborations. I sincerely hope that the deliberations during the conference will contribute significantly to advancing research and innovation for the benefit of society.

I wish all the delegates a fruitful and enriching conference experience.

Ningombam Swapana

(Ningombam Swapana)
Chairman, ICAMSE–2026

Dr. Angom Devadatta Mani
Convenor, ICAMSE–2026
Department of Basic Sciences
Manipur Technical University, Imphal

MESSAGE

It gives me immense pleasure to welcome you to the *International Conference on Advances in Multidisciplinary Sciences and Engineering (ICAMSE 2026)*, scheduled to be held during 21–23 January 2026 at Department of Basic Sciences, Manipur Technical University, Imphal.

ICAMSE 2026 is envisioned as a vibrant platform that brings together academicians, researchers, scientists, and industry professionals to exchange ideas, share recent advancements, and explore emerging challenges in mathematical sciences and engineering. The conference aims to foster interdisciplinary dialogue, encourage collaborative research, and bridge the gap between theory and real-world applications.

The technical program has been carefully designed to include keynote addresses by eminent experts, invited talks, and high-quality oral and poster presentations covering contemporary themes and innovations. We are confident that the deliberations during the conference will inspire meaningful discussions and contribute significantly to academic and societal development, particularly in the context of the North-Eastern region and beyond.

On behalf of the organizing committee, I extend my sincere gratitude to all speakers, authors, reviewers, funding agencies, sponsors, and volunteers for their invaluable support. I warmly invite you to actively participate in ICAMSE 2026 and make this academic gathering a memorable and enriching experience.

I look forward to welcoming you to Imphal and to ICAMSE 2026.

(Dr. Angom Devadatta Mani)
Convenor, ICAMSE–2026

Rajkumar Kamaljit Singh, PhD
Convenor, ICAMSE–2026
Department of Basic Sciences
Manipur Technical University

MESSAGE

It gives me immense pleasure to welcome you to the *International Conference on Advances in Multidisciplinary Sciences and Engineering (ICAMSE 2026)*, being held from 21st to 23rd January 2026 at Manipur Technical University, Imphal. On behalf of the Department of Basic Sciences and the Organizing Committee, I extend a warm and heartfelt greeting to all delegates, speakers, authors, and participants joining us from across India and abroad.

ICAMSE 2026 has been conceived with a clear and meaningful objective: to provide a common platform where ideas from different branches of science and engineering can meet, interact, and grow together. This conference aims to encourage dialogue across traditional academic divisions and to promote collaborative thinking that leads to practical and impactful outcomes.

The abstracts compiled in this volume reflect the diversity and depth of the conference themes. They cover a wide spectrum of topics, including nanomaterials, environmental remediation, earth observation and climate analytics, biotechnology, medicinal plants, and advances in mathematical sciences. I sincerely appreciate the authors for choosing this forum to share their work and contribute to collective learning.

We are fortunate to have distinguished plenary and keynote speakers, as well as experts from academia, research institutions, and industry, who will enrich the conference through their insights and experiences. Equally important are the young researchers and students participating through oral and poster presentations. Their enthusiasm and fresh perspectives are essential for the future of scientific progress.

I also hope that participants will take time to experience the cultural richness and natural beauty of Manipur during their stay. Beyond academic exchange, conferences such as ICAMSE 2026 are about building lasting professional relationships and fostering mutual understanding.

I hope that the discussions initiated here are fruitful in making ICAMSE 2026 a success.

With best wishes,

(Rajkumar Kamaljit Singh, PhD)
Convenor, ICAMSE–2026

Anand Jyoti Sanasam
Co-Convenor, ICAMSE–2026

MESSAGE

It gives me great pleasure to welcome all participants to the International Conference on Advances in Multidisciplinary Sciences and Engineering (ICAMSE–2026), organized by the Department of Basic Sciences, Manipur Technical University. The conference reflects a collective academic vision to promote interdisciplinary dialogue and to address contemporary scientific and technological challenges through collaborative research.

ICAMSE–2026 brings together researchers, academicians, scientists, and industry professionals from diverse backgrounds, providing a common platform for the exchange of ideas, sharing of research outcomes, and exploration of emerging trends in science and engineering. The multidisciplinary nature of the conference is particularly significant in today's research environment, where complex problems demand integrated approaches and cross-disciplinary perspectives.

The abstracts compiled in this volume highlight the depth and diversity of ongoing research across various domains. They represent not only individual scholarly efforts but also a shared commitment to advancing knowledge and fostering innovation. I sincerely appreciate the authors for their valuable contributions and for choosing ICAMSE–2026 as a forum to disseminate their research.

I would like to express my heartfelt gratitude to the Hon'ble Vice-Chancellor, Registrar, Finance Officer, Chairman, Convenors, Organising Secretaries, members of the advisory and technical committees, reviewers, and volunteers for their unwavering support and dedication. Their collective efforts have been instrumental in the successful organization of this conference.

I am confident that ICAMSE–2026 will serve as a meaningful academic platform, encouraging fruitful discussions, strengthening professional networks, and inspiring future research collaborations. I wish all participants an engaging and enriching conference experience.

With best regards,

(Anand Jyoti Sanasam)
Co-Convenor, ICAMSE–2026

Dr. Moirangthem Dinesh Singh
Co-Convenor, ICAMSE-2026
Department of Basic Sciences
Manipur Technical University

MESSAGE

It is with immense pride and excitement that I extend a warm welcome to all participants of the International Conference on Advances in Multidisciplinary Sciences and Engineering. As we gather to explore the cutting-edge innovations in science and engineering, we are reminded of the power of collaboration in shaping the future of research and development.

This conference is more than just a gathering of minds; it is an opportunity for each of us to contribute to the collective journey of knowledge creation and application. Through the exchange of ideas, experiences, and perspectives, we seek not only to advance our individual disciplines but to build a stronger, more interconnected scientific community.

We believe in the importance of a holistic approach to education and innovation, where ideas flow seamlessly across boundaries, empowering each of us to think differently and push the frontiers of what is possible. As the co-convenor of this event, I encourage you to approach this conference with an open mind, a spirit of inquiry, and a deep sense of purpose.

A heartfelt thank you to each of you for bringing your expertise and enthusiasm to this platform. Let us use this opportunity not just to showcase our work, but to ignite new conversations, forge lasting partnerships, and inspire the next wave of breakthroughs.

I look forward to the exciting discussions ahead and the transformative impact this conference will undoubtedly have.

With warm regards,

(Dr. Moirangthem Dinesh Singh)
Co-Convenor, ICAMSE-2026

Dr. Thokchom Chhatrajit Singh
Organising Secretary, ICAMSE-2026

MESSAGE

It gives me immense pleasure to present this abstract book of the *International Conference on Advances in Multidisciplinary Sciences and Engineering (ICAMSE-2026)*, organized by the Department of Basic Sciences, Manipur Technical University.

ICAMSE-2026 aims to provide a vibrant international platform for academicians, researchers, scientists, and industry professionals to exchange innovative ideas, recent research findings, and practical experiences in the broad domains of mathematical sciences and engineering. The conference endeavors to foster interdisciplinary collaboration and promote high-quality research addressing contemporary scientific and technological challenges.

The abstracts compiled in this volume reflect the depth and diversity of current research being carried out across various disciplines. Each submission has undergone a rigorous review process by experts, ensuring academic integrity and relevance. We sincerely appreciate the contributors for sharing their valuable research and enriching the academic discourse of the conference.

I take this opportunity to express my heartfelt gratitude to the Hon'ble Vice-Chancellor, Registrar, members of the Advisory and Technical Committees, reviewers, session chairs, and the organizing team for their unwavering support and dedicated efforts in making ICAMSE-2026 a success. I am also thankful to all participants and delegates for their enthusiastic response and active involvement.

I am confident that ICAMSE-2026 will serve as a meaningful platform for knowledge dissemination, collaboration, and future research initiatives. I wish all participants fruitful deliberations and a rewarding conference experience.

With best regards,

(Dr. Thokchom Chhatrajit Singh)
Organising Secretary, ICAMSE-2026

Dr. P. Ramwungzan
Organising Secretary, ICAMSE–2026

MESSAGE

It is a distinct pleasure to present the abstract book of the International Conference on Advances in Multidisciplinary Sciences and Engineering (ICAMSE 2026), organized by the Department of Basic Sciences, Manipur Technical University. This volume brings together the work of scholars, scientists, academicians, and professionals across multiple disciplines, reflecting their curiosity, creativity, and dedication.

ICAMSE 2026 provides an important platform for exchanging ideas, presenting research findings, and fostering collaboration among researchers. The abstracts included in this book are a testament to the hard work and scholarly commitment of all contributors.

I sincerely thank the Hon'ble Vice-Chancellor, Registrar, and Chief Finance Officer of Manipur Technical University for their guidance and support, as well as the organizing staff, authors, and reviewers, whose combined efforts have made this abstract book possible.

I hope this Abstract book inspires meaningful discussions, encourages collaboration, and supports ongoing research in science and engineering.

With best wishes,

(Dr. P. Ramwungzan)
Organising Secretary, ICAMSE–2026

Huidrom Malemnganbi
Treasurer, ICAMSE–2026

MESSAGE

The organisation of the International Conference On Advances in Multidisciplinary Sciences and Engineering (ICAMSE-2026) by the Department of Basic Sciences, Manipur Technical University is a matter of great pride and satisfaction, reaffirming the continuing importance of foundational sciences in contemporary research. In an age where disciplinary boundaries increasingly converge, ICAMSE-2026 recognises Mathematics, Physics, Chemistry and Biology as the enduring intellectual pillars that sustain all allied and applied fields. While interdisciplinarity defines modern scientific inquiry, its depth and reliability remain rooted in the conceptual rigour and methodological discipline of the basic sciences. These "sciences" continue to guide innovation across engineering, technology, environmental studies, data science and biomedical research, forming a vital link between foundational knowledge and modern application.

The successful conduct of this conference reflects the strong institutional support of Manipur Technical University and the collective efforts of the organising and advisory bodies, reviewers, staff, and dedicated volunteers who ensured its smooth execution.

I also place on record my sincere appreciation for the sponsorship extended by the North Eastern Council (NEC), Anusandhan National Research Foundation (ANRF), Board of Research in Nuclear Sciences (BRNS), and the Council of Scientific and Industrial Research (CSIR). The support of these esteemed national research and funding agencies has significantly strengthened the academic quality, outreach and overall impact of this international conference. I further acknowledge the valuable support received from other sponsoring agencies, institutions, and partners whose valued contributions elevated ICAMSE-2026.

This book of abstracts reflects both the strength of the basic sciences and their evolving dialogue with interdisciplinary research. I am confident that the ideas presented herein will stimulate meaningful academic exchange, foster collaboration, and contribute to sustained scientific advancement. I extend my best wishes to all participants for a meaningful and enriching conference experience, and I hope ICAMSE-2026 leaves a lasting scholarly impact.

Warm regards

(Huidrom Malemnganbi)
Treasurer, ICAMSE–2026

Preface

The *Abstracts of International Conference on Advances in Multidisciplinary Sciences and Engineering (ICAMSE 2026)* stands as a scholarly snapshot of the ideas, innovations, and interdisciplinary engagements that define this conference. ICAMSE 2026 has been envisioned as a global academic forum that brings together researchers, academicians, scientists, engineers, and professionals to share original research, exchange perspectives, and explore emerging frontiers across the sciences and engineering.

The abstracts presented in this volume represent a broad and carefully selected spectrum of contemporary research, ranging from fundamental theoretical advances to experimental studies, computational techniques, and practical applications. Each contribution has undergone a rigorous structured review process to ensure academic integrity, relevance, and originality. Collectively, they reflect current research trends and underscore the growing importance of interdisciplinary approaches in addressing complex scientific, technological, and societal challenges.

In an era marked by rapid technological transformation and increasingly interconnected fields of knowledge, meaningful progress often lies at the intersection of disciplines. The contributions compiled here exemplify this spirit by encouraging dialogue beyond conventional boundaries and by fostering the cross-fertilization of ideas. This volume therefore serves not only as a guide to the technical programme of ICAMSE 2026, but also as a permanent academic record of the research presented during the conference.

The preparation of this book of abstracts has been made possible through the dedicated efforts of the authors, reviewers, and members of the Technical Programme Committee and Organising Committee. Their commitment to scholarly excellence, timely collaboration, and academic rigor is gratefully acknowledged. We also extend our sincere appreciation to all contributors for enriching the conference with their valuable research.

It is our hope that this volume will stimulate insightful discussions during the conference, inspire future collaborations, and continue to serve as a source of reference and motivation for researchers, scholars, and students in the years ahead.

Department of Basic Sciences
Manipur Technical University, Imphal, India

January 2026

Acknowledgements

First and foremost, the Organising Committee of *International Conference on Advances in Multidisciplinary Sciences and Engineering (ICAMSE 2026)* gratefully acknowledges the generous financial support received from the North Eastern Council (Government of India), the Ministry of Earth Sciences (Government of India), the Anusandhan National Research Foundation, the Board of Research in Nuclear Sciences (Department of Atomic Energy, Government of India), and the Council of Scientific and Industrial Research (Ministry of Science and Technology, Government of India). Their valuable support has been instrumental in the successful organisation of the International Conference on Advances in Mathematical Sciences and Engineering (ICAMSE 2026).

The Committee also expresses its sincere gratitude to all individuals and institutions whose support and cooperation have contributed to the successful preparation of this book of abstracts.

We respectfully acknowledge the encouragement and guidance extended by the Hon'ble Governor of Manipur, the Chancellor, and the Vice-Chancellor of Manipur Technical University, which have been instrumental in fostering an environment conducive to academic excellence and research engagement.

We are grateful to the members of the Academic Council, the Board of Studies, and the Advisory and Organising Committees for their valuable suggestions, academic oversight, and dedicated efforts in planning and executing the conference. Our sincere appreciation is also extended to the reviewers and session chairs for their time, expertise, and commitment in ensuring the academic quality of the submissions.

We thankfully acknowledge the authors and presenters for their scholarly contributions, which form the core of this volume, and for their active participation in ICAMSE 2026. We also appreciate the support of collaborating institutions, sponsors, and partners for their cooperation and assistance.

Finally, we extend our sincere thanks to the faculty members, staff, research scholars, and student volunteers of Manipur Technical University for their enthusiastic involvement and tireless efforts in organizing the conference and in preparing this publication.

Organising Committee, ICAMSE 2026

Overview and Background

About the Conference

The International Conference on Advances in Multidisciplinary Sciences and Engineering (ICAMSE–2026) aims to bring together leading researchers, scientists, engineers, academicians, industry professionals and policy makers from across the globe to discuss interdisciplinary research, emerging trends and innovations.

The event will feature plenary lectures, invited talks, oral and poster presentations, and provide a vibrant platform for collaboration and networking.

The conference is designed to foster meaningful dialogue across disciplines, encouraging the exchange of ideas that transcend traditional academic boundaries. By creating a common forum for diverse scientific and engineering communities, ICAMSE–2026 seeks to promote integrative approaches to problem-solving and to stimulate collaborative research addressing contemporary societal and technological challenges.

ICAMSE–2026 will also emphasize the translation of research outcomes into practical applications, highlighting innovations with the potential to contribute to sustainable development, industrial advancement, and evidence-based policy formulation. Special sessions and thematic tracks will focus on cutting-edge developments, methodological advancements, and case studies that demonstrate the impact of multidisciplinary research.

Through active participation and engagement, the conference aspires to strengthen academic–industry linkages, nurture early-career researchers, and build lasting international partnerships. Overall, ICAMSE–2026 aims to serve as a catalyst for knowledge creation, dissemination, and collaboration, advancing excellence in multidisciplinary sciences and engineering at both national and global levels.

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Professor, Department of Mathematics, Manipur University, Imphal, India

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About the University

Manipur Technical University (MTU) is the first technical university in the state established under *The Manipur Technical University Act, 2016* on 23 April 2016. It is included in the UGC list of universities under section 2(f) of The University Grants Commission Act, 1956, and empowered to award degrees under section 22 of the act through its departments.

The university is actively building capacity in infrastructure and human resources. It has mounted tremendous efforts in developing itself into a modern university incorporating all elements from the contemporary scientific and socio-cultural milieu. At present, the university is located in the Government Polytechnic Campus, Takyelpat, Imphal West District, Manipur.

About the Department

The Department of Basic Sciences at MTU plays a pivotal role in laying the academic foundation for all engineering disciplines by offering comprehensive courses in Physics, Chemistry, Mathematics, and Biology. These subjects form the backbone of engineering education, equipping students with the essential scientific knowledge and analytical skills required to excel in their specialized fields. In addition to imparting high-quality teaching, the faculty members of the department are actively engaged in cutting-edge research across diverse areas of science and technology. Their contributions extend beyond traditional disciplinary boundaries, fostering innovation and promoting interdisciplinary collaboration. By integrating fundamental sciences with engineering applications, the Department nurtures critical thinking, problem-solving abilities, and a spirit of inquiry among students. This holistic approach not only strengthens the academic experience but also supports MTU's broader mission of advancing research, innovation, and societal development.

Contents

Message from the Hon'ble Governor of Manipur iii

Message from the Commissioner-cum-Secretary, Education-S, Higher and Technical Education iv

Message from the Commissioner-cum-Secretary, Education-S, Higher and Technical Education v

Message from the Vice-Chancellor vi

Message from the Registrar vii

Message from the Chief Finance Officer viii

Message from the Chairman, ICAMSE–2026 ix

Message from the Convenor, ICAMSE–2026 x

Message from the Convenor, ICAMSE–2026 xi

Message from the Co-Convenor, ICAMSE–2026 xii

Message from the Co-Convenor, ICAMSE-2026 xiii

Message from the Organising Secretary, ICAMSE-2026 xiv

Message from the Organising Secretary, ICAMSE–2026 xv

Message from the Treasurer, ICAMSE–2026 xvi

Preface xvii

Acknowledgements xviii

Overview and Background xix

Theme: Nanomaterial Heterostructure Modelling 1

Paper ID: 025: Calcination Temperature–Modulated Structural, Magnetic, and Optical Properties of $BiFeO_3$ 2

Paper ID: 029: Structural, Morphological and Optical characterization of Nanocrystalline PbSe thin films prepared at different molarity by CBD 3
Paper ID: 071: Photoluminescence Properties of CdSe:Mn^{2+} Thin Films Synthesized Using the Chemical Bath Deposition (CBD) Technique 4
Paper ID: 079: Solid-State Optical Beam Scanner for LiDAR Application 5
Paper ID: 106: Engineered Graphene Quantum Dots for High-Temperature Supercapacitors: A Pathway Toward Sustainable and High-Performance Energy Storage 6
Paper ID: 115: Analog Resistive Switching in Nickel Ferrite Thin Film Fabricated via Sol-Gel Spin Coating Technique 7
Paper ID: 117: Investigation of magnetoelectric response in lead-free $K_{0.5}Na_{0.5}NbO_3$–$SrFe_{12}O_{19}$ novel composite system 8
Paper ID: 120: An Improved Modified Mesh-Based Topology For NoC 9
Paper ID: 124: A Progressive Shortest-Path Routing Approach for 3D Mesh-Based Topologies with Supplementary 2D Links 10
Paper ID: 135: Structural and Photocatalytic Analysis of Mn and Gd in BFO . . . 11

Theme: Environmental Remediation **12**
Paper ID: 035: ZnO Bionanocomposites in Wastewater Treatment 13
Paper ID: 040: Design of CO gas sensor based on chemically deposited ZnO:Ga thin films 14
Paper ID: 050: Management of Major insect pests of Cabbage using Bio-insecticides 15
Paper ID: 056: Bio-management of southern root-knot nematode, *Meloidogyne incognita* in CUCUMBER 16
Paper ID: 077: Green emitting $CaMoO_4$:Tb^{3+} nanoparticles as luminescent probe for selective sensing of Fe^{3+}/Fe^{2+} ions 17
Paper ID: 082: Modeling and Simulation of a Dual-Battery System for Thermal Runaway Prevention in Electric Vehicles 18
Paper ID: 086: Solar Integrated Bidirectional Converter For Vehicle To Grid . . . 19
Paper ID: 122: Zinc substituted Nickel Copper ferrite ceramics: A study on structural, magnetic and dielectric properties 20
Paper ID: 131: Evaluation of Lead (Pb) Contamination and Groundwater Quality Using HPI and WQI in Regions of Delhi NCR 21

Theme: Earth Observation and Climate Analytics **22**
Paper ID: 027: Antarctic Sea-Ice Concentration and Extent from SARAL/AltiKa Radiometer over the Recent Decade 23
Paper ID: 031: Underwater Image Hyper-Resolution Using MLDRG 24
Paper ID: 039: Observation of Greenland Ice Sheet melting using Oceansat-3 . . . 25
Paper ID: 046: Geometry of Moho Depth beneath Northeastern Indian Plate by Joint Inversion of Gravity and Seismological Data 26
Paper ID: 059: Simulation of LW Window Channel Brightness Temperature (BT-11) for INSAT-3DR Using Machine Learning Model 27
Paper ID: 061: Retrieval of Cloud Optical Depth for INSAT-3DR Using Machine Learning XGBoost Model 28

Paper ID: 096: Investigation of Morphological Changes over Larsen C Ice Shelf Using MODIS Data 29
Paper ID: 146: Seasonal Surface Ice Velocity Variability over Polar Record Glacier, East Antarctica Using SAR Data 30

Theme: Medicinal and Aromatic Plants **31**
Paper ID: 036: "DIET BOX": An AI Powered Personalized Diet and Management System 32
Paper ID: 041: Computational Investigation of Bioactive Compounds from *Zanthoxylum armatum* DC. for Their Anti-Inflammatory Potential 33
Paper ID: 042: Environmental Ampicillin Pollution Disrupts Gut Microbiome Composition and Host Immunity in *Drosophila melanogaster* 34
Paper ID: 044: Glycoconjugate Recognition by Asialofetuin-Binding Lectins: Implications for Malignancy Stratification 35
Paper ID: 045: Bioassay-Guided Fractionation of *Zanthoxylum armatum* DC. Stem Extract Identifies Sesamin and Fargesin as Inhibitors of CpG-Induced Inflammatory Responses in cDC1 Cells 36
Paper ID: 047: Antimalarial Activity, Toxicity and Phytochemical Profiling through GCMS of *Toona ciliata* M.J. Roem. (Meliaceae) 37
Paper ID: 051: Traditional Knowledge-Based Evaluation of *Tupistra nutans* for Its Therapeutic Potential and Phytochemical Resources 38
Paper ID: 054: Study on the Stability Characteristics of Partially Purified Fruit Bromelain from Pineapple *Ananas comosus* L. (Merr.) cv. Queen 39
Paper ID: 057: Formulation of Nanocarriers of *Acorus calamus* Essential Oil for Amelioration of Diabetes-Induced Memory Dysfunction in Rats 40
Paper ID: 058: Development and Evaluation of a Topical Formulation of Azelaic Acid and Rosemary Essential Oil for the Treatment of Acne Vulgaris 41
Paper ID: 060: Influences of Season on Soil Characteristics in the Microhabitat of *Bambusa kingiana* in Manipur 42
Paper ID: 062: Genotype-specific electrolyte leakage and secondary metabolite production in *Andrographis paniculata* under heavy-metal stress 43
Paper ID: 063: Essential Oil-Loaded Montmorillonite Clay-Based Formulation for Sustained Bioherbicidal Activity 44
Paper ID: 067: Bio Synergy Fusion: Biotech-Driven Phytomedicine Powering Multitarget Alzheimer's Therapy 45
Paper ID: 069: From Traditional Remedy to Therapeutics: Integrated GC-MS/HPTLC Quantification of Methyl Salicylate as the Novel Anti-Inflammatory Lead in *Gaultheria fragrantissima* Essential Oil from Meghalaya 46
Paper ID: 070: Phytochemical Diversity and Ethnomedicinal Significance of Genus *Ophiorrhiza* in Manipur with Special Reference to *O. japonica* Blume 47
Paper ID: 094: Chemical profiling of Melacanna beccifera fruits 48
Paper ID: 100: Comparative Pollen Load and Floral Diversity in *A. cerana* and *A. dorsata* Honeys of Manipur Valley 49

Paper ID: 118: Antioxidant and Phytochemical Analysis of *Murraya koenigii*: Traditional Uses and Modern Insights 50
Paper ID: 127: Green Synthesis and Characterization of Silver Nanoparticles Using Zederone from the Rhizomes of *Curcuma caesia* Roxb. and Catalytic Activity 51
Paper ID: 130: GC-MS Analysis of Bioactive Constituents of *Curcuma leucorrhiza* Roxb. (Zingiberaceae) Rhizome Extract 52

Theme: Biotechnology Today **53**
Paper ID: 028: Evaluation Of Cytotoxic Activity of fruit pericarp extract of Soapberry (*Sapindus mukorossi* Gaertn) on Human cancer cell lines using Bioassay Guided Fractionation 54
Paper ID: 037: VitalsVault: A Web-Based Platform for Chronic Disease Tracking and Intelligent Health Record Management 55
Paper ID: 049: Efficacy of native bacterial isolates against root-knot nematode, *Meloidogyne incognita* 56
Paper ID: 066: Nanobiotechnology-Driven Ocular Delivery of Biologics Using Advanced Nanocarriers 57
Paper ID: 072: Isolation, Identification & Characterisation of *Bacillus* species from Peruyaan 58
Paper ID: 074: Hypoxia-Driven nAChR–AKT–HIF Signaling in Lung Adenocarcinoma: A Biotechnology-Based Approach to Understanding Cancer Progression in Never-Smokers 59
Paper ID: 076: Microbial Biotechnology Approach: Synergistic Plant Growth Promoting Rhizobacterial Consortia for Sustainable Chakhao Cultivation . . 60
Paper ID: 078: Hepato-protective assessment study of *Hydrous indicus* and *Gryllotalpa orientalis*, the highly consumed edible insects of Manipur, North-eastern states of India 61
Paper ID: 083: Bioactivity screening of endophytic bacteria associated with selected medicinal plants of Manipur 62
Paper ID: 084: Optimization of Keratinolytic Protease Production by *Streptomyces diastaticus* strain TS1-48 63
Paper ID: 085: Partial Purification of Multiple Proteases from the Latex of *Ficus heterophylla* L.f. using Hydrophobic Interaction Chromatography 64
Paper ID: 101: Recent trends in the application of Nanotechnology in pharmaceutical and natural products 65
Paper ID: 103: A report on domestication and cultivation of split gill mushroom, Kanglayen 66
Paper ID: 104: A Systematic NLP-Driven Study on Mushroom Poisoning: Clinical Syndromes, Amatoxin Hepatotoxicity, Diagnostics, and Global Epidemiology 67
Paper ID: 105: HemoSight: A Hybrid CNN and RAG Framework for Automated Intracranial Hemorrhage Detection and Report Generation 68
Paper ID: 107: Dual incretin-modulating effects of Roselle (*Hibiscus sabdariffa*) extract and its flavonoids in experimental type 2 diabetes 69
Paper ID: 114: Gut Plastisphere Microbiota-Mediated Polystyrene Depolymerization in the Plastivore Insect *Tenebrio molitor* 70

Paper ID: 119: Developing a Machine Learning-Based Cardiometabolic Disease Model for Predicting Liver Disease . . . 71
Paper ID: 126: Isolation and Identification of Pathogenic Bacteria from Sewage Water in Imphal East District, Manipur . . . 72
Paper ID: 129: Epidemiological and Climatic Determinants of Scrub Typhus in Manipur, India: A Retrospective Surveillance-Based Study . . . 73
Paper ID: 140: Virtual prediction of domains in genomes of actinobacteria using NaPDoS, Domain Search Program for NRPS, NP Searcher, and NRPS substrate predictor for bioactive compounds . . . 74
Paper ID: 149: Nanostructured Lipid Carriers Loaded with PDE4 Inhibitors to Attenuate Neuroinflammation in Parkinson's Disease: A Review . . . 75

Theme: Advances in Mathematical Sciences **76**
Paper ID: 023: Detection of Blind Spot in Heavy vehicles: A multi Criteria Decision making Approach using Machine learning . . . 77
Paper ID: 024: A Novel Diagonal Hamming technique for efficient Multi-Bit error correction in Memories . . . 78
Paper ID: 026: Integrating Zero-Trust Architectures into DevSecOps for Cloud Workloads . . . 79
Paper ID: 030: Computational Analysis and Recognition of Manipuri Traditional Motifs . . . 80
Paper ID: 033: A Robust Machine Learning Framework for Preclinical Alzheimer's Detection Using Cognitive Features and Ensemble Voting . . . 81
Paper ID: 034: NextGen Intern Manager for Effective Talent Development and Skill Tracking . . . 82
Paper ID: 038: A Machine Learning Framework for Forecasting Rice Production, Cultivated Area, and Yield in Manipur using Feed Forward Artificial Neural Network . . . 83
Paper ID: 043: A Comparative Study on Binary Composition in Fuzzy Relations . 84
Paper ID: 064: SENTRY Error-Budget-Constrained Causal Canary Orchestrator . 85
Paper ID: 075: Fixed points of some contractive mappings in S_b metric space . . . 86
Paper ID: 088: Fixed Point Theorems for convex contraction mappings on Partially E-Cone Metric Spaces . . . 87
Paper ID: 089: Coupled Fixed Point in Partial Modular Metric Space . . . 88
Paper ID: 090: Tripled fixed point theorems for non-compatible self-maps in generalized metric spaces . . . 89
Paper ID: 091: On the application of partial cone b-metric spaces to boundary value problem . . . 90
Paper ID: 092: On Fixed Figure Problems in Fuzzy Cone Metric Spaces . . . 91
Paper ID: 093: Non-singular Durgapal–Fuloria gravastar solutions in $f(R, L_m, T)$ gravity . . . 92
Paper ID: 095: Dynamical System Approach of Modified $f(R, G, T)$ Gravity and Its Cosmological Implications . . . 93
Paper ID: 097: Non-singular Vaidya–Tikekar gravastar model in $(3 + 1)$ dimensions 94
Paper ID: 098: Dynamical system approach of viscous fluid in $f(T)$ gravity theory 95

Paper ID: 102: Steinhaus Graphs and Its Application in Cryptography 96
Paper ID: 108: Optimizing Semantic-Driven Sentiment Analysis and Text Classification Using Rivoli's Hummingbird Optimization in ERNIE (RHO–ERNIE) 97
Paper ID: 109: Construction of fractals with Picard–CR iteration equipped with s-convexity for a complex rational function 98
Paper ID: 110: Fixed points of some F-contractions using Mann's iteration in (θ, δ)-convex b-metric spaces 99
Paper ID: 111: $(\alpha - \psi)$-interpolative Kannan and Ćirić–Reich–Rus-type cyclic contraction in b-metric spaces 100
Paper ID: 112: Lattice Homomorphisms on L^p-Spaces 101
Paper ID: 116: Some fixed point theorems on complete (α, β, c)-interpolative S-metric spaces 102
Paper ID: 121: Transfer Learning Approach for Handwritten Character Recognition of Meitei Mayek Script Using Deep CNNs 103
Paper ID: 123: Detection of Attacks in Wireless Sensor Networks Using Unsupervised Learning Approach 104
Paper ID: 125: On the Compactness of Higher Order slant Hankel and slant Toeplitz Operators 105

Theme: Plenary and Invited Presentations **106**
Paper ID: PT–01: Phytochemicals of Liverworts: Biological Activity and Their Application to Cosmetics, Foods and Medicines 107
Paper ID: PT–02: Number Theory and Science of Secure Communications 109
Paper ID: PT–03: Antarctica: Exploring the Frontiers of Nature and Science . . . 110
Paper ID: PT–04: Magnetic Oxides: Materials for Potential Applications 111
Paper ID: PT–05: Genetic Basis of Anti-Tuberculosis Drug-Induced Liver Injury (AT-DILI) 112
Paper ID: PT–06: Evidence-Based Perspectives on Traditional Medicine in the Management of Lifestyle Diseases 113
Paper ID: PT–08: Recent Approaches in Natural Products Research for Drug Discovery 114
Paper ID: PT–09: Synergistic Nanocomposite Photocatalysts for Photodegradation of Organic Pollutants in Water 115
Paper ID: PT–10: Fixed Points by Iterative Methods and Applications 116
Paper ID: PT–11: A Brief Retrospective History and Advancement on the Fuzzy Metric Fixed Point Theory 117
Paper ID: IT–01: Disorder Induced Localization in Optical Lattices 118
Paper ID: IT–02: Defect-Engineered Nitride-based MXene/rGO Nanohybrids: A Unified Strategy for High-Performance Energy Storage and Corrosion-Resistant Electrodes 119
Paper ID: IT–03: Ensuring Purity: Analysis and Control of Contaminants and Residues in Herbal Medicines 120
Paper ID: IT–04: Mechanistic Studies on Alicyclic and Heterocyclic Compounds Using Newer Synthetic Methodologies 121

Paper ID: IT–05: Mean Chain Transitivity and Almost Mean Shadowing Property of Iterated Function Systems . . . 122
Paper ID: IT–06: Nash Equilibrium Through the Lens of Fixed Point Theory . . . 123
Paper ID: IT–07: Waste to Wealth: Pineapple Processing Waste for Production of Sustainable Bioenergy and Biochemicals . . . 124
Paper ID: IT–08: Illuminating the Microbial Dark Matter in Fermented Foods and Gut: Unlocking Insights for Cardiometabolic Health and Biotherapeutics . . . 125
Paper ID: IT–09: Phenolic compounds from *Cotinus coggygria* Scop. . . . 127
Paper ID: IT–10: Design of Doped Graphene Quantum Dot Composites for Next-Generation Energy Storage Devices . . . 128
Paper ID: IT–11: How Science and Technology Will Revolutionize the 21st Century 129
Paper ID: IT–12: Dynamical System Analysis of Barrow Holographic Dark Energy 131
Paper ID: IT–13: Obesity-Linked Pancreatic Fat Rewires Tumor Nerves to Promote Cancer Growth . . . 132
Paper ID: IT–14: Diversity, Bioactivity, Therapeutic Potential, and Future Challenges of Bibenzyls and Bisbibenzyls in Bryophytes . . . 133
Paper ID: IT–15: Sampling and Reconstruction via Frames: From Theory to Applications . . . 134
Paper ID: IT–16: Nanostructured Catalytic Materials for Efficient Energy Conversion and Storage . . . 135
Paper ID: IT–18: Extension of the Concept of Nilpotency in a Module . . . 136

Theme: Nanomaterial Heterostructure Modelling

Abstract 1 – Paper ID: 025

Calcination Temperature–Modulated Structural, Magnetic, and Optical Properties of $BiFeO_3$

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Abstract

The narrow temperature range of phase stabilization has limited the successful synthesis of pure phase bismuth ferrite. Bismuth ferrite (BFO) has been synthesized using a facile sol–gel route by calcining the as–prepared BFO powder at different temperatures of 350°C, 450°C, 550°C, 600°C and 650°C. The influence of temperature variation on the structural, magnetic, and optical properties of BFO has been investigated. XRD patterns show the characteristic peaks of pure BFO along with secondary phases like $Bi_2Fe_4O_9$, $Bi_{25}FeO_{40}$, and Bi_2O_3 in all the samples calcined at different temperatures. Leaching with 1 M HNO_3 followed by subsequent washing has been employed as an efficient route to remove the impurity peaks. XRD and Rietveld Refinement analysis of the leached samples confirmed the phase formation of pure BFO with no extra peaks. Crystal growth with increase in temperature could be observed from the morphology investigated through FESEM. Stretching and bending vibrations of Fe–O and Bi–O bonds have been confirmed from FTIR. The influence of calcination temperatures on magnetic properties is analysed from M–H loop revealing the presence of weak ferromagnetism in the synthesized BFO nanoparticles. The UV–V is spectroscopy measured the optical band gap of the samples which could be tuned in the visible region and can ultimately be exploited for applications in photocatalysis and photovoltaic devices.

Keywords: Sol-gel, Rietveld Refinement, FESEM, Magnetization, Ferromagnetism, Band Gap

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Abstract 2 – Paper ID: 029

Structural, Morphological and Optical characterization of Nanocrystalline PbSe thin films prepared at different molarity by CBD

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Abstract

Nanocrystalline Lead selenide (PbSe) thin films are successfully synthesized by the simple chemical bath deposition (CBD) method at different molarities (0.2 M, 0.4 M, 0.6 M, and 0.8 M) by keeping the constant pH value 11.5 and deposition bath temperature 333K. The deposited PbSe thin films on the bare glass substrates are characterized by using X-ray diffraction (XRD), Scanning electron microscopy (SEM), energy-dispersive X-ray analysis (EDAX), and Raman spectroscopy. XRD analysis confirmed the deposited films are polycrystalline nature with cubic structure. The estimated crystallite sizes are found in between 15.5 nm to 24.5 nm. The crystallite size increases with increase in molarity whereas the microstrain and dislocation density decreased systematically, which indicates the improvement of crystal quality at higher molarity. The crystallite sizes which are calculated from the Monshi–Scherrer method [1] and different Williamson–Hall (W–H) models [2] such as UDM, USDM, and UDEDM are in good inter-correlation with TEM results. The SEM micrographs show without any voids and pin holes. EDAX analysis confirms the presence of Pb and Se in the prepared films. Raman studies further signifying better crystallization quality at higher molarities. The overall findings demonstrates that the structural characteristics of PbSe thin films are strongly dependence on the concentration of the precursor solution.

Keywords: Nanocrystalline, Thin film, CBD, X-ray diffraction, SEM, EDAX

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Abstract 3 – Paper ID: 071

Photoluminescence Properties of CdSe:Mn^{2+} Thin Films Synthesized Using the Chemical Bath Deposition (CBD) Technique

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Abstract

The Photoluminescence (PL) properties of CdSe is crucial for its optoelectronics applications like LEDs and lasers. The PL analysis can also characterize the quality of CdSe by revealing electronic states, defects, and surface properties, which is essential for optimizing device performance. The undoped CdSe and Mn^{2+} doped CdSe thin films were deposited on ordinary glass substrate using Chemical Bath Deposition (CBD) Method. The structural characterization and surface morphological study of the thin films were done using XRD and SEM. The UV-Visible Spectroscopy was used to determine the band gap energy for thin films. The PL excitation and emission spectra of thin films were studied for exploration of its potential to develop Laser and LED.

Keywords: Band Gap, CBD, CdSe, Photoluminescence, Thin Film

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Abstract 4 – Paper ID: 079

Solid-State Optical Beam Scanner for LiDAR Application

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Abstract

We demonstrate a silica arrayed waveguide grating (AWG) based on optical phased array (OPA) solid-state beam scanner with a low total insertion loss of 4.04 dB. The 64-channel AWG OPA, combined with a digital MEMS device, achieves two-dimensional (2D) optical beam steering via wavelength tuning from 1535 nm to 1565 nm, providing a field-of-view (FOV) of 15.8°(H)×12°(V). Furthermore, the FOV is efficiently expanded to 76.58°×48° using a compact lens relay system without deteriorating the beam profile. A metalens with a hyperbolic cylindrical phase gradient reshapes the elliptical output beam into a circular profile, yielding a full-angle divergence of 0.125°(H)×0.095°(V). In addition, we propose and experimentally demonstrate a synchronous transceiving FMCW ranging scheme using a single silica AWG OPA chip, functioning as both transmitter (Tx) and receiver (Rx), offering a promising approach with a negligible errors and highlighting its potential for future solid-state FMCW LiDAR sensors.

Keywords: Optical phased array, arrayed waveguide grating, 2D beam steering

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Abstract 5 – Paper ID: 106

Engineered Graphene Quantum Dots for High-Temperature Supercapacitors: A Pathway Toward Sustainable and High-Performance Energy Storage

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Abstract

In this study, advanced electrode materials based on graphene quantum dots (GQDs) and polyaniline (PANI) composites are developed to achieve high-performance supercapacitors for next-generation energy storage systems. GQDs were synthesized via a microwave-assisted hydrothermal (MAH) route, providing a rapid, energy-efficient, and scalable method. Pristine GQDs exhibited promising electrochemical behaviour when integrated with PANI through chemical oxidative polymerization performed at both room temperature and 4°C. The low-temperature synthesis induced distinct morphological transformations in the GQD/PANI composites, as confirmed through XRD and FESEM analyses, resulting in improved charge-storage capability.

Symmetrical supercapacitor devices fabricated using the optimized GQD/PANI electrodes delivered high specific capacitance along with superior energy and power densities. To ensure device operability under extreme conditions, room-temperature ionic liquid (RTIL) and bentonite-based gel electrolytes were employed. These electrolytes enabled stable performance at elevated temperatures up to 150°C, demonstrating excellent thermal stability, sustained energy density, and prolonged cycling durability under harsh operating environments.

Overall, the synergistic material architecture, combined with temperature-adaptive electrode engineering, highlights the potential of GQD-based hybrid electrodes as robust, high-energy, and high-temperature-resilient candidates for next-generation supercapacitor applications. This work positions GQD/PANI composites as a promising platform for advanced electrochemical energy storage technologies.

Keywords: Graphene quantum dots, Polyaniline composites, Supercapacitors, High-temperature energy storage, Ionic liquid gel electrolytes

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Abstract 6 – Paper ID: 115

Analog Resistive Switching in Nickel Ferrite Thin Film Fabricated via Sol-Gel Spin Coating Technique

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Abstract

Nickel ferrite ($NiFe_2O_4$) thin films were deposited on platinized silicon [$Pt/TiO_2/SiO_2/Si$] substrate to investigate their resistive switching characteristics for potential non-volatile memory applications. The $Pt/TiO_2/SiO_2/Si$ substrate was spin coated with 2 layers of $NiFe_2O_4$ and was annealed at 700°C for 1 hour for crystallization of the amorphous film. X-Ray Diffraction spectroscopy confirms that the film so obtained shows preferred orientation along (311) plane indexed using ICDD card no. 010-0325. Metal-Insulator-Metal (MIM) structure was developed by applying gold dots of 60 nm thick over the film by using thermal evaporation technique. The platinum will act as bottom electrode and the gold dots will act as top electrode. The resistive switching behaviour was measured by using Keysight B2901A SMU precision system. The film exhibits a well-defined analog resistive switching behaviour, characterized by reproducible SET and RESET processes under opposite voltage polarities from 0 V $\rightarrow$ +2 V $\rightarrow$ 0 V $\rightarrow$ −2 V $\rightarrow$ 0 V. Current-Voltage (I–V) measurements reveal a stable transition between high-resistance (HRS) and low-resistance (LRS) states with a good switching ratio and at a low operating voltage of 0.5 V. Endurance tests demonstrate consistent switching over multiple cycles and long-term stability of resistance states. Structural and interfacial analyses suggest that the switching mechanism is governed by the creation and rupture of oxygen-vacancy-mediated conductive filaments within the ferrite layer, influenced by the Schottky-like contact at the $Pt/NiFe_2O_4/Au$ interface. These results highlight the suitability of nickel ferrite thin films on platinized silicon as promising candidates for applications in resistive random-access memory (ReRAM) devices, magneto-resistive memristors, smart sensors, etc.

Keywords: Nickel ferrite, resistive switching, sol-gel, spin coating, thin films, oxygen vacancy

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Abstract 7 – Paper ID: 117

Investigation of magnetoelectric response in lead-free $K_{0.5}Na_{0.5}NbO_3$–$SrFe_{12}O_{19}$ novel composite system

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Abstract

Lead free multiferroic composites have drawn the interest of research fraternity due to their potential applications in memory devices, magnetic probes, transducers, phase shifters etc. In this work, lead free KNN–SFO composites viz: (1-x) $K_{0.5}Na_{0.5}NbO_3$–(x) $SrFe_{12}O_{19}$ with x = 30, 40 and 50 wt.% were prepared via the solid-state reaction route. XRD patterns confirmed the formation of diphase composites with KNN and SFO having perovskite monoclinic and hexagonal structure respectively. Scanning Electron Microscope (SEM) and Energy Dispersive X-ray Spectroscopy (EDAX) were employed to study the morphological and compositional analysis. The electrical properties of the samples were studied in the frequency range of 100 Hz to 1 MHz at temperatures of 50°C, 100°C, 150°C, and 200°C. Dielectric measurements showed a typical frequency dispersion behaviour with the value of dielectric constant increases with the addition of SFO. The AC conductivity analysis of the samples were found to follow Jonscher's Power Law (JPL). Nyquist plot analysis confirmed the evidence of thermally activated semi-conducting behaviour. Room temperature magnetisation is found to increase; however, polarisation decreases with ferrite concentration. The composite with 30 wt.% SFO has shown maximum room temperature magnetoelectric (ME) coefficient of $\alpha_{ME} \approx 47$ mV·cm^{-1}·Oe^{-1}. This features in KNN–SFO composites underscores their potential for multifunctional device applications.

Keywords: KNN-SFO, XRD, dielectric, conductivity, magnetoelectric, Nyquist plot

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Abstract 8 – Paper ID: 120

An Improved Modified Mesh-Based Topology For NoC

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Abstract

Over the years, many 2D topologies have been proposed by the researchers, such as MIN FAT Tree, Cubes, mesh, torus etc. Among those Mesh and Torus are used most prominently in commercial deployments. This is due to the simple design, regular grid of routers and links and straightforward physical implementation in VLSI. In a typical 2-D mesh each router connects to up to four neighbours and to a local processing element, producing a tiled "city-grid" layout that maps well to floor planning and clock-tree design. This regularity simplifies router design, supports systematic scaling to large core counts, and enables many well-studied routing and mapping methods.

However, Mesh topology suffers from large network diameter and have tight edge bandwidth. This problem was tackled by torus topology by adding wrap around links from every edge node vertically and horizontally. The tori successfully decreased the network diameter and reduced the end–to–end delays of the packet travelling from corner node to corner node of a mesh topology, however, the long extra wrap around links introduced long wire delays. Over the years, many attempts were made to reduce the diameter of a mesh topology by introducing extra links, but, either, they have used too many short links or very long links which increased the total wire length of the resulting topology.

Here, we propose an improved modified $N \times N$ mesh topology ($N \geq 4$) with four extra links, with an aim of restricting the hop count strictly to $N - 1$, which in regular mesh goes up to $N - (N - 1)$. The proposed topology is simulated using Dijkstra's algorithm based shortest path Routing algorithm and result shows the maximum hop count of $N - 1$. An approximate reduction of around 73% in the total wire length is achieved by our proposed topology, as compared to torus. The proposed topology incurred an average latency of 20×10^{-6} Seconds for a 5×5 network size.

Keywords: Network-on-Chip, System-on-Chip, Latency, Hop count, Topology

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Abstract 9 – Paper ID: 124

A Progressive Shortest-Path Routing Approach for 3D Mesh-Based Topologies with Supplementary 2D Links

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Abstract

The development of 3D Network-on-Chip (NoC) architectures marks a major advancement in integrated circuit design, addressing the scaling limitations faced by traditional 2D NoCs. The pioneering academic work on 3D NoC surfaced around 2006, blending 3D integration—stacking multiple active silicon layers—with network-on-chip communication fabrics to boost system performance, bandwidth, and scalability.

Attempts to reduce 2D network diameter always invariably introduces supplementary links between corner nodes or to nodes in the middle. As is seen in the case of 2D mesh. Many variants such as 2D torus, diagonally connected mesh, C2 mesh, C mesh, diametrical mesh, XD mesh and torus heavily rely on adding supplementary links. These links do somewhat solve the issue at the cost of scalability in the 2D plane.

We evaluate a mesh-based 3D topology augmented with supplementary 2D links formed by vertically stacking and scaling the network along the Z-axis. Four supplementary links connect the four corner nodes to four central (middle-region) nodes in each 2D mesh plane. These links are invoked when the 2D routing distance exceeds N in an $N \times N \times NN$ 3D mesh ($N \geq 4$), as they always provide a shortest path of less than NNN hops in the 2D plane.

The proposed progressive shortest-path routing algorithm computes the shortest distance from the source to a node with a supplementary link and from the destination to the corresponding node. Once the minimum 2D distance is achieved, the packet is routed through that node. If the source and destination lie in the same plane, delivery is completed within the plane; otherwise, the packet is forwarded along the Z-axis—either upward or downward—to reach the destination plane and final node.

The 3D network has been simulated and found to be generating only the shortest path and have incurred an average latency of 20×10^{-6} Seconds for $5 \times 5 \times 5$ network size and an average latency of 12.587×10^{-6} Seconds for $4 \times 4 \times 4$ network size.

Keywords: 3D Network-on-Chip, System-on-Chip, Latency, Hop count, Mesh topology

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Abstract 10 – Paper ID: 135

Structural and Photocatalytic Analysis of Mn and Gd in BFO

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Abstract

Bismuth ferrite ($BiFeO_3$) has attracted significant attention due to its wide range of potential applications. In the present work, rare-earth (Gd) and transition-metal (Mn) are codoped in bismuth ferrite. $Bi_{1-x}Gd_xFe_{1-y}Mn_yO_3$ samples with doping concentrations ($x, y = 0$, 0.05, 0.10, 0.15, and 0.20) were synthesized using a modified sol–gel auto-combustion method. The samples were finely ground using an agate mortar and pestle and subsequently annealed at 550°C for 2 h in air using a muffle furnace.

XRD analysis indicates the formation of a rhombohedral crystal structure with space group R3c. The morphological characteristics of the samples were examined using (FESEM). The photocatalytic performance of pure and co-doped BFO samples was evaluated using a solar lamp simulator. The results demonstrate enhanced photocatalytic activity for Mn and Gd co-doped BFO compared to pure BFO, attributed to improved charge separation and modified electronic structure induced by co-doping.

Keywords: Bismuth ferrite, Sol–gel auto-combustion method, XRD,FESEM, Photocatalysis, Solar lamp simulator

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Theme: Environmental Remediation

Abstract 11 – Paper ID: 035

ZnO Bionanocomposites in Wastewater Treatment

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Abstract

Detrimental water is the challenging threat to human civilization in 21st century. Bionanocomposites are the ideal alternative to conventional technique in water purification. ZnO nanocomposites (ZnO NCs) were synthesized using the plant extracts of *Phragmites australis* as reducing and capping agents and chitosan as stabilizing agents. To confirm the shape, size, optical properties, thermal properties, stability and involvement of phytochemicals and chitosan in the synthesis and stabilization of NCs Transmission Electron Microscope (TEM), Scanning Electron Microscope (SEM), X–Ray Diffraction (XRD), UV–Visible, Thermo gravimetric Analysis (TGA), Dynamic Light Scattering (DLS), Zeta potential and Fourier Transform Infrared (FTIR) analysis were performed respectively. Photo–reduction of organic pollutants was carried out in presence of ZnO NCs to examine the photocatalytic activity of NCs. Kinetics of the dye degradation, effects of concentration of ZnO NCs, reusability and heterogeneity of ZnO NCs in the dye degradation were studied. Hence, *Phragmites australis*/cellulose/ZnO NCs will be novel innovative multifunctional materials for treatment of wastewater for safe drinking water.

Keywords: Bionaocomposites, Chitosan, *Phragmites australis*, Wastewater, ZnO nanocomposites (ZnO NCs)

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Abstract 12 – Paper ID: 040

Design of CO gas sensor based on chemically deposited ZnO:Ga thin films

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Abstract

Pure and Ga-doped ZnO thin films were successfully deposited on glass substrates using the chemical bath deposition technique. SEM analysis confirmed that undoped ZnO exhibits nanorod structures, whereas the incorporation of Ga in the host lattice resulted in nanospheres, and the increase in wt% of Ga led to the reduction in crystallite size. The optical studies further showed a slight decrease in band gap energy, from 3.87 eV to 3.83 eV, with Ga doping. The electrical behaviour and CO gas-sensing performance of the films were evaluated, including measurements of response and recovery times in the presence of CO gas. Based on these findings, a prototype gas-sensing device has also been proposed.

Keywords: Chemical Bath Deposition, Thin films, Zinc Oxide, gas sensor

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Abstract 13 – Paper ID: 050

Management of Major insect pests of Cabbage using Bio-insecticides

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Abstract

A field investigation was done at the College of Agriculture, Iroisemba, CAU, Imphal during Rabi season of 2023-24 to evaluate the bio-efficacy of certain microbial insecticides (Green Lipel, Green Racer, Green Pacer and Green Mealikil), avoidable yield loss and cost effectiveness against Diamondback moth (DBM), *Plutella xylostella* Linn., Cabbage butterfly (CB), *Pieris brassicae* Linn. and Cabbage aphid, *Brevicoryne brassicae* Linn. in Cabbage var. "Green Hero". The findings on the determination of avoidable yield loss and cost effectiveness of the various insecticidal treatments showed that maximum mean yield (21.91 t/ha) was harvested from the plots treated with Green Lipel @2000 ml/ha, followed by Zorba 25 SE @ 800 ml/ha (20.33 t/ha) and Green Racer @2000 ml/ha(18.98 t/ha) which significantly differed from one another. Among the treatments, Green Lipel resulted the highest increased yield over control with mean yield of 9.30 t/ha, followed by Zorba 25 SE (7.72 t/ha) and Green Racer (6.37 t/ha). The lowest per cent avoidable yield loss (7.21%) was recorded in Zorba 25 SE, followed by Green Racer (13.37%) treated plots. The treatment with Zorba 25 SE also had maximum Cost-Benefit – Ratio of 1:14.84, followed by Green Lipel (1:10.74) and Green Racer (1:6.56). Though, chemical insecticide, Zorba 25 SE recorded highest mean yield and Cost-Benefit Ratio, taking into consideration of healthy environment eco-friendly insecticides like Green Lipel for Diamond back moth & Cabbage butterfly, and Green Racer for Cabbage aphids may be recommended for sustainable and environmentally sound management of these three major insect under Cabbage Crop-Ecosystem of Manipur Valley.

Keywords: Cabbage, Bio-insecticides, Bio-efficacy, *P. xylostella*, *P. brassicae*, *B. brassicae*

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Abstract 14 – Paper ID: 056

Bio-management of southern root-knot nematode, *Meloidogyne incognita* in CUCUMBER

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Abstract

Field trials were carried out during *kharif* seasons of 2022–2023 and 2023–2024 to know the efficacy of different bio-agents (Neem cake, *Pseudomonas putida*, *Bacillus megaterium*, *B. amyloliquefaciens* and *Pseudomonas fluorescens*) against southern root-knot nematode, *Meloidogyne incognita* in cucumber. It was revealed that, best treatment was observed in combined application of neem cake @ 1 t/ha + seed treatment with *P. putida* @ 10 g/kg of seed followed by neem cake @ 1 t/ha + seed treatment with *B. amyloliquefaciens* @ 10 g/kg of seed significantly increased the yield and reduced the galls, egg masses as well as final nematode population in soil as compared to untreated control. However, application of Carbofuran @ 33 kg/ha (chemical check) was found to be very effective in reducing the galls, egg masses and soil nematode population.

Keywords: Cucumber, *kharif*, neem cake, *Pseudomonas putida*, *Bacillus megaterium*, *B. amyloliquefaciens*, *Pseudomonas fluorescens*, *M. incognita*, Carbofuran

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Abstract 15 – Paper ID: 077

Green emitting $CaMoO_4$:Tb^{3+} nanoparticles as luminescent probe for selective sensing of Fe^{3+}/Fe^{2+} ions

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Abstract

Polyvinylpyrrolidone (PVP) functionalized Tb^{3+} activated $CaMoO_4$ nanoparticles (NPs) were prepared through hydrothermal synthesis method. The structure and morphology of the tetragonal phase $CaMoO_4$ nanoparticles were characterized using XRD and TEM respectively. The surface functionalization and formation of the sample was confirmed from the FT-IR spectroscopy. The photoluminescence (PL) studies show the presence of broad absorption peak ∼275 nm corresponds to the MoO_4^{2-}. An intense green emission of Tb^{3+} at 544 nm was observed. This is due to efficient energy transfer from host to the activator i.e. from the molybdate absorption to the excited states of Tb^{3+}. Out of various metal ions, the nanoparticles show selective detection of Fe^{3+} ions in the whole pH range with a limit of detection of ∼6 μM. Also, these nanoparticles detect Fe^{2+} ions in alkaline media. This is due to PL quenching of the NPs in the presence of Fe^{3+}/Fe^{2+} ions. Both dynamic and static quenching are responsible for PL quenching process. The PL decay lifetime also supports the nature of quenching mechanism. These NPs could be a potential candidate for sensing of Fe^{3+}/Fe^{2+} ions in aqueous media.

Keywords: Hydrothermal, Nanoparticles, Photoluminescence, Quenching, Decay lifetime, Sensing

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Abstract 16 – Paper ID: 082

Modeling and Simulation of a Dual-Battery System for Thermal Runaway Prevention in Electric Vehicles

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Abstract

Burning of carbon-based fuels causes environmental pollution. To avoid this environmental threat, the best replacement available is electric vehicles. The electric vehicles make use of lithium-ion batteries, which can store more energy in less volume. The major problem with lithium-ion batteries is that at high-temperature conditions, thermal runaway comes into action and causes the risk of explosion of the electric vehicles. To prevent the explosion of the batteries, they should be operated in the safe temperature range. This paper introduces a methodology to sort out this issue by a dual battery system that activate only one battery at a time, which has a lower temperature than the threshold, and keeping another battery in idle condition, which has a temperature higher than the threshold. By using this methodology chances of thermal runaway can be reduced by limiting the maximum operating temperature to 45°C.

Keywords: Lithium-ion batteries, electric vehicles, dual-battery system, operating temperature

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Abstract 17 – Paper ID: 086

Solar Integrated Bidirectional Converter For Vehicle To Grid

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Abstract

The rapid adoption of Electric Vehicles (EVs) has created new opportunities for integration into smart grids through Vehicle-to-Grid (V2G) technology. This paper presents the design and analysis of a single-phase onboard hybrid converter that supports both vehicle propulsion and bidirectional power exchange with the grid. The proposed converter efficiently operates in propulsion, charging, and discharging modes, thereby eliminating the need for multiple power conversion units. In grid-connected mode, it enables controlled energy transfer between the EV battery and the utility grid, allowing the battery to serve as a distributed energy storage system that enhances grid stability, energy reliability, and renewable power utilization. Advanced control algorithms ensure stable voltage, current, and power factor across varying operating conditions, facilitating seamless mode transitions without performance loss. The compact, integrated design enhances overall efficiency, reduces system weight and cost, and promotes the sustainability of EV systems. Simulation and performance results validate the converter's high efficiency and stability, demonstrating its potential as a practical solution for effective V2G implementation.

Keywords: Electric Vehicle, Smart Grid, bidirectional Converter, Distributed Energy Storage

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Abstract 18 – Paper ID: 122

Zinc substituted Nickel Copper ferrite ceramics: A study on structural, magnetic and dielectric properties

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Abstract

Zinc substituted Nickel Copper ferrite ceramics (ZNC) with the structural formula $Ni_{(0.7-x)}Cu_{0.3}Zn_xFe_2O_4$, where $x = 0$, 0.1, 0.2 and 0.3 were synthesized using citrate precursor auto-combustion method. The prepared samples were calcined at 550°C using microwave furnace for 30 minutes at a heating rate of 10°C per minute. The calcined samples were pelletized using PVA as binder and sintered at 600°C in the microwave furnace for 30 minutes with the same heating rate. Sintered samples were characterized for their structural, magnetic and dielectric properties using X-ray diffraction, FTIR spectra, VSM and LCR meter, respectively. X-ray diffractogram confirmed the spinel phase formation of all the samples. Average crystallite sizes of all the samples were found out from the X-ray diffractogram using Scherrer's formula. The average crystallite size decreases with increasing Zn concentration. Lattice constant and theoretical density of the samples were obtained from the X-ray diffractogram using Rietveld refinement technique. FTIR spectra showed the presence of various metal-oxygen bonds present in the samples supporting the XRD. VSM results shows the soft magnetic nature of the samples. Further, dielectric properties such as dielectric constant and dielectric loss of the sintered samples were studied at room temperature as a function of frequency in the range of 20 Hz–2 MHz. Here, the dielectric constant and dielectric loss showed normal dispersive behaviour of ferrites in the considered frequency range. The variation of dielectric constant and dielectric loss with increasing concentration of Zinc substitution were also studied. Possible mechanisms of all the results obtained were discussed.

Keywords: Ni-Cu-Zn ferrite, Microwave, XRD, Saturation magnetization, Dielectric constant, Dielectric loss

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Abstract 19 – Paper ID: 131

Evaluation of Lead (Pb) Contamination and Groundwater Quality Using HPI and WQI in Regions of Delhi NCR

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Abstract

Lead (Pb) contamination in groundwater is increasing and poses a serious threat to human health and the environment due to its non-biodegradable nature. Prolonged exposure to lead through contaminated groundwater can result in severe health effects, including renal dysfunction, neurological disorders, and developmental issues, particularly in children. Rapid industrialisation, urbanisation, and the disposal of untreated waste contribute significantly to lead enrichment in groundwater through landfill leachate infiltration. In this context, the present study evaluates the concentration of lead and associated water quality indices in groundwater near major landfill sites of the Delhi National Capital Region (NCR), India. Seven groundwater samples were collected from landfill-impacted areas including Bhalsawa, Ghazipur, Kalindikunj, Abul Fazal, and Okhla, along with nearby locations. The samples were analysed using Inductively Coupled Plasma Mass Spectrometry (ICP–MS), enabling precise detection of Pb at parts-per-billion levels. The results indicate elevated lead concentrations ranging from 66 µg/L to 245 µg/L, which significantly exceed the permissible limit of 10 µg/L prescribed by the World Health Organization (WHO) and the Bureau of Indian Standards (BIS). The highest Pb concentration was observed near the Okhla Bird Sanctuary, suggesting a strong influence of landfill leachate on groundwater quality. To assess the overall groundwater quality status with respect to lead contamination, the Heavy Metal Pollution Index (HPI) and Water Quality Index (WQI) were calculated based primarily on Pb concentrations. The computed index values classify most groundwater samples as poor to unsuitable for drinking purposes, indicating substantial deterioration of groundwater quality in landfill-affected regions of Delhi NCR.

Keywords: Lead (Pb), Groundwater contamination, Water quality assessment, ICP–MS, Heavy Metal Pollution Index, Water Quality Index, Landfill leachate, Delhi NCR

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Theme: Earth Observation and Climate Analytics

Abstract 20 – Paper ID: 027

Antarctic Sea-Ice Concentration and Extent from SARAL/AltiKa Radiometer over the Recent Decade

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Abstract

This study presents monthly Antarctic sea-ice concentration (SIC) and sea-ice extent (SIE) derived from SARAL/AltiKa using the SARAL/AltiKa Sea Ice Algorithm (SSIA) applied to bi-frequency radiometer brightness temperatures at 37 and 23.8 GHz on a 25 km Polar Stereographic South grid. Study period is for April 2013–December 2024, and SIE is computed using the standard 15% concentration threshold with coastline buffering to mitigate land spillover. Processing includes monthly resampling of daily AltiKa data, use of an Antarctic land mask, and application of NOAA Climate Data Record (CDR) monthly fields as spurious-ice masks; Antarctic tie-points are tuned from the Arctic SSIA for optimal performance. Against independent references, Antarctic SIC shows high agreement across all months: correlation, R = 0.92 with NOAA CDR, NASA Bootstrap, and NASA Team; RMSE = 9.38%, 9.28%, and 12.48%; and mean bias error (MBE) = +0.55%, +0.52%, and –8.39%, respectively. Seasonal analysis indicates stronger winter performance (R ≈ 0.95–0.96; RMSE ≈ 5.9–11.7%) and larger summer scatter (R ≈ 0.88–0.89; RMSE ≈ 12.3–13.5%) consistent with marginal ice zone sensitivities. The Antarctic SIE series exhibits near-perfect coherence with NOAA CDR, NASA Bootstrap, and NASA Team (R = 0.99 for all), with RMSE of 0.11, 0.12, and 0.28 million km^2 and MBE of –0.03, –0.08, and +0.25 million km^2, respectively. Across all datasets, SIE declined by approximately 0.29 million km^2 per year over the past decade. Together, these SIC and SIE products provide a coherent, validated Antarctic sea-ice record suitable for climatology, anomaly tracking, and model evaluation.

Keywords: Antarctic sea ice, Sea-ice concentration, Sea-ice extent, SARAL/AltiKa, Radiometer, Cryosphere

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Abstract 21 – Paper ID: 031

Underwater Image Hyper-Resolution Using MLDRG

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Abstract

The combination of underwater environment conditions with suspended particles and wavelength-dependent light absorption creates severe image degradation. The combination of these effects results in distorted colors and decreased contrast and lost details, which makes visual interpretation challenging. The traditional enhancement methods including histogram equalization and white balancing produce limited improvements because they fail to address the complex nonlinear distortions which occur in actual underwater environments. The latest deep learning models demonstrate promising results, but they fail to achieve simultaneous structure recovery and color correction and resolution enhancement.

The Hyper-resolution Generative Framework (HGF) represents an end-to-end deep learning system which restores and enhances underwater images with high clarity. The MLDRG component of the model addresses noise and haze and color distortion, while the HFLM module specializes in texture recovery and detailed structural element restoration. The framework receives training data from the UIEB dataset which contains matched underwater image pairs between degraded and reference images. The model trains through a combination of reconstruction loss and perceptual loss and structural loss and adversarial loss to achieve both realistic and faithful results.

The evaluation results demonstrate that HGF delivers top results in PSNR and SSIM metrics and perceptual quality assessment, particularly when dealing with scenes that have severe color distortion. The model generates natural-looking output with improved definition and accurate color representation. The framework demonstrates practical value for marine research and underwater robotics and coastal monitoring and scientific documentation because of its improved performance. The research presents a single method which restores and enhances underwater images while maintaining essential high-frequency details required for underwater analysis in real-world scenarios.

Keywords: Underwater Imaging, Hyper-Resolution, Image Restoration, MLDRG, HFLM, Deep Learning, UIEB Dataset, PSNR, SSIM, GAN-based Enhancement

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Abstract 22 – Paper ID: 039

Observation of Greenland Ice Sheet melting using Oceansat-3

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Abstract

The melting of the Greenland Ice Sheet is a critical indicator of climate change. The melting of the ice sheets can be performed by using scatterometer data. The EOS-06 (Oceansat-3), an Indian satellite, has a Ku-band (13.5 GHz) scatterometer sensor. It provides three data types namely σ_0 (sigma-nought), γ_0 (gamma-nought) and BT (brightness temperature) in two polarizations (horizontal and vertical). This study attempted to detect the surface melt of the Greenland Ice Sheet using γ_{0H} (gamma-nought horizontal component) to observe the temporal and spatial melting of the Greenland Ice Sheet. The thresholding technique is applied to identify the melting signature of the ice sheet from February 2023 to October 2025. Instead of using a particular threshold value, different threshold values are used to find a close result with melting data of National Snow and Ice Data Centre (NSIDC-0755).

Keywords: Greenland, ice sheet melting, thresholding technique, Oceansat-3, EOS-06, Arctic

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Abstract 23 – Paper ID: 046

Geometry of Moho Depth beneath Northeastern Indian Plate by Joint Inversion of Gravity and Seismological Data

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Abstract

The northeastern region of the Indian plate, situated between the Indo-Eurasian plate, the Indo-Burman subduction zone, and the world's largest Ganga–Brahmaputra delta, forms one of the most complex seismotectonic domains across the globe. This region has experienced several of the deadliest earthquakes and hosts one of the largest hydrocarbon deposits in India. Despite its geological, seismotectonic, and economic significance, information on Moho depth beneath NE India has remained limited due to sparse and uneven geophysical data coverage. In this study, we attempt to address this gap using a regularized nonlinear inversion of satellite gravity data constrained by seismological observations. Sedimentary layer effects (-3 to -68 mGal) and terrain corrections (5 to 381 mGal) were applied through tesseroid-based forward modelling using CRUST 1.0 and ETOPO1 elevation data, respectively. The terrain-corrected Bouguer anomaly and 37 seismologically derived Moho depth estimates were used as input for the inversion. A systematic parameter search was carried out across six regularization coefficients, reference Moho depths ranging from 32 to 40 km, and crust–mantle density contrasts between 300 and 500 kg/m^3. The optimum crust–mantle depth and density contrast, corresponding to the minimum mean square error, were obtained at 32 km and 450 kg/m^3, respectively. The resulting Moho depth varies from 26 to 67 km across the NE Indian plate. The thickest crust (50-67 km) is observed beneath the Himalayan orogenic belt, reflecting the underthrusting of the Indian plate beneath the Eurasian plate, whereas the thinnest crust (26-30 km) occurs beneath the Ganga–Brahmaputra deltaic domain. The Shillong Plateau exhibits Moho depths of 32–35 km, while the Indo-Burman subduction zone shows crustal thicknesses of 35-45 km. The inverted Moho geometry is consistent with previous geophysical studies and provides improved constraints on the seismotectonic and geodynamic processes operating in NE India.

Keywords: Gravity, Seismology, Inversion, Moho depth, NE India, Himalaya

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Abstract 24 – Paper ID: 059

Simulation of LW Window Channel Brightness Temperature (BT-11) for INSAT-3DR Using Machine Learning Model

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Abstract

This study investigates the behaviour of brightness temperature of LW window channel (BT-11) under cloudy sky conditions using machine learning techniques and INSAT-3DR L2 satellite data, with focus on how BT-11 measurements are influenced by various cloud and atmospheric factors. Under successful simulation this ML model can emulate a radiative transfer model with an emphasis on lesser and simpler computation loads for meteorological application utilising satellite data. Collocated sounder and imager data from INSAT-3DR for the year 2024, over the Central India region during the pre-monsoon season (March–May), is used in the simulation. The input dataset comprises L2 products such as atmospheric temperature and humidity profiles, surface temperature parameters, surface pressure, and other thermodynamic parameters along cloud conditions, cloud properties viz. CTT (Cloud Top Temperature), CTP (Cloud Top Pressure), etc. Two machine learning models, Extreme Gradient Boosting (XGBoost) and Random Forest, are designed to train the datasets to predict the corresponding brightness temperature. Feature importance analysis and correlation studies reveal strong physical relationships, particularly surface temperature. And, XGBoost model is found to provide the better accuracy in simulating brightness temperatures.

Keywords: INSAT 3DR, XGBoost, Cloud Top Pressure, Cloud Top Temperature, Brightness Temperature (BT-11), Surface Temperature

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Abstract 25 – Paper ID: 061

Retrieval of Cloud Optical Depth for INSAT-3DR Using Machine Learning XGBoost Model

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Abstract

The study aims to retrieve the cloud optical depth for INSAT-3DR primarily from its L1 Sounder IR channels brightness temperature data of 11 μm, 12 μm, 12.6 μm, 3.79 μm, and radiance data of the visible channel at 0.695 μm using a machine learning model. The brightness temperatures, visible channel radiance, and MERRA-2 reanalysis products such as specific humidity, air temperature, surface pressure, and surface skin temperature, which govern the atmospheric thermodynamic conditions, are used to train the model. Cloud optical depth from MERRA-2 is used as the output. This study is carried out over the central Indian region for pre-monsoon and monsoon seasons of 2024. The XGBoost model is used for training. Feature analysis and correlation coefficients are obtained to understand the influence of radiance and meteorological conditions in retrieving cloud optical depth. The study is a preliminary analysis to design a retrieval technique for cloud properties retrieval for INSAT-3DR sounders using machine learning-based models.

Keywords: INSAT-3DR, cloud optical depth, brightness temperature, XGBoost model, MERRA-2, retrieval

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Abstract 26 – Paper ID: 096

Investigation of Morphological Changes over Larsen C Ice Shelf Using MODIS Data

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Abstract

Ice shelves are extended cantilever part of ice sheets, attached with ground and floats on ocean, act as sensitive indicators of climate change. More than 40% of Antarctic coast is fringed with it. Larsen ice shelf (LIS) is a long fringing ice shelf in the northwest part of the Weddell Sea, extending along the east coast of the Antarctic Peninsula which consists of four ice shelves as Larsen A, B, C and D. Catastrophic collapse of Larsen A and B during the years 1995 and 2000 respectively, turned attention of researcher to this area and thereafter, monitoring of the changes happening over the remaining part of LIS was started. In the present study, we have investigated decadal (2003–2014) morphological changes occurring over seven different locations on Larsen C ice shelf using five MODIS (Moderate Resolution Imaging Spectro-radiometer) channel 2 (near-infrared) (250 m resolution) cloud clear images of summer period. Average advancement of ∼0.82 km/yr has been measured over two locations with reference to the boundary of the year 2000 generated using RAMP (Radarsat Antarctic Mapping Mission). In the year 2005 the iceberg of area ∼1625.50 km^2 was calved from the ice shelf. The high pass filter with a kernel of 5 × 5 pixels is used to map the rifts and crevasses present over the shelf. The maximum percentage of rift area and maximum crevasses area were found to be ∼8% and ∼24% respectively, in the year 2006. Rate of rift widening was measured to be ∼0.14 km/yr. Along with these we have used MOD09 reflectance (500 m resolution) products of MODIS to investigate a feature on shelf showing different reflectance relative to nearby place on shelf. We have plotted a reflectance curve for all five images over a specific feature which showed a similar pattern resembling a typical snow reflectance curve. NDSI (Normalized Difference Snow Index) values calculated over the same region for all five years are greater than 0.4, which implies region is covered with snow.

Keywords: Larsen C Ice Shelf, MODIS, Morphological changes, Ice shelf dynamics, Rift and crevasse mapping, Antarctic cryosphere

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Abstract 27 – Paper ID: 146

Seasonal Surface Ice Velocity Variability over Polar Record Glacier, East Antarctica Using SAR Data

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Abstract

The marine terminating glaciers play a vital role to understand the ice dynamics of Antarctic ice sheet, mass balance and it contributing to sea level rise. To track glacier's activity, surface ice velocity (SIV) and strain rate is important, as it indicate basal sliding, deformation and also know about how environment changes. In this study, we used Sentinel-1, 12-days interval GRD HH pol data of Polar Record Glacier from November 2024 to April 2025 (austral summer to early winter). To derive velocity, we used MATLAB-based ImGRAFT (Image Geo Rectification And Feature Tracking) toolbox, which is based on normalized cross correlation method, the displacement tracks between pairs specified with search and template windows. With the help of this high-resolution temporal data, we collectively find seasonal velocity as well as short-term variability. We found minimum velocity near inland area and higher velocity found in north west of glacier's terminus region. The average velocity is around 1.92 m/day and range between ≈400 to 1000 m/yr, it shows active discharge. Even though Polar Record is stable glacier but we notice minor fluctuations during this period, it may because of basal melting, increasing sea surface temperature and decreasing sea ice concentration. Together, these finding shows subtle dynamics of Antarctica's one of the marine terminating outlet glacier, how crucial it is and its behavior. It is important, because it affects on increasing sea level rise.

Keywords: Antarctica, Polar Record Glacier, Surface ice velocity, SAR, ImGRAFT

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Theme: Medicinal and Aromatic Plants

Abstract 28 – Paper ID: 036

"DIET BOX": An AI Powered Personalized Diet and Management System

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Abstract

With the current hustle and bustle urban life, a healthy and customized diet has become very difficult especially to the old people, those who indulge in fitness, and people who have demanding work schedules. Zomato and Swiggy are the current food delivery platforms, which aim at convenience, but do not emphasize nutritional personalization or health optimization. In this paper, the researcher will suggest an AI-driven dietary recommendation and delivery service built on OAuth2/JWT-based user authentication and a machine learning-based personal diet plan generation. The suggested system will allow the user to either subscribe to dietary plans or create their own meal plans by choosing dishes depending on their availability and health value. Moreover, a smart AI bot helps users that are not aware of the proper dieting by proposing the best meal combinations based on their age, weight, and health status, and lifestyle information. The site provides scalable payment systems of fixed subscriptions and tailor-made daily or periodic plans. Besides, an intelligent delivery scheduling system will enable customers to specify favorite delivery time or get automatic notifications prior to every delivery, which will increase the convenience of the user and decrease the number of delivery conflicts. The effectiveness of the proposed model is proven by experimental assessments and architectural design, which prove the model to be possible, scalable, and secure. Secure authentication and AI powered personalization combined with automated logistics will help in closing the gap between nutrition science and the current food delivery ecosystems, enabling healthier living by dietary management enabled by technology.

Keywords: JWT Authentication, Machine Learning models, AI Chatbot, Diet Recommendation, Subscription Plans, Payment Gateway, Delivery Scheduling, Nutrition Database, Cloud Architecture

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Abstract 29 – Paper ID: 041

Computational Investigation of Bioactive Compounds from *Zanthoxylum armatum* DC. for Their Anti-Inflammatory Potential

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Abstract

Zanthoxylum armatum DC. locally named *Mukthrubi* is a medicinally important plant widely used plant in Manipur. It is recognised for its rich phytochemical profile and traditional use in managing inflammatory disorders. This study presents a comprehensive computational investigation of various major bioactive compounds to evaluate their anti-inflammatory potential.

To assess how well these compounds bind to important inflammatory proteins such as COX-2, TNF-α and IL-1β, molecular docking simulation was performed to measure predicted affinity for binding as well as types of interactions. Density Functional Theory (DFT) was applied to establish the electronic nature of each compound by determining HOMO–LUMO distributions, energy gaps between them, and molecular reactivity indices which are indicative of their potential ability to interact with target sites.

Furthermore, ADMET profiling was evaluated for drug-likeness, pharmacokinetics, and toxicity characteristics, followed by molecular dynamics (MD) simulations analysis to observed the stability of the ligand–protein complexes.

The Docking simulations identified key compounds of *Zanthoxylum armatum* DC. as the potent inhibitor of COX-2, TNF-α and IL-1β compared to the control inhibitors and reference compounds. The DFT simulations confirmed the favorable electronic characteristics necessary for a high level of interaction between the ligands and their target. Additionally, ADMET simulation predicted a good oral absorption and safety profile for all the investigated compounds. The combined data from docking, DFT and MD simulations provide a promising anti-inflammatory activity of the Phytocompounds in *Zanthoxylum armatum* DC. and serve as a rational base for subsequent experimental validation.

Keywords: Molecular Docking, Anti-inflammatory, ADMET, DFT, MD Simulations

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Abstract 30 – Paper ID: 042

Environmental Ampicillin Pollution Disrupts Gut Microbiome Composition and Host Immunity in *Drosophila melanogaster*

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Abstract

The problem of environmental pollution by antibiotic residues, and ampicillin, is gaining growing concern throughout the world because of the long-term impacts on the ecology and a possible disruption of the interaction of host microbes. Antibiotics are vital in the treatment of infections is that an enduring presence of antibiotics in the water and soil ecologies causes chronic exposure of non-target organisms to low dose antibiotics. The present study tries to understand the effect of environmentally relevant concentrations of ampicillin on the structure of the gut microbiota, including their functional potential and host physiology. 16S rRNA amplicon sequencing showed that antibiotic exposed flies are strongly dysbiotic in their gut. Large bacterial phyla (Proteobacteria, Firmicutes, Bacteroidota, Actinobacteria, Verrucomicrobiota and Planctomycetata) were subject to great change. Intervention of ampicillin led to the drastic reduction of the major symbionts, including Proteobacteria and Firmicutes and the growth in relative abundance of Bacteroidota and Chloroflexi. On the genus level fourteen taxa such as *Wolbachia*, *Lactobacillus*, *Bacillus*, *Pseudomonas*, *Vibrio*, *Clostridium* and *Staphylococcus* had significant increases ($p \geq 0.05$). Among the most notable changes, the significant decrease of *Acetobacter* which is an essential part of the commensal nutrient metabolism and the simultaneous increase in the number of the *Wolbachia* lineages, particularly *Wolbachia pipientis*, were noteworthy. Functional prediction analysis revealed improvement of microbial abilities of the ampicillin-treated groups in terms of nucleotide biosynthesis, metabolism, and enzymatic activities. Host physiological measurements also showed a decreased production of antimicrobial peptides (AMP) and impaired innate immune factors representing a disturbed immune homeostasis of gut in response to antibiotic stress. Generally, the present study demonstrates the low but consistent effects of environmental pollution of ampicillin at low levels on the microbial ecology of the gut and host immunity. Results justify the importance of the increased control of the release of antibiotics and increasing the number of checks on the pollution of the environment with antibiotics.

Keywords: Ampicillin pollution, Gut microbiome, *Drosophila melanogaster*, Dysbiosis, Host immunity

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Abstract 31 – Paper ID: 044

Glycoconjugate Recognition by Asialofetuin-Binding Lectins: Implications for Malignancy Stratification

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Abstract

Cancer remains a major global health challenge, reinforcing the need for selective molecular tools that can both detect and differentiate malignant glycosignatures. Asialofetuin-binding lectins are particularly valuable in this context because they recognize exposed terminal galactose residues on desialylated glycans—hallmarks of tumor-associated glycosylation changes, including aberrant sialylation and elevated galectin expression. Their high-affinity, multivalent binding enables sensitive discrimination between malignant and normal cells, often producing measurable agglutination useful for malignancy stratification. In this study, lectin extracted and partially purified (0–30% ammonium sulfate fraction) from *Bridelia retusa* (L.) A. Juss. exhibited strong and selective binding to asialofetuin, indicating a clear ability to target tumor-associated glycan alterations. This affinity suggests its suitability as a candidate biomolecule for developing lectin-based diagnostic assays aimed at identifying desialylated glycopatterns. Plant-derived asialofetuin-binding lectins also show potential anticancer relevance due to their preferential interaction with tumor cells, although their therapeutic implications require deeper investigation.

Keywords: Asialofetuin-binding lectins, Glycoconjugate recognition, Tumor-associated glycosylation, Malignancy stratification, *Bridelia retusa* lectin, Galectin-associated tumors

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Abstract 32 – Paper ID: 045

Bioassay-Guided Fractionation of *Zanthoxylum armatum* DC. Stem Extract Identifies Sesamin and Fargesin as Inhibitors of CpG-Induced Inflammatory Responses in cDC1 Cells

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Abstract

This study aimed to investigate the major constituents of the stem of *Zanthoxylum armatum* DC. through bio-guided isolation and to evaluate their anti-inflammatory potential. *Zanthoxylum armatum* DC. is well known for its medicinal value, and bioassay-guided isolation of active metabolites from medicinal plants remains a powerful strategy for identifying novel therapeutic candidates. Hydromethanolic stem extract of *Z. armatum* was sequentially fractionated, and the resulting fractions were subjected to bioassay-guided purification using column chromatography combined with heat-induced haemolysis inhibition and albumin denaturation inhibition assays. Structural characterization of the isolated compounds was performed using single-crystal XRD and NMR spectroscopy. The anti-inflammatory activities of the purified compounds were assessed *in vitro* by analyzing IL-12 and CD80 expression levels in conventional type 1 dendritic cells via flow cytometry. Among all fractions, the sequential ethyl acetate fraction exhibited the strongest protein anti-denaturation and membrane-stabilizing activities. Subsequent purification led to the isolation of sesamin and fargesin from this fraction. Both compounds suppressed IL-12 production, while fargesin additionally demonstrated significant inhibition of CD80 expression. Overall, the study identified bioactive constituents with promising activity against proinflammatory dendritic cells for the first time. These findings provide scientific support for the traditional use of *Zanthoxylum armatum* DC. as an anti-inflammatory agent.

Keywords: *Zanthoxylum armatum* DC., Sesamin, Fargesin, Anti-inflammation, Intracellular IL12p40/70, CD80

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Abstract 33 – Paper ID: 047

Antimalarial Activity, Toxicity and Phytochemical Profiling through GCMS of *Toona ciliata* M.J. Roem. (Meliaceae)

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Abstract

Towards accomplishing the roll back malaria initiative, phytochemical screening of traditionally used medicinal plants for novel antimalarials are highly required. The present research evaluates the antimalarial activity of hydro methanolic extract of *Toona ciliata* (*Tc*HME). The in vitro antiplasmodial activity was assessed against *Plasmodium falciparum* (*Pf*) 3D7 and *Pf*Cam3 I^{R539T} using [^{3}H]-hypoxanthine. Further, cell cytotoxicity, acute toxicity, in vivo antimalarial activity, and phytochemical screening were carried out. The antimalarial activity in mice was evaluated using four day Peter's suppressive test against *Plasmodium berghei* ANKA. To identify phytochemicals, we performed gas chromatography mass spectrophotometry (GCMS) fingerprinting of *Tc*HME.

The study revealed that *Tc*MHE exhibited good antiplasmodial activity in dose-dependent manner with parasite's growth inhibition having IC_{50} values of 22.07 ± 1.99 μg/ml and 42.68 ± 1.06 μg/ml against *Pf*3D7 and *Pf*Cam3.I^{R539T} strains, respectively. *Tc*MLE exhibited low cytotoxicity (<20%) against HeLa and HEK293T cells at the highest tested concentration of 200 μg/ml. Dosage greater than 5000 mg/kg of the extract represents the acute lethal dose (LD_{50}) in mice. Three separate doses, i.e., 1200, 800 and 400 mg/kg body weight were tolerated, showing decrease in parasite's growth rate of 70.74 ± 3.53%, 51.13 ± 2.34% and 39.39 ± 3.29%, respectively, as compared to standard drug Chloroquine. The presence of various bioactive metabolites such as alkaloids, flavonoids, glycosides, saponin, phenols, terpenoids, tannins, steroids and coumarins were confirmed through GCMS chemical fingerprinting. Our findings demonstrate that *Tc*MHE possesses good antimalarial property in their crude form. Hence, *T. ciliata* is recommended as a new candidate for antimalarial drug development. Foresight, it is suggested that efforts on isolation of lead compounds from *Tc*MHE ameliorates the eradication of malaria.

Keywords: *Toona ciliata*, Antimalaria, *Plasmodium*, Chloroquine, Toxicity, Dose

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Abstract 34 – Paper ID: 051

Traditional Knowledge-Based Evaluation of *Tupistra nutans* for Its Therapeutic Potential and Phytochemical Resources

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Abstract

Tupistra nutans, locally known as Nakima in the Sikkim Himalaya region, is an economically and medicinally important plant of the Eastern Himalayas. It is traditionally used to manage blood sugar and has antioxidant properties. Diabetes Mellitus (DM) is a global health concern, and inhibiting carbohydrate-hydrolyzing enzymes, α-amylase and α-glucosidase, is a key therapeutic strategy for managing postprandial hyperglycemia. This study aimed to scientifically validate the antidiabetic and antioxidant potential of a crude extract of *Tupistra nutans* and to profile its bioactive constituents using LC-MS. The extract was prepared using a suitable hydroalcoholic solvent (ethanol:water 1:1) and subsequently evaluated in vitro for enzyme inhibitory effects on α-amylase and α-glucosidase. The inhibitory concentration (IC_{50}) values were determined and compared with those of the standard antidiabetic drug, acarbose. Furthermore, the antioxidant capacity was evaluated using DPPH, and *Tupistra nutans* extract exhibited significant ($p < 0.05$), dose-dependent inhibitory activity against both α-amylase and α-glucosidase, which is crucial for mitigating oxidative stress associated with diabetes complications. LC-MS analysis was performed to identify the phytochemical compounds responsible for these bioactivities. The chromatographic profile revealed the presence of several key secondary metabolites, confirming the extract's rich phytochemical profile and correlating specific compounds with the observed enzyme inhibition and antioxidant effects. In conclusion, the findings support the traditional use of *Tupistra nutans* as a natural antidiabetic agent, primarily through dual inhibition of α-amylase and α-glucosidase, coupled with its powerful antioxidant capacity. The LC-MS profile provides a foundation for isolating and characterizing the most potent bioactive compounds for future development as natural therapeutic agents for diabetes management.

Keywords: *Tupistra nutans*, Diabetes Mellitus, Postprandial hyperglycemia, α-amylase, α-glucosidase, LC-MS

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Abstract 35 – Paper ID: 054

Study on the Stability Characteristics of Partially Purified Fruit Bromelain from Pineapple *Ananas comosus* L. (Merr.) cv. Queen

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Abstract

Bromelain is a cysteine protease with high industrial demand due to its wide range of applications in the pharmaceutical, cosmetic, and food industries. It is used as an anti-inflammatory agent, immune modulator, drug absorption enhancer, potential anticancer agent, and meat tenderizer, among others. Depending on the source, bromelain is classified into fruit bromelain and stem bromelain. Among these, fruit bromelain generally exhibits higher proteolytic activity than stem bromelain; however, it is relatively unstable during long-term storage. Consequently, most industrial applications currently rely on stem bromelain. A systematic study on the stability characteristics of the more potent fruit bromelain is therefore important to enable its economical and profitable industrial utilization.

In the present investigation, fruit bromelain was partially purified from ripe pineapple (*Ananas comosus* L. (Merr.) cv. Queen) using ammonium sulphate fractionation (20–50%). The pH stability (pH 6–9), temperature stability (0–10 °C), and the effects of different reducing agents on the activity of the partially purified fruit bromelain were evaluated. In addition, the stability of the enzyme was assessed by storing it either as an ammonium sulphate precipitate or in lyophilized form.

Keywords: Fruit bromelain, *Ananas comosus*, Ammonium sulphate fractionation, Enzyme stability, Lyophilization

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Abstract 36 – Paper ID: 057

Formulation of Nanocarriers of *Acorus calamus* Essential Oil for Amelioration of Diabetes-Induced Memory Dysfunction in Rats

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Abstract

Memory dysfunction is a common and serious complication of diabetes mellitus, resulting from persistent hyperglycemia-induced oxidative stress and impairment of the cholinergic system. This review explores the potential of *Acorus calamus* essential oil (ACEO) formulated as solid lipid nanoparticles (SLNs) for management of diabetes-induced cognitive deficits. Existing literature on SLN formulation methods, including hot homogenization and ultrasonication, lipid and surfactant selection, and nanoparticle characterization techniques such as dynamic light scattering (DLS) and transmission electron microscopy (TEM), is summarized. Behavioral and biochemical evidence from in vivo studies using streptozotocin (STZ)-induced diabetic models is reviewed, focusing on cognitive assessment through behavioral tests and markers including acetylcholinesterase activity and oxidative stress. The review highlights how nanoencapsulation strategies improve the brain bioavailability and sustained release of ACEO, enhancing its neuroprotective effects. The comprehensive analysis suggests that SLN-based delivery of *Acorus calamus* essential oil holds promise as a novel approach to counteract diabetes-associated memory impairment. This review synthesizes current research on the formulation and therapeutic potential of *Acorus calamus* essential oil-loaded solid lipid nanoparticles for neuroprotection in diabetic cognitive dysfunction. By consolidating formulation techniques and preclinical evidence, it provides critical insights into how nanotechnology can overcome delivery challenges of phytoconstituents to the brain. The information presented offers a scientific foundation for future experimental designs aiming to develop effective nanotherapeutics targeting oxidative stress and cholinergic deficits in diabetes-induced memory decline.

Keywords: Diabetes-associated cognitive dysfunction, *Acorus calamus* essential oil, solid lipid nanoparticles, neuroprotection, oxidative stress, cholinergic dysfunction

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Abstract 37 – Paper ID: 058

Development and Evaluation of a Topical Formulation of Azelaic Acid and Rosemary Essential Oil for the Treatment of Acne Vulgaris

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Abstract

Acne vulgaris affects over 20% of individuals aged 16 and above, with peak prevalence (28.3%) among those aged 16–24 years. Globally, cases have surged from 132 to 184 million, with India contributing over 30 million.

Acne vulgaris is one of the most common chronic inflammatory skin diseases of the pilosebaceous unit characterized by comedones, papules, pustules, and acne scars. The main pathogenic mechanisms of the disease, i.e., follicular hyperkeratinization, seborrhea, proliferation of *Cutibacterium acnes*, and inflammation, determine the treatment regimens. The use of traditional drugs in the treatment of acne is often accompanied by symptoms such as dry skin, irritation, and resistance to microbial agents, thereby necessitating the search for better alternatives.

This article reviews the therapeutic potential of a topical azelaic acid and rosemary essential oil combination in acne management. Azelaic acid confers antimicrobial, anti-inflammatory, and keratolytic effects, and rosemary essential oil delivers antioxidant, antibacterial, and sebum-regulating activities through its bioactive molecules such as cineole, camphor, and α-pinene. The formulation is intended to improve skin-targeted delivery, effectiveness, and patient compliance with less toxicity.

Overall, the therapeutic use of azelaic acid in combination with rosemary essential oil represents a natural, patient-friendly, and promising strategy for acne management. This combination effectively targets both microbial and inflammatory pathways while enhancing the cosmetic appearance and overall treatment outcome.

Keywords: Acne vulgaris, azelaic acid, rosemary essential oil, *Cutibacterium acnes*, topical combination therapy, anti-inflammatory and antimicrobial activity

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Abstract 38 – Paper ID: 060

Influences of Season on Soil Characteristics in the Microhabitat of *Bambusa kingiana* in Manipur

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Abstract

Bamboo is a group of perennial, evergreen, woody giant grasses having a unique offset rhizome system. Bamboo plays a substantial role in enhancing soil fertility and contributing to carbon sequestration through its extensive root system, which improves soil structure by increasing porosity and promoting aeration. *Bambusa kingiana* is a bamboo species that holds significant ecological, economic, and cultural importance. This study investigates the physical and chemical soil characteristics in the microhabitat of *Bambusa kingiana.* Soil samples were collected from two different sites during the summer and winter seasons to analyse parameters such as texture, pH, moisture levels, oxidisable organic carbon, nitrogen, potassium, and phosphorus. Analysis revealed that *Bambusa kingiana* thrives in soils with a well-drained sandy loam texture and a slightly acidic to neutral pH ranging between 5.9 and 6.8. Key soil parameters, such as oxidisable organic carbon (SOC), available nitrogen (AN), and available phosphorus (AP), were higher during the summer season, measuring 1.4±0.1%, 298±0.5 kg/ha, and 18±0.5 kg/ha, respectively. These conditions support optimal growth by enhancing nutrient uptake and root development. Analysis of soil characteristics helps in understanding the ecological needs of *Bambusa kingiana* for its conservation and cultivation in its natural habitat.

Keywords: *Bambusa kingiana*, Soil characteristics, Season, Habitat, Manipur

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Abstract 39 – Paper ID: 062

Genotype-specific electrolyte leakage and secondary metabolite production in *Andrographis paniculata* under heavy-metal stress

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Abstract

Toxic metal stress disrupts membrane integrity, causing electrolyte leakage, but genotype-specific differences in leakage composition and metabolic sensitivity under distinct metal stress remain unexplored. The experiment was performed with two genotypes of *Andrographis paniculata* (T1 and T2) under individual and combined metal (As, Cd, and Pb) stresses. The concentration of different osmolytes (Cl^-, NO_3^-, SO_4^{2-}, PO_4^{3-}, Na^+, K^+, Ca^{2+}, Mg^{2+}, and NH_4^+), sugars (inositol, sorbitol, sucrose, glucose, and xylose), and secondary metabolites were analysed. Results indicated that both genotypes showed reduced biomass, protein, and chlorophyll under metal stress, with T2 exhibiting greater declines, especially under Pb and combined metal exposure. Andrographolide and neo-andrographolide levels decrease under all metal treatments in both genotypes, with a strong reduction in T2. Basal electrolyte leakage and antioxidant enzyme levels were inherently higher in T2, reflecting greater physiological sensitivity to metal stress compared to T1. Metal stress caused significant increases in both anion and cation leakage with Cl^- showing the highest anion rise, and Mg^{2+} in T1 or Ca^{2+} and Na^+ in T2 showing the highest cation increases. Combined metal exposure induced the greatest overall ion loss, while specific metals triggered distinct leakage patterns, such as Pb-driven nitrate release observed in T1 and Cd-driven nitrate release in T2. Sugar leakage was consistently higher in T2, with xylose showing the largest increase under stress. Inositol, sucrose, sorbitol, and glucose exhibited genotype and metal specific responses, with mixed metals generally causing the strongest release. These contrasting profiles reflect genotype-specific metabolic sensitivity, membrane damage and osmotic responses to metal stress highlighting distinct stress tolerance mechanism and regulation of diterpenoid biosynthesis in two genotypes.

Keywords: Electrolyte leakage; Androgaphis paniculata; Sugar leakage; Plant genotypes; Sugar leakage.

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Abstract 40 – Paper ID: 063

Essential Oil-Loaded Montmorillonite Clay-Based Formulation for Sustained Bioherbicidal Activity

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Abstract

Ocimum basilicum essential oil, with its rich composition of bioactive compounds like linalool and methyl chavicol, has shown promising weed control potential. Montmorillonite nano-clay (M-NC) can enhance the effectiveness of volatile essential oil herbicide through sustained release mechanisms. The oil of *O. basilicum* was loaded on M-NC (NC-OF) and examined for sustained-release and bioherbicidal properties. Results indicated that NC-OF show successful loading of key oil constituents, i.e., linalool and methyl chavicol. Characterization of the formulation suggested that binding between oil constituents and NC-OF occurred through hydrophobic, hydrogen bonding, and π–π interactions. NC-OF demonstrated sustained release (t_{50}% up to 30 days) at 32 ± 1°C. Different experiments revealed that the formulation disrupted weed stomata and epidermal cells, causing cellular damage and vascular irregularities in roots. Field tests demonstrated inhibitory effects on various weeds, NC-OF formulation showing 100% population reduction for *A. arvensis* and *S. arvensis*. In addition, the formulation did not harm soil enzymatic activity, suggesting a reduced ecological impact.

Keywords: Formulation, Linalool, Methyl chavicol, Hydrophobic interaction, Sustained release

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Abstract 41 – Paper ID: 067

Bio Synergy Fusion: Biotech-Driven Phytomedicine Powering Multitarget Alzheimer's Therapy

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Abstract

"Alzheimer's disease, a formidable adversary impacting over half a billion lives worldwide, unfolds as a complex and unyielding molecular battlefield. In this dynamic landscape, oxidative stress, neuroinflammation, Aβ toxicity, mitochondrial dysfunction, and synaptic breakdown intertwine, relentlessly driving the progressive loss of memory and cognitive function." Current FDA-approved therapies, predominantly synthetic or semi-synthetic, offer only symptomatic relief. They are often constrained by poor pharmacokinetics, limited specificity, and adverse effects such as dizziness, gastrointestinal issues, appetite loss, and cognitive fatigue. These limitations highlight the shortcomings of the traditional one-molecule, one-target therapeutic approach. However, nature weaves a more promising narrative. Phytomedicines, abundant in polyphenols, flavonoids, alkaloids, carotenoids, and tannins, provide a multi-layered neuroprotective shield. Their combined antioxidant, anti-inflammatory, anti-apoptotic, and AChE-modulating actions work synergistically rather than in isolation. This poster enlightens the audience with the concept of bio-synergy fusion—a cutting-edge biotechnological philosophy. Here, synergistic phytochemical networks create a molecular symphony, simultaneously modulating multiple pathways associated with Alzheimer's disease. Preclinical and computational research shows that these combinations surpass individual agents by reducing Aβ burden, restoring neurotransmitter balance, enhancing mitochondrial resilience, and significantly boosting cognition. As the need for safer and more comprehensive neurotherapeutic strategies continues to rise, synergistic phytomedicine emerges not merely as an alternative, but as a genuine biotechnological breakthrough with the power to transform the future of Alzheimer's treatment.

Keywords: Alzheimer's disease, phytomedicine, synergy, biotechnology, multitarget therapy, phytoconstituents

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Abstract 42 – Paper ID: 069

From Traditional Remedy to Therapeutics: Integrated GC-MS/HPTLC Quantification of Methyl Salicylate as the Novel Anti-Inflammatory Lead in *Gaultheria fragrantissima* Essential Oil from Meghalaya

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Abstract

The search for novel, natural anti-inflammatory agents is a keystone of pharmacological research. *Gaultheria fragrantissima*, also known as Indian wintergreen, is indigenous and found abundantly in the Khasi Hills of Meghalaya. Traditionally it is used for its potent pain-relieving properties and is prescribed to treat sciatica, rheumatic arthritis, neuralgia and menstrual pain. The local healers use this plant as proprietary balm, liniments or ointments, tender leaves are chewed to cure headaches, muscle ache and sore throats. With modern techniques and scientific validation this plant reveals a wide range of pharmacological activities, including analgesic, anti-oxidant, antibacterial, anti-diabetic, anticancer, diuretic, hypothermic, and antiepileptic properties.

This study explores the chemical profile and anti-inflammatory potential of *G. fragrantissima* essential oil, collected from East Khasi Hills. The oil was extracted from leaves by hydrodistillation using a Clevenger apparatus with a yield of 0.8–1.5% v/w. It was then subjected to gas chromatography–mass spectrometry (GC-MS) analysis, which revealed methyl salicylate (MeSA) as a major compound (>95%). MeSA was also effectively identified and quantified by high-performance thin-layer chromatography (HPTLC), using hexane–acetone (30:2 v/v) as mobile phase and silica gel 60 F_{254} as stationary phase, with the R_f value of MeSA being 0.64. Egg albumin denaturation assay was used to assess the anti-inflammatory effectiveness, and compared to the usual reference medication diclofenac sodium, the essential oil showed a notable reduction of protein denaturation. The findings clearly show that the presence of MeSA can be responsible for the notable anti-inflammatory activity. This study supports the traditional use of this plant and demonstrates its essential oil, particularly MeSA, as a viable option for natural therapeutics.

Keywords: *Gaultheria fragrantissima*, Methyl salicylate, Anti-inflammatory, GC-MS, HPTLC, Indian wintergreen

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Abstract 43 – Paper ID: 070

Phytochemical Diversity and Ethnomedicinal Significance of Genus *Ophiorrhiza* in Manipur with Special Reference to *O. japonica* Blume

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Abstract

Genus *Ophiorrhiza* represents a substantial ethnomedicinal and pharmacologically important group that is widely distributed in India. In Manipur, eleven species of the genus are reportedly present. Ethnobotanical usage revealed that multiple species of the genus are traditionally used in the treatment of fever, gastrointestinal disorders, and inflammatory conditions, while others serve as an edible food source. These findings corroborate pharmacological studies suggesting the presence of bioactive constituents like alkaloids, flavonoids, and terpenoids, while also reflecting their socioeconomic importance in the region. This study documents a comprehensive account of genus *Ophiorrhiza* present in Manipur and their diverse pharmacological properties, including anticancer, antiviral, antimicrobial, and antioxidant activities. It also includes phytochemical analysis of *O. japonica* found in Manipur and a comparative study against reference materials reported from established regions.

Keywords: Genus *Ophiorrhiza*, ethnomedicinal plants, pharmacological activities, phytochemical analysis, Manipur

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Abstract 44 – Paper ID: 094

Chemical profiling of Melacanna beccifera fruits

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Abstract

The types of bamboo that bloom range greatly from one another. For instance, the Bambosa species (Thingtam) took 18–20 years to blossom, but the Melacanna species (Mautam) took 45–50 years. At the cost of the others, it signals the start of one. Sporadic or gregarious blossoming has a backstory all its own. For example, bamboo flowering causes a rat population boom that results in hunger in the affected area. The Y chromosomes in particular were damaged in the rats that were gathered during the Melacanna species in the Tamenglong region. Therefore, it is necessary to elucidate the relationship between the chemical responsible for the chromosomal damage and the aphrodisiac nature. Thus, the goal of the current study was to address the aforementioned question. Melacanna baccifera fruits were gathered, the seed slides were shade-dried, and some of the strong solvents were used to conduct a credible chemical analysis. The biochemical profile of the extracted seeds, such as the presence of steroids, total phenol, and total flavonoids, was examined. Bamboo seeds indicate the presence of steroids. The epicarp/mesocarp extract exhibited greater overall phenolic and antioxidant qualities, but the total flavonoid concentration remained same. The characteristics of these substances should be carefully examined for potential aphrodisiac or mutagenic effects. There are numerous myths about eating the Melacanna species in different parts of the Northeast, and certain tribal communities in South India consume the seeds, especially the Bambosa. Intense chemical profiling will therefore be very important for next research.

Keywords: Melacanna, Chemical Component, Phenol, Steroid, Flavonoids

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Abstract 45 – Paper ID: 100

Comparative Pollen Load and Floral Diversity in *A. cerana* and *A. dorsata* Honeys of Manipur Valley

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Abstract

Melissopalynology provides critical insights into the botanical origin and geographical authenticity of honey. The present study investigates the pollen composition and quantitative pollen load of honey samples collected from five valley districts of Manipur: Imphal East, Imphal West, Thoubal, Bishnupur, and Kakching, using microscopic pollen identification and haemocytometer-based pollen counting. The pollen concentration of ten honey samples representing *Apis cerana indica* (C1–C5) and *Apis dorsata* (D1–D5) showed considerable variation among districts. *Apis cerana indica* samples recorded counts ranging from low (C4: 4) to moderate (C2: 56), whereas *Apis dorsata* samples exhibited substantially higher pollen loads, with maximum counts in D3 (67). Microscopic examination of acetolysed residues revealed the presence of diverse pollen types, including *Ageratum*, *Lantana camara*, *Brassica* spp., *Oryza sativa*, *Melastoma*, *Mimosa*, *Eucalyptus*, and *Helianthus*, indicating a polyfloral nature of honey from the Manipur valley. District-wise pollen distribution suggested floral variability across the landscape, with Thoubal and Bishnupur showing richer pollen spectra compared to Kakching. *Apis dorsata* honeys consistently showed higher pollen density compared to *Apis cerana indica* honeys, indicating a wider foraging range and preference for pollen-rich floral sources. The study highlights significant botanical diversity in Manipur valley honeys and demonstrates that combining qualitative pollen identification with quantitative haemocytometer counting provides an effective tool to understand floral availability, foraging behaviour, and regional honey characteristics. These findings contribute foundation pollen data for Manipur and support future authentication and quality assessment of local honeys.

Keywords: Honey, *Apis cerana*, *Apis dorsata*, Haemocytometer, Manipur

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Abstract 46 – Paper ID: 118

Antioxidant and Phytochemical Analysis of *Murraya koenigii*: Traditional Uses and Modern Insights

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Abstract

Murraya koenigii (curry leaf), a versatile plant native to India, is widely recognised for its medicinal, culinary, and industrial applications. It is rich in phytochemicals such as alkaloids, flavonoids, and terpenoids, offering a range of beneficial properties, including antioxidant, anti-inflammatory, antimicrobial, and anti-diabetic effects. This study investigates the phytochemical composition and antioxidant potential of *Murraya koenigii* leaves. Qualitative and quantitative screening was performed to identify key phytocompounds, including phenolics, alkaloids, steroids, glycosides, tannins, saponins, flavonoids, terpenoids, and flavanols. GC-MS analysis further characterised the chemical profile. The antioxidant activity was assessed using DPPH, ABTS, and FRAP assays, which demonstrated dose-dependent scavenging activity with IC_{50} values of 1497 μg/ml, 176 μg/ml, and 1095 μg/ml, respectively. These findings highlight the antioxidant potential of *Murraya koenigii* leaves, supporting its therapeutic applications in traditional and modern medicine.

Keywords: Murraya koenigii, GC-MS, Antioxidant activity, DPPH, ABTS, FRAP

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Abstract 47 – Paper ID: 127

Green Synthesis and Characterization of Silver Nanoparticles Using Zederone from the Rhizomes of *Curcuma caesia* Roxb. and Catalytic Activity

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Abstract

Zederone has been isolated from the rhizomes of *Curcuma caesia* Roxb. and used for the green synthesis of silver nanoparticles (AgNPs). Various characterization techniques such as UV–Vis spectroscopy, Fourier transform infrared spectroscopy (FT-IR), X-ray diffraction (XRD), electron paramagnetic resonance (EPR), energy-dispersive X-ray (EDX) spectroscopy, scanning electron microscopy (SEM), transmission electron microscopy (TEM), and selected area electron diffraction (SAED) were used to confirm the reduction of Ag^+ and the formation of AgNPs. The catalytic activity of the synthesized AgNPs is established in the reduction of DPPH by BHT + AgNPs. The UV–Vis spectra were recorded at regular intervals of time.

Keywords: Zederone, *Curcuma caesia* Roxb., Nanoparticles, Green synthesis

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Abstract 48 – Paper ID: 130

GC-MS Analysis of Bioactive Constituents of *Curcuma leucorrhiza* Roxb. (Zingiberaceae) Rhizome Extract

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Abstract

Curcuma leucorrhiza Roxb., commonly known as Yanghou in Manipuri, is a tuberous plant. The rhizomatous tubers have been used by the indigenous people of Manipur, North-East India, for the treatment of enlarged liver and spleen, stomach ulcer, diabetes, and cancer, hence this study forms a basis for the establishment of active components present in it. The present study conducted phytochemical screening of petroleum ether, chloroform, and ethanol extracts of *Curcuma leucorrhiza* rhizomes. The rhizome extracts were prepared sequentially from low-polarity to high-polarity solvents, viz., petroleum ether, chloroform, and ethanol. In comparison to other extracts, the ethanolic extract showed the presence of all the important phytoconstituents such as flavonoids, alkaloids, tannins, glycosides, steroids, cardiac glycosides, saponins, carbohydrates, and proteins. On this basis, the GC-MS analysis of the extract was carried out and revealed the presence of 34 compounds. The present study will be very helpful for the isolation of bioactive compounds from the extract of the plant for medicinal applications.

Keywords: *Curcuma leucorrhiza* Roxb., Phytochemicals, Extracts, Bioactive compounds, GC-MS

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Theme: Biotechnology Today

Abstract 49 – Paper ID: 028

Evaluation Of Cytotoxic Activity of fruit pericarp extract of Soapberry (*Sapindus mukorossi* Gaertn) on Human cancer cell lines using Bioassay Guided Fractionation

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Abstract

Sapindus mukorossi Gaertn (SM), commonly known as soapberry, is a member of the Sapindaceae family. It is a large deciduous tree widely distributed in tropical and subtropical regions of Asia and is a valuable medicinal plant which has recently been reported to have cytotoxicity properties. However, detailed investigation of its anticancer activity on methanolic extract has not been reported yet. SM plant samples (fruit pericarp) were collected and further extracted using soxhlet apparatus. Sequential extraction was carried out using different solvents followed by bioassay-guided purification using preparative HPLC and MTT assay. Two human cancer cell lines, cervical cancer cell line HeLa cells and lung adenocarcinoma cell line A549 cells were used for the study. The IC_{50} value of the methanolic crude extract on HeLa cells and A549 cells were determined as 56.43 ng/μl and 71.37 μg/ml respectively. Colony forming assay, Comet assay and DAPI staining assay were used for analysis of cell proliferation and apoptotic activities of the cell lines after treatment. Western blot analyses also revealed that the crude extract induced cleavage of PARP and caspase 7 in HeLa cells, however caspase 3 cleavage was not observed. It also suggested that SM extract induces apoptosis in a dose-dependent manner through PARP and caspase 7 pathway in the cervical cancer cells. Furthermore, reduced cell viability and increased apoptosis were also observed in treated A549 cells; however, Western Blot analyses revealed that SM did not activate caspase 3 and did not deactivate PARP, suggesting that SM-induced apoptosis in lung cancer is independent of the caspase/PARP pathway.

Therefore, the present study indicates that the crude extract of SM fruit exhibits antitumour bioactivity and provides insights into its potential pharmacological application as an antitumour agent.

Keywords: *Sapindus* extract, HeLa, A549, antitumour, apoptosis

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Abstract 50 – Paper ID: 037

VitalsVault: A Web-Based Platform for Chronic Disease Tracking and Intelligent Health Record Management

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Abstract

Conditions categorized as chronic diseases, specifically including diabetes, hypertension, and various cardiovascular pathologies, demand a regimen that integrates perpetual observation with immediate medical intervention. Conventional paper-based health record systems, however, frequently lead to fragmented data and protracted diagnostic timelines. To counteract these deficiencies, VitalsVault introduces a secure, web-enabled chronic disease tracking and health record platform. This system unites patients, healthcare professionals, and advanced technologies within a singular digital environment. The platform facilitates real-time observation of vital signs—such as blood pressure, heart rate, temperature, and oxygen saturation—via IoT devices and wearable sensors. Crucially, all collected data are securely archived within an encrypted Electronic Health Record (EHR) system. By leveraging data-driven analytics, VitalsVault facilitates anomaly detection, automatically generates alerts for abnormal readings, and assists clinicians in personalized diagnosis and treatment planning. Its offline-first architecture ensures accessibility even in low-connectivity areas, enhancing usability and reach. A descriptive research design, supported by survey-based data collection and literature synthesis, validates the system's relevance and effectiveness in addressing issues like data fragmentation, delayed intervention, and limited patient engagement. The developed prototype successfully illustrates the potential of an integrated digital platform to markedly enhance chronic disease management. This capability is realized through instantaneous access to health metrics, fostering proactive care strategies, and consequently lowering the socio-economic impact on the health sector. In its final outcome, VitalsVault encourages the assimilation of digital health architecture in accordance with national e-health initiatives, thereby shifting healthcare delivery from a reactive stance to a preventive approach.

Keywords: Chronic disease monitoring, Electronic health records, IoT, AI in healthcare, Digital health platform, Preventive care

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Abstract 51 – Paper ID: 049

Efficacy of native bacterial isolates against root-knot nematode, *Meloidogyne incognita*

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Abstract

Plant-parasitic nematodes (PPNs) are known to be the most destructive groups of crop pathogens and cause annual crop losses of approximately $125 billion globally (Chitwood, 2003). Chemical nematicides are commonly used to control root-knot nematodes, RKN, but these toxic chemicals pose a significant threat to the soil ecosystem and human health (Oka, 2010). Hence, the development of affordable and environmentally friendly bio-agents has become imperative due to restrictions on the use of nematicides. Using of biological control agents is an alternative method for sustainable management of RKNs. Considering the importance of the damage done by RKNs in Manipur, an investigation was carried out to know the efficacy of native bacterial isolates against root-knot nematode, *Meloidogyne incognita* in *in-vitro* condition. Effect of bacterial isolates on egg hatching and second stage juvenile (J2) mortality of *M. incognita* were observed. A total of 100 numbers of eggs as well as second stage juvenile (J2) of *M. incognita* were used for the study. Results of the efficacy of native bacterial isolates against *M. incognita* revealed that, among the bacterial isolates namely *Bacillus megaterium* (MF36134), *B. amyloliquefacience* (OR304217), *B. subtilis* (OR298285), *Providencia rettgeri* (OR294194) and *P. vermicola* (OR335551), *B. subtilis* showed the lowest percentage (18.70 per cent) of egg hatching and highest percentage of juvenile mortality (83.50 per cent) followed by *B. amyloliquefacience* (24.77 per cent) in egg hatching and 80.83 per cent in juvenile mortality over control. The above findings resulted that the antagonistic effect of bacterial isolates against *M. incognita* gave positive response.

Keywords: Root-knot nematode, plant parasitic nematodes, biological control agents, sustainable, *Bacillus subtilis*, *B. amyloliquefacience*

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Abstract 52 – Paper ID: 066

Nanobiotechnology-Driven Ocular Delivery of Biologics Using Advanced Nanocarriers

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Abstract

Biotechnology is progressively advancing modern healthcare through the development of targeted, patient-friendly therapeutic strategies. Ocular diseases severely affect visual functions and quality of life, yet conventional drug delivery systems remain ineffective due to the unique anatomical and physiological barriers (cornea, sclera) of the eye. The Integration of nanobiotechnology offers a promising approach for enhancing the targeted delivery of biologics, including antibodies, peptides, and mRNA molecules, which possess high therapeutic potential but are hindered by stability, permeability, and bioavailability challenges. Advanced nanocarrier systems, including liposomes, emulsions, nanostructured lipid carriers, and polymeric nanoparticles, are being explored as they address these challenges by improving corneal permeability, protecting biologics from enzymatic degradation, and enabling sustained and localized delivery to both the anterior and posterior segments of the eye. These nanosystems effectively enhance therapeutic residence time, facilitate controlled release, and reduce systemic exposure, therefore improving patient compliance and treatment outcomes. This highlights recent advances in nanocarrier-mediated ocular delivery strategies that represent the principles of transformative biotechnology in healthcare. Therefore, integration of nanotechnology with biologically active therapeutics offers safer, more effective, and patient-centric alternatives, thereby reshaping the future of ocular disease management.

Keywords: Ocular delivery, Nanobiotechnology, Biologics, Nanocarriers, Corneal permeability, Bioavailability

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Abstract 53 – Paper ID: 072

Isolation, Identification & Characterisation of *Bacillus* species from Peruyaan

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Abstract

Peruyaan, a traditional fermented soybean product of Arunachal Pradesh, India, contains a diverse microbial community dominated by *Bacillus* species that drive its biochemical transformation and functional attributes. Understanding the taxonomy and physiology of these strains is essential for developing standardized starter cultures and improving the nutritional and therapeutic value of fermented foods. This study focused on the isolation, identification, and characterization of *Bacillus* spp. associated with Peruyaan using a polyphasic approach. Fresh samples were collected from local markets and processed through serial dilution and selective plating. Distinct isolates were purified and identified using 16S rRNA gene sequencing. Phylogenetic analysis confirmed the prevalence of *Bacillus subtilis*, *B. amyloliquefaciens*, and *B. licheniformis*, aligning with earlier findings from other fermented soybean foods of Northeast India. Biochemical and enzymatic profiling showed high protease, amylase, and fibrinolytic activities, indicating their role in substrate degradation and bioactive peptide formation. Several isolates also demonstrated antioxidant and antimicrobial properties against common enteric pathogens, supporting the functional food potential of *Bacillus*-fermented soybeans. The study further highlights that *Bacillus*-mediated fermentation enhances nutritional components such as isoflavone aglycones, peptides, vitamins, and poly-γ-glutamic acid (γ-PGA), as reported in related fermented soybean systems. Overall, these findings suggest that indigenous *Bacillus* strains from Peruyaan possess strong biotechnological value for controlled fermentations, functional food development, and enzyme production, while providing deeper insight into the microbial ecology of this traditional product.

Keywords: *Bacillus* species, Peruyaan, Fermented soybeans, 16S rRNA identification, Enzymatic characterization, Functional foods

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Abstract 54 – Paper ID: 074

Hypoxia-Driven nAChR–AKT–HIF Signaling in Lung Adenocarcinoma: A Biotechnology-Based Approach to Understanding Cancer Progression in Never-Smokers

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Abstract

Lung cancer in never-smokers remains a challenging biomedical problem, with clinical outcomes nearly as poor as those of smokers. In our analysis of 1,727 lung cancer patients, we found only a 47-day difference in overall survival between smoker and never-smoker lung adenocarcinoma patients, underscoring the similarly aggressive disease course irrespective of smoking status. To investigate the molecular basis for this parity, we explored hypoxia-mediated crosstalk between the nicotinic acetylcholine receptor (nAChR) pathway and key oncogenic signaling networks using tumor cells and complementary biotechnological approaches. We discovered a previously unrecognized hypoxia-induced elevation in acetylcholine levels and nAChR-α7 expression in non-small cell lung cancer (NSCLC) cells, a pattern further validated across multiple cancer cell lines and primary tumor tissues. Mechanistic analysis revealed direct binding of HIF-1α to a hypoxia-response element located 48 base pairs upstream of the nAChR-α7 transcriptional start site, establishing nAChR-α7 as a hypoxia-inducible gene. Elevated acetylcholine reinforced this response by activating the PI3K/AKT pathway, creating a positive feedback loop that stabilized HIF-1α and strengthened hypoxia-adapted tumor behavior. Functionally, this signaling axis promoted metastasis and enhanced hypoxia-driven cellular responses. Importantly, pharmacological inhibition of nAChR-α7 with bungarotoxin significantly reduced HIF-1α accumulation and reversed hypoxia-mediated metastatic activity, highlighting its therapeutic relevance. Collectively, our findings identify a novel nAChR–AKT–HIF signaling network that operates independently of nicotine and may contribute to the equally poor prognosis observed in never-smoker lung adenocarcinoma patients. This work demonstrates how biotechnological tools can reveal mechanisms underlying cancer progression and identifies potential molecular targets for improving therapeutic outcomes.

Keywords: Lung adenocarcinoma, Never-smokers, hypoxia signaling, nAChR-α7, HIF-1α, PI3K/AKT pathway, Tumor metastasis

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Abstract 55 – Paper ID: 076

Microbial Biotechnology Approach: Synergistic Plant Growth Promoting Rhizobacterial Consortia for Sustainable Chakhao Cultivation

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Abstract

Rhizobacterial communities associated with Chakhao (black scented rice) remain largely underexplored, particularly regarding their potential to enhance crop growth and vigor. In this study, special emphasis was placed on identifying a compatible and efficient PGPR consortium capable of improving plant development. Among the screened isolates, *Enterobacter cloacae* SAY12 exhibited the strongest plant growth–promoting profile, showing positive responses across all evaluated PGP attributes, including phytohormone production, nutrient mobilization, and siderophore activity. *Bacillus subtilis* SAK2, while also demonstrating notable growth-promoting traits, was further recognized for its ability to provide disease protection, displaying inhibition levels of 65% against *Rhizoctonia solani*, 64% against *Fusarium oxysporum*, and 41% against *Curvularia oryzae*.

Growth optimization and compatibility assays revealed that the SAY12–SAK2 combination formed the most synergistic consortium when compared to other PGPR groupings. This compatible pair significantly enhanced seed germination under sterile blotting paper conditions and improved early plant growth in nutrient-enriched agar medium. Plants treated with the consortium consistently outperformed uninoculated controls, showing increased vigor, better root–shoot development, and stronger establishment. These findings highlight the consortium of SAK2 and SAY12 as a promising bioinoculant for boosting growth, productivity, and overall plant health in Chakhao rice.

Keywords: Chakhao, Bacterial Consortium, PGPR, Biocontrol, Bioinoculant, Sustainable agriculture

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Abstract 56 – Paper ID: 078

Hepato-protective assessment study of *Hydrous indicus* and *Gryllotalpa orientalis*, the highly consumed edible insects of Manipur, North-eastern states of India

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Abstract

This study presents the first hepatoprotective assessment of *Hydrous indicus* and *Gryllotalpa orientalis*, two commonly consumed edible insects of Manipur. The results reveal that *in vitro* cytotoxicity evaluation of the compounds–HepG2, *Gryllotalpa orientalis*, was found to be more effective than *Hydrous indicus*; *in vitro* hepato-protective effect of the compound/HepG2, the effect was not observed; in Super Oxide Dismutase Activity Assay (SOD), highest enzyme activity (SOD) was observed in *Hydrous indicus* when cells were exposed to sample *Hydrous indicus* only, and lowest enzyme activity (SOD) was observed when cells were exposed with *Gryllotalpa orientalis* (IC_{50} dose) and H_2O_2, both with respect to control; in estimation of MDA content (TBARS assay), it was observed that *Hydrous indicus* treatment lowers MDA content, while *Gryllotalpa orientalis* and H_2O_2 treatments cause high oxidative stress; in estimation of reduced glutathione, highest reduced glutathione was estimated in *Hydrous indicus*, which provides stronger protection by maintaining higher GSH levels, whereas *Gryllotalpa orientalis* offers moderate protection, and both samples show reduced GSH under H_2O_2-induced stress. Further, both exhibited notable antioxidant activity in the CUPRAC assay, with *Gryllotalpa orientalis* being the more effective antioxidant source. The DPPH assay results reveal that both treatments exhibit minimal free radical scavenging activity, with the cell lysate + FC + H_2O_2 group showing the highest value (7.3%). In Lactate Dehydrogenase Activity, both samples show measurable LDH activity, with *Hydrous indicus* showing a stronger response than *Gryllotalpa orientalis*. In Alkaline Phosphate Activity, it was found to be observed in both the samples. Thus, the results of the study suggest that *Hydrous indicus* and *Gryllotalpa orientalis* were found to possess high hepato-protective properties and thus can be a big help in treating liver disease in future India.

Keywords: Hepatoprotective, Liver and chronic disease, Modern medicine, Health and diseases, Food security, indigenous product

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Abstract 57 – Paper ID: 083

Bioactivity screening of endophytic bacteria associated with selected medicinal plants of Manipur

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Abstract

Endophytes, which reside within plant tissues without causing harm, exhibit several plant growth-promoting (PGP) traits. This makes them valuable tools in sustainable agriculture and environmental management. In the current study, 3 medicinal plants were selected for isolation of endophytic strains, viz. *Borassus flabellifer* (local name: *Kona pambi*), *Nicotiana tabacum* (local name: *Hidak mana*), and *Viola pilosa* Blume (local name: *Huikhong*). 61 endophytic bacteria were isolated and screened for antimicrobial activity against bacterial test pathogens, viz. *Micrococcus luteus* (MTCC 106), *Bacillus subtilis* (MTCC 121), *Escherichia coli* (MTCC 739), and antifungal activity against fungal test pathogens, viz. *Pyricularia oryzae* (MTCC 1477), *Curvularia oryzae* (MTCC 2605), and *Aspergillus niger* (MTCC 1344). The isolates were then evaluated for PGP potential. Of 61 isolates, 21 produced indole-3-acetic acid (IAA), 30 could solubilize phosphate, and all 61 were found to produce ammonia. 3 isolates (VP11, VP17, and BF2) exhibited broad-spectrum antimicrobial activities as well as PGP traits. These potent isolates were subjected to rice seed vigour assays. Rice seeds treated with these isolates showed considerably enhanced vigour indices, VP11 (780), VP17 (959), and BF2 (1041) over the control (581). The morphological, physiological, biochemical, and molecular characterizations of these endophytic isolates were done. Details of these experiments will be presented in the paper.

Keywords: Endophytic bacteria, Medicinal plant, Antimicrobial activity, Antifungal activity

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Abstract 58 – Paper ID: 084

Optimization of Keratinolytic Protease Production by *Streptomyces diastaticus* strain TS1-48

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Abstract

Keratinolytic proteases are inducible extracellular enzymes mainly produced by microorganisms in presence of keratinaceous substrates, e.g., feather, wool, nail, and hair. Keratinases are usually serine or metalloproteases that have biotechnological applications in production of feather meal, rare amino acids (serine, cysteine, and proline), or peptides. They also find varied applications in leather, pharmaceutical, and cosmetic industries. The present work deals with keratinolytic proteases produced by *Streptomyces diastaticus* strain TS1-48. Seventy-two bacterial isolates were obtained from feather dumping soil in Taothong, Manipur, of which 41 were found to be proteolytic. These 41 proteolytic isolates were subjected to keratinolytic screening using feather basal medium (FBM). Eleven isolates (TS1C-1, TS1C-3, TS1C-5, TS1C-6, TS1C-21, TS1C-22, TS1C-34, TS1-17, TS1-42, TS1-43, and TS1-48) could degrade chopped chicken feathers, of which TS1-48 was most potent. TS1-48 was identified as *Streptomyces diastaticus* strain TS1-48 by 16S rDNA sequence analysis. It was cultivated in FBM containing 0.5% white feather (30°C; pH 7.5; 96 hrs). In protease assay, using azocasein as substrate (70°C; pH 9), the activity was found to be 98.85 U/mL/min. Production of enzyme at different temperatures, medium pH, feather concentrations, C and N sources, and inoculum percentages was then evaluated. The best production was achieved at 30°C, pH 10, 2% feather concentration, lactose as C and yeast extract as N sources, and 5% inoculum. Keratinase activity was performed using keratin azure as substrate. Details of the experimental findings will be presented in the paper.

Keywords: Keratinolytic proteases, serine, metalloproteases, *Streptomyces diastaticus* strain TS1-48, azocasein, keratin azure

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Abstract 59 – Paper ID: 085

Partial Purification of Multiple Proteases from the Latex of *Ficus heterophylla* L.f. using Hydrophobic Interaction Chromatography

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Abstract

Proteases are biologically important hydrolytic enzymes that catalyze the cleavage of peptide bonds in proteins and have wide physiological and biotechnological significance. Plant latex, a milky secretion produced by laticifer cells, represents a rich natural source of diverse proteolytic enzymes. In this study, hydrophobic interaction chromatography (HIC) was employed for the resolution and partial purification of multiple proteases present in the latex of *Ficus heterophylla* L.f. Crude enzyme extract was prepared from latex collected from the plant fruits and subjected to ammonium sulfate fractionation up to 1.5 M saturation. The resulting supernatant was applied onto a Phenyl Sepharose 6 Fast Flow (high sub) column pre-equilibrated with 0.05 M sodium acetate buffer (pH 5.0) containing 1.5 M ammonium sulfate. Bound proteins were eluted using a stepwise decreasing ammonium sulfate gradient (1.0, 0.8, 0.7, 0.6 and 0 M). Multiple chromatographic fractions exhibiting proteolytic activity were obtained. The presence of multiple proteases in the crude latex extract was confirmed by casein zymography, while SDS-PAGE and zymographic analyses of the HIC fractions demonstrated effective separation and partial purification of the enzymes. Protease activity was quantified using azocasein as the substrate, and protein concentration was determined by the modified Lowry method. Overall, the study demonstrates that step-gradient HIC is an efficient strategy for resolving latex proteases from *Ficus heterophylla* L.f., providing a basis for further biochemical characterization.

Keywords: Proteases, Latex, Ammonium sulfate, Phenyl Sepharose, SDS-PAGE, Zymography

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Abstract 60 – Paper ID: 101

Recent trends in the application of Nanotechnology in pharmaceutical and natural products

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Abstract

Over the decades it has been observed that pathogenic bacteria are resisting against antibiotics. Through this study, silver nanoparticles have been developed as a promising candidate for antibacterial agents in the medical field. Compared to bulk materials, extremely small sized nanoparticles exhibit different or enhanced properties. While various physical and chemical methods exist for nanoparticle synthesis, there is always a need for developing environmentally friendly synthesis processes. Plant-mediated nanoparticle synthesis is a highly innovative method that surpasses conventional chemical and physical methods, representing a truly green chemistry technology. Large-scale synthesis of this material is environmental friendly, cost effective and easily scalable. Furthermore, this method eliminates the necessity of excessive energy, harmful chemicals and high temperature. In the present study the agar well diffusion method is used to assess the antibacterial activity of Ag nanoparticles by *Polyalthia longifolia* and *Phyllanthus acidus.* Pure culture of *Bacillus subtilis*, *Escherichia coli* and *Staphylococcus aureus* were obtained from the Department of Botany, Manasagangotri, University of Mysore. The change in color of the solution confirms the formation of silver nanoparticles. The formation of metal ions during the exposure of plant extract to $AgNO_3$ was followed by UV–Vis spectroscopy. The extracts of *Polyalthia longifolia* and *Phyllanthus acidus* leaves were capable of producing Ag nanoparticles extracellularly and they were quite stable in the solution. The stock solution tested against *Escherichia coli*, *Staphylococcus aureus* and *Bacillus subtilis* showed antibacterial activity successfully with a zone of inhibition 16.3 mm, 16 mm and 26 mm respectively. In medical applications of antibacterial activity green synthesis of silver nanoparticle proven to be excellent candidates. Further it can be exploited for disease management strategies.

Keywords: Green synthesis, Antibiotic, *Polyalthia longifolia*, *Phyllanthus acidus*

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Abstract 61 – Paper ID: 103

A report on domestication and cultivation of split gill mushroom, Kanglayen

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Abstract

Schizophyllum commune is a wild edible mushroom which grows on wood in a natural environment such as forest. They are forest-derived biological resources which can often be harvested sustainably without causing significant harm to the ecosystem. They are vital to the lives and cultures of many indigenous and forest-dwelling communities, as they contribute significantly to household incomes and food security of rural and tribal peoples. The present study focused on cultivation of *S. commune* on broad leaf wood sawdust mixed with rice bran along with calcium carbonate as substrate since it is not yet commercially cultivated. A pure culture of *S. commune* was obtained by growing a tissue of the mushroom on Potato Dextrose Agar (PDA) medium. Spawns were produced by growing the mycelium on paddy grains. It was cultivated on sawdust of broad leaf wood mixed with rice bran and calcium carbonate in the ratio of 80:19:1 on a dry weight basis at 28 ± 2°C to 33 ± 2°C and 80–90% relative humidity. The best incubating temperature for mycelial growth on the substrate was 35°C. Thus, a cultivation technology of *S. commune* was standardized on saw dust bag logs at 28 to 33 ± 2°C and 80–90% relative humidity. The cultivation trial recorded growing and fruiting of *S. commune* profusely in comparison to their growth in natural habitat.

Keywords: *Schizophyllum commune*, Spawn, Substrate, Cultivation, Sawdust

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Abstract 62 – Paper ID: 104

A Systematic NLP-Driven Study on Mushroom Poisoning: Clinical Syndromes, Amatoxin Hepatotoxicity, Diagnostics, and Global Epidemiology

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Abstract

Mushroom poisoning continues to be a pressing global toxicological issue, responsible for high morbidity and mortality, with Asia and Europe bearing the greatest burden of reported cases. Despite advances in toxin detection and supportive care, clinical management is frequently undermined by delayed recognition and challenges in species identification. To systematically synthesize the evidence base, our study applies a natural language processing (NLP) framework that integrates SciBERT embeddings with BERTopic clustering to organize published reports on mushroom poisoning. The analysis identified four dominant themes: general clinical manifestations, hepatotoxicity linked to amatoxins, epidemiological case series, and emerging diagnostic technologies for toxin detection. By consolidating knowledge on toxin groups, clinical outcomes, diagnostic strategies, and therapeutic approaches, our study provides a structured overview of current evidence and highlights future opportunities for AI-driven diagnostic tools, improved prevention strategies, and strengthened public health responses of causes related to Mushroom poisoning.

Keywords: Mushroom Poisoning, Amatoxin, Natural Language Processing (NLP), Epidemiology, Machine Learning, SciBERT, BERTopic

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Abstract 63 – Paper ID: 105

HemoSight: A Hybrid CNN and RAG Framework for Automated Intracranial Hemorrhage Detection and Report Generation

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Abstract

In order to prevent fatal outcomes, intracranial haemorrhage (ICH), a potentially fatal medical condition marked by bleeding within the cranial vault, frequently necessitates prompt diagnosis and treatment. Conventional diagnosis techniques mainly depend on radiologists manually reviewing computed tomography (CT) scans, which can be laborious and prone to human error. This study introduces an AI-assisted diagnosis system that combines a Retrieval-Augmented Generation (RAG) module for comprehensive report generation with a Hybrid Convolutional Neural Network (CNN) for automated haemorrhage classification. Clinicians can upload CT images, get diagnostic predictions, and access structured medical reports thanks to the system's Flask-based web interface. The dataset consists of labelled CT images that have been divided into subtypes such as haematoma, left lateral ventricle haemorrhage, right lateral ventricle haemorrhage, brain middle haemorrhage, and non-hemorrhage cases. OpenCV and Pillow (PIL) are used for preprocessing in order to guarantee consistent greyscale input for the Hybrid CNN model. The RAG component creates contextual, medically relevant interpretations by utilising pre-trained language models. The suggested method provides an affordable and easily accessible diagnostic tool while achieving high classification accuracy and showing promise for integration into telemedicine and rural healthcare systems.

Keywords: Intracranial Hemorrhage (ICH), Hemorrhage Detection, Hybrid Convolutional Neural Networks (CNN), Deep Learning in Healthcare, Medical Image Analysis, Computed Tomography (CT) Scan, Radiological Diagnosis, Report Generation (RAG–Retrieval Augmented Generation), Flask Web Framework, MongoDB Database, Artificial Intelligence in Medicine, Telemedicine Applications, Computer-Aided Diagnosis (CAD), OpenCV and Image Preprocessing, Healthcare Chatbot

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Abstract 64 – Paper ID: 107

Dual incretin-modulating effects of Roselle (*Hibiscus sabdariffa*) extract and its flavonoids in experimental type 2 diabetes

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Abstract

Background: Altered incretin signaling, characterized by reduced GLP-1 secretion and enhanced DPP-4 activity, drives the pathogenesis of T2DM. Roselle (*Hibiscus sabdariffa*) is rich in bioactive flavonoids, which may potentially modulate the incretin pathway.

Methods: The crude extracts and ethyl acetate subfractions of Roselle were assessed for DPP-4 inhibitory activity and GLP-1 secretion by using enzyme-based assays and STC-1 cell-based HTRF assays. Bioactivity-guided fractionation and HPLC profiling identified quercetin and myricetin as major active constituents. Molecular docking analysis was conducted to examine the interaction of flavonoids with the DPP-4 catalytic site. Mechanistic studies employed pharmacological inhibitors targeting bitter taste receptor associated signaling pathways including PLC, ROCK, and intracellular Ca^{2+} mobilization. The in vivo efficacy of Roselle extracts was examined in a high-fat diet/low-dose streptozotocin-induced C57BL/6 mouse model of T2DM.

Results: Roselle extract showed potent DPP-4 inhibition and stimulated glucose-dependent GLP-1 secretion, which was more effective in the quercetin-rich fractions. Docking analysis supported stable binding of flavonoids within the DPP-4 active pocket. GLP-1 secretion significantly reduced by inhibitors of the pathway, suggesting the involvement of bitter taste receptor–mediated PLC–IP_3–ROCK–Ca^{2+} signaling. In diabetic mice, Roselle treatment improved fasting glycemia, decreased triglyceride levels, increased oral glucose tolerance, increased circulating GLP-1 levels, and decreased plasma DPP-4 activity.

Conclusion: Roselle exhibits dual incretin-modulating actions through the inhibition of DPP-4 directly and stimulation of GLP-1 secretion mediated by the bitter taste receptor, which was indicative of its potentiality to function as a plant origin therapeutic approach in T2DM management.

Keywords: Roselle, GLP-1, DPP-4 inhibition, Polyphenolic flavonoids, Type 2 diabetes mellitus, Incretin signaling

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Abstract 65 – Paper ID: 114

Gut Plastisphere Microbiota-Mediated Polystyrene Depolymerization in the Plastivore Insect *Tenebrio molitor*

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Abstract

Polystyrene (PS) is extensively employed in various industrial applications. Its recalcitrant to depolymerization and biodegradation leads to detrimental environmental persistence, necessitating finding sustainable bioresources such as microbiota and biocatalysts that could degrade plastics. Here, we investigated the role of gut plastisphere microbiome of plastivore *Tenebrio molitor* (yellow mealworm) in the degradation of PS. Metagenomic sequencing using Long-Read Nanopore (LRN) MinION platform was employed to profile the gut microbiome of the *T. molitor* larvae fed with PS in comparison with a control diet. The depolymerization of PS in the gut was characterized by FTIR and ^{1}H NMR analyses. The LRN sequencing of full-length metagenomic 16S rDNA delineated the species-level identification of *Tenebrionibacter* (*T. intestinalis*), *Enterococcus* (*E. faecalis*, *E. canis*, *E. thailandicus*, *E. hermanniensis*), *Spiroplasma* (*S. lampyridicola*, *S. gladiatoris*) and *Clostridium* (*C. cellulovorans*) genera in the gut microbiota of *T. molitor*. PS allotrophagy by *T. molitor* was associated with the elevated levels of *T. intestinalis* (1–1.2-fold), *E. faecalis* (1.2–1.5-fold), *E. canis* (1.1–3.3-fold) and *C. cellulovorans* (7.2-fold) in the gut microbiota. Various *Enterococcus* spp. were only associated with PS allotrophagy, indicating their role in plastic degradation in the gut plastisphere. Furthermore, FTIR and ^{1}H NMR analyses revealed the presence of new functional groups (–OH, C=O) in the frass of PS-fed mealworm, signifying PS depolymerization after ingestion by the mealworms. Taken together, we identified the link between the gut plastisphere microbiota of the plastivore *T. molitor* larvae and PS depolymerization, highlighting the gut plastisphere microbiota as a unique niche for identifying microbes and enzymes that could help develop innovative plastic biodegradation solutions.

Keywords: Gut microbiota, *Tenebrio molitor*, Plastic degradation, FTIR, ^{1}H-NMR, Nanopore sequencing

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Abstract 66 – Paper ID: 119

Developing a Machine Learning-Based Cardiometabolic Disease Model for Predicting Liver Disease

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Abstract

Cardiometabolic diseases, which are a leading cause of global mortality, are interconnected metabolic and cardiovascular disorders that include diabetes, MASLD and ischemic heart diseases. Predicting disease may help in its early diagnosis and treatment. Cohort studies are crucial in cardiometabolic disease research as it can give significant insight into disease demographics, prevalence and its prediction. Here, we utilise the data of a national longitudinal cohort study to investigate and predict liver disease. Clinical and anthropometric data of Phenome India Cohort ($n = 207$) were analysed and divided into subgroups based on the status of hepatic steatosis and fibrosis. Sixteen key metadata, including liver enzyme, renal, FibroScan and anthropometric parameters were used for initial model development, and eight parameters were identified using forward and recursive feature selection. Seven machine learning (ML) algorithms, namely Random Forest, XGBoost, CatBoost, SVM, Logistic Regression, Naïve Bayes, and Neural Network, were trained on the new parameters, and data was split into training (75%) and testing (25%) sets. Models using all 16 features tended to overfit, achieving perfect performance on the training set but lower generalisation on the testing set. Feature reduction to eight resulted in a simpler model with similar performance. SVM provided the most desirable test performance among the seven algorithms achieving balance between sensitivity and specificity (accuracy 0.738, sensitivity 0.857, specificity 0.500, F1-score 0.814, ROC-AUC 0.724; 5-fold cross-validated accuracy 0.710 and ROC-AUC 0.741). Adjusting the decision threshold between 0.55 and 0.80 led to lower sensitivity at lower thresholds and high sensitivity at higher thresholds. The application of ML algorithms to clinical metadata can help in the prediction of liver disease.

Keywords: Cardiometabolic disease, machine learning, cohort study, liver disease, SVM, clinical metadata

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Abstract 67 – Paper ID: 126

Isolation and Identification of Pathogenic Bacteria from Sewage Water in Imphal East District, Manipur

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Abstract

The waste water from various human activities, such as domestic, agricultural and industrial activities, is technically referred to as sewage. The sewage is mostly composed of organic and inorganic compounds, toxic substances, heavy metal and pathogenic organisms, etc. The bacteriological examination of waste water has a special significance in pollution studies as it is the direct indicator of deleterious effect of pollution on human health. The serial dilution–agar planting method, microscopic examination and biochemical test were employed to isolate and identify the bacterial colony from waste water samples which were collected from 10 randomly selected major drainage systems of Imphal-East District, Manipur. The isolated bacterial colonies were identified as *Escherichia coli*, *Shigella dysenteriae*, *Staphylococcus aureus*, *Enterococcus faecalis*, *Salmonella typhimurium* and *Streptococcus lactis*. The presence of coliform bacteria in the sewage water demonstrates the level of pollution of their environment, because coliforms are not the normal bacterial flora of sewage water and are known for potential pathogens. The presence of *S. aureus* and *Shigella sp.* and *E. coli* indicate faecal contamination and environmental pollution attributed to the contamination of the aquatic animals by the faecal material fed to them.

Keywords: Imphal-East, Sewage water, Pathogenic bacteria, Bacteriological examination, Community health, Pollution

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Abstract 68 – Paper ID: 129

Epidemiological and Climatic Determinants of Scrub Typhus in Manipur, India: A Retrospective Surveillance-Based Study

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Abstract

Scrub typhus, caused by *Orientia tsutsugamushi*, is a re-emerging vector-borne zoonotic disease and a major cause of acute undifferentiated febrile illness in India. Accurate laboratory testing and climate-sensitive surveillance are essential for early detection and prevention of outbreaks. A retrospective descriptive study was conducted using secondary surveillance data from the Integrated Health Information Platform (IHIP) under the Integrated Disease Surveillance Programme (IDSP) for the period 2023–2025. District-wise laboratory testing data were analysed for testing trends and positivity rates using descriptive biostatistics. Age- and sex-wise distributions were assessed. Climatic interpretation was performed using India Meteorological Department (IMD) reports on temperature, rainfall, and humidity to assess ecological suitability for chigger proliferation.

During the study period, 13,814 individuals were tested, of which 2,715 (19.7%) were laboratory-confirmed scrub typhus cases. Testing increased substantially over time, with peak positivity observed in 2024 followed by a decline in 2025, reflecting improved diagnostic coverage. A higher laboratory-confirmed burden was consistently reported from hill districts including Senapati, Churachandpur, and Ukhrul, indicating persistent transmission foci with outbreak potential. Most cases occurred in the 31–45 and 46–60 year age groups, with male predominance suggesting occupational exposure, while notable female involvement indicated peri-domestic transmission. IMD data showed rising temperatures, intense monsoonal rainfall, and sustained high humidity during the study period, creating favourable conditions for chigger survival and seasonal transmission.

Enhanced laboratory-based surveillance combined with climate-informed interpretation highlights the potential for localized outbreaks of scrub typhus in Manipur and underscores the importance of integrating climatic indicators into routine public health surveillance.

Keywords: Scrub typhus, *Orientia tsutsugamushi*, Epidemiological surveillance, Climatic determinants, Manipur

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Abstract 69 – Paper ID: 140

Virtual prediction of domains in genomes of actinobacteria using NaPDoS, Domain Search Program for NRPS, NP Searcher, and NRPS substrate predictor for bioactive compounds

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Abstract

Natural products are widely distributed and one such source is *Streptomyces* in actinobacteria group. *Streptomyces* are known for producing natural products as secondary metabolites. For predicting domains responsible for production of natural products through NRPS/PKS pathways in actinobacteria by *in silico* approaches there is need of bioinformatics tools for analyzing the growing number of natural products. In the present investigation, thirty six species of *Streptomyces* were retrieved from NCBI and analyzed using four bioinformatics tools (NaPDoS, Domain Search Program for NRPS, NP Searcher NRPS and NRPS substrate predictor), and reporting the findings from the species of *Streptomyces*. Adenylation domain sequences where various domains such as A, KS, T, TE, E and C are predicted that responsible for various natural products. The results revealed 86.1% adenylation domain by Domain Search Program for NRPS, 69.4% condensation domains by NaPDoS, 58.3% by Domain Search Program for NRPS, 13.8% E domains by Domain Search Program for NRPS, 66.7% of T domains, 77.8% of TE domains by Domain Search Program for NRPS are detected. 2.8% KS by Domain Search Program for NRPS and 83.3% by NaPDoS are also detected. Domain Search Program for NRPS predicted maximum number of domains as compare to others. It is suggested to use combination of tools that could support in mining the domains that codes bioactive compounds.

Keywords: Actinobacteria, Virtual prediction, Domains, Natural products, NRPS and PKS

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Abstract 70 – Paper ID: 149

Nanostructured Lipid Carriers Loaded with PDE4 Inhibitors to Attenuate Neuroinflammation in Parkinson's Disease: A Review

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Abstract

Parkinson's disease (PD) is a progressive neurodegenerative condition marked by movement impairments and the degeneration of dopaminergic neurons, often associated with chronic neuroinflammation. Recent data shows that neuroinflammation plays a key role in the development of Parkinson's disease, mainly due to the activation of microglia, release of pro-inflammatory cytokines, and oxidative stress. Phosphodiesterase 4 (PDE4), which hydrolyzes cyclic adenosine monophosphate (cAMP), is essential for the regulation of inflammatory responses in the central nervous system. Inhibiting PDE4 has become a hopeful approach to raise cAMP levels inside cells and block inflammatory signals, especially by reducing the levels of NF-κB and TNF-α. However, the use of PDE4 inhibitors in medicine has been slowed down because they do not easily pass through the blood–brain barrier (BBB) and can cause side effects throughout the body. Nanostructured lipid carriers (NLCs) are gaining more attention as an alternative method to deliver drugs that can overcome the limitations of conventional PDE4 inhibitor formulations. The synergistic effects of PDE4 inhibitors that reduce inflammation and NLCs that target the brain offer an alternative approach to treat neuroinflammation and the loss of dopaminergic neurons in PD. This review provides a detailed look at the latest advancements in creating and developing nanostructured lipid carriers that are loaded with PDE4 inhibitors for treating Parkinson's disease.

Keywords: Parkinson's disease, Neuroinflammation, cAMP, PDE4 inhibitors, Nanostructured lipid carriers

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Theme: Advances in Mathematical Sciences

Abstract 71 – Paper ID: 023

Detection of Blind Spot in Heavy vehicles: A multi Criteria Decision making Approach using Machine learning

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Abstract

Heavy vehicle blind spot identification is an important issue for IVS since, because to their size, these vehicles provide extensive areas of reduced sight for drivers, which increases the likelihood of accidents and deaths on the road. Although they do their job, traditional sensor-based approaches have problems with cost, flexibility, and integrating with changing driving conditions. To improve the accuracy of blind spot identification and decision assistance for drivers, this study suggests a multi-criteria decision-making (MCDM) strategy that incorporates machine learning. A powerful collection of features is constructed by merging data from several sources, such as LiDAR, radar, ultrasonic sensors, and vision systems based on cameras. The use of machine learning techniques like Support Vector Machines (SVM), Random Forest (RF), and Deep Neural Networks (DNN) allows for the real-time classification and prediction of probable blind spot items. With the help of the MCDM framework, we may optimize the decision-making process for alert generation by prioritizing variables including computing efficiency, environmental adaptability, reaction speed, and detection accuracy. Comparing the suggested method to traditional single-sensor or single-algorithm systems, experimental findings on real-world datasets of heavy vehicles show that it produces better performance. Not only does the framework make roads safer by decreasing accidents caused by blind spots, but it also offers a scalable solution for autonomous car and next-gen driver support systems.

Keywords: Blind Spot Detection, Heavy Vehicles, Multi-Criteria Decision-Making (MCDM), Machine Learning, Sensor Fusion, Intelligent Transportation Systems (ITS), Driver Assistance Systems, Deep Learning, Road Safety, Real-Time Object Detection

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Abstract 72 – Paper ID: 024

A Novel Diagonal Hamming technique for efficient Multi-Bit error correction in Memories

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Abstract

This research articles represents the On-chip memory in a die that is prone bit errors that resulting in single upset units to multiple upset units. Some of these errors are caused by environmental factors, alpha particles, cosmic rays and extreme temperatures such instances can lead to data corruption, creates critical issue especially in space application. To address such issue, this article presents an enhanced error detection and detection techniques. The proposed models describes the utilization of code based on divide symbol scheme, specially introduced radiation introduced in memory devices. The core of this technique involves a series of XOR operations to encode data bits, diagonal bits, and parity and check bits. To retrieve the original data, a second XOR operation is performed between the encoded bits and recalculated encoded bits. Following this, a verification, selection, and correction process is initiated. The proposed method focuses on detecting and correcting soft errors, which are temporary data corruption events caused by voltage fluctuations or external radiation. These soft errors are particularly prevalent in memory systems. The research describes a multi-bit error detection and repair approach capable of identifying two-bit errors within a single memory row. The design proposed method is simulated and synthesized using Xilinx Verilog HDL.

Keywords: On-chip memory, Bit errors, Single-cell upsets (SCUs), Multi-cell upsets (MCUs), Cosmic radiation, Alpha particles

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Abstract 73 – Paper ID: 026

Integrating Zero-Trust Architectures into DevSecOps for Cloud Workloads

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Abstract

Businesses continually adopt modern applications and architectures, accelerating the migration of traditional IT workloads like containers and serverless configurations to cloud platforms. However, the expanded attack surfaces and turning off key infrastructure protection controls inherent to these cloud platforms increase susceptibility to attacks. These unique characteristics result in complex operational processes, decreasing the effectiveness of traditional security approaches. Consequently, there is an upsurge in attacks on cloud workloads. Integrating Zero-Trust, continuous security validation, security policy automation, and automated remediation emerging in DevSecOps are paramount to protecting cloud workloads. This research develops a framework for embedding Zero-Trust architectures and corresponding mechanisms into DevSecOps to secure cloud workloads, validated through real-world case studies. Compliance with the integration objectives remains a formidable challenge.

Keywords: DevOps, Continuous Integration (CI), Continuous Testing, Auto-scaling, Resource Scaling, Cloud Computing, Cost-Aware DevOps

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Abstract 74 – Paper ID: 030

Computational Analysis and Recognition of Manipuri Traditional Motifs

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Abstract

The traditional textile motifs represent an invaluable component of the cultural heritage, preserving the artistic identity, historical narratives and the indigenous knowledge systems of a particular region. In Northeast India, Manipuri traditional dress motifs hold an exceptional cultural significance and are also deeply embedded in the garments such as Innaphi, Phanek and ceremonial textiles. These motifs had exhibit intricate geometric, floral and script-inspired structures that are produced through a labour intensive manual weaving and embroidery techniques. However, due to the lack of systematic digital documentation and the automated analysis poses a serious threat to their long-term preservation. With the rapid advancement of computer vision and artificial intelligence, particularly deep learning, automated recognition of textile motifs has emerged as a promising research domain within cultural heritage informatics. This paper presents a comprehensive and systematic review of the computational techniques employed for the textile and motif pattern recognition with a focused that emphasis on the Manipuri traditional motifs such as Khamen Chatpa, Namthang Khuthat, Thambal Cheplei and Ningkham Mayek patterns. The paper critically analyses the handcrafted feature extraction methods, the convolutional neural network (CNN) based models, lightweight deep learning architectures and the emerging transformer-based vision models. Furthermore, the importance of a curated and annotated datasets tailored to Manipuri motifs is highlighted in this paper. This survey provides the first consolidated review focused specifically on Manipuri traditional motifs and highlights future research directions for culturally informed AI systems. Various key challenges, unresolved research gaps and the potential future directions are also discussed to guide the development of robust recognition frameworks and support the sustainable digital preservation of the Manipuri textile heritage.

Keywords: Manipuri Traditional Motifs, Pattern Recognition, Computer Vision, Deep Learning, Cultural Heritage Digitization, Machine Learning

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Abstract 75 – Paper ID: 033

A Robust Machine Learning Framework for Preclinical Alzheimer's Detection Using Cognitive Features and Ensemble Voting

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Abstract

Alzheimer's disease (AD) is a brain disorder that deteriorates with time and interferes with memory, thinking, and behaviour. Early diagnosis is significant as it can be treated and manage the symptoms at the right time. The proposed voting-based ensemble machine learning model is used to detect the presence of Alzheimer disease when selected cognitive features are used in the study. Neighborhood Component Analysis (NCA) and correlation-based filtration were used to extract important features and enhance accuracy and eliminate unnecessary data. Several classifiers were fused via a soft-voting system to enhance the stability and general performance. The individual machine learning models are not as accurate and as consistent as the proposed model. The findings indicate that the ensemble approach can contribute to early diagnosis and assist medical practitioners to make more sound decisions.

Keywords: Alzheimer disease, Cognitive features, Machine learning, Ensemble learning, Voting classifier, Early detection, Feature selection, NCA, Soft voting

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Abstract 76 – Paper ID: 034

NextGen Intern Manager for Effective Talent Development and Skill Tracking

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Abstract

The NextGen Intern Manager for Effective Talent Development and Skill Tracking is a web-based platform designed to streamline and modernize the management of internship programs in academic and organizational settings. The system addresses key limitations of traditional supervision methods by providing an automated and centralized environment for monitoring attendance, tasks, learning progress, and overall intern performance. It offers dedicated dashboards for interns, mentors, and administrators, enabling seamless interaction and real-time visibility into internship activities. The platform is developed using React.js for the user interface and the Django REST Framework for backend logic, ensuring modularity, scalability, and efficient data handling. Security is reinforced through PBKDF2-SHA256 encryption and role-based access control, guaranteeing restricted and authorized information access. Integrated analytics and visualization modules generate meaningful performance insights, helping mentors evaluate interns objectively and identify skill development trends. The system architecture, deployed on a local server, supports centralized data storage, cost-effectiveness, and reliable backup mechanisms. Developed using Agile methodology, the platform underwent iterative refinement, resulting in improved usability and adaptive feature enhancements. Experimental evaluation demonstrates reduced administrative workload, higher accuracy in attendance and task tracking, and enhanced transparency in performance assessment. Overall, the system contributes to a more accountable, data-driven, and development-oriented internship ecosystem through a secure and user-friendly digital framework.

Keywords: Internship management, skill tracking, performance analytics, Django REST Framework, React.js, role-based access control, PBKDF2–SHA256, Agile methodology, centralized data management, talent development

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Abstract 77 – Paper ID: 038

A Machine Learning Framework for Forecasting Rice Production, Cultivated Area, and Yield in Manipur using Feed Forward Artificial Neural Network

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Abstract

Accurate forecasting of rice production is crucial, as rice is a staple food and a primary source of livelihood for the people of Manipur. This study examines variations in rice production, cultivated area, and productivity, aiming to identify significant contributing factors and propose strategies for future enhancement. Utilizing secondary time-series data from the Economic Survey of Manipur 2021–2022, published by the Directorate of Economics and Statistics, Government of Manipur, the research adopts a Multilayer Feed Forward Neural Network (FNN) approach. A three-layer Artificial Neural Network (ANN) model was developed to predict rice production, cultivated area, and yield. The ANN model formulates relationships between multiple input variables and output targets using the Rectified Linear Unit (ReLU) as the activation function. Training was conducted using the backpropagation algorithm. Specifically, a Feed Forward Neural Network (FNN) with a 7-64-32-1 architecture was employed to predict rice production, while a 5-64-32-1 FNN, 3-64-32-1 was used for predicting cultivated area–each model utilizing a different window size for input data.

Keywords: Time Series, Feed Forward Neural Networks, Rectified Linear activation unit, Backpropagation

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Abstract 78 – Paper ID: 043

A Comparative Study on Binary Composition in Fuzzy Relations

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Abstract

In complex systems, fuzzy relations play a vital role in modeling uncertainty and vagueness. The concept of binary composition of fuzzy relations is fundamental in fuzzy logic, decision-making, control systems, and artificial intelligence. Various binary composition operators such as max-min, max-product and max-average have been proposed to handle different application requirements. This paper dealt with a comparative study of these operators in fundamental relational properties, namely reflexivity, symmetry and transitivity. Further, an illustrative example is also provided for each composition by using a 3×3 order of matrix.

Keywords: Fuzzy sets, fuzzy relations, composition of fuzzy relations, order of matrix

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Abstract 79 – Paper ID: 064

SENTRY Error-Budget-Constrained Causal Canary Orchestrator

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Abstract

Error-Budget-Constrained Causal Canary Orchestrator in SENTRY: present a rigorous, evidence-based, formal discussion, prioritizing precise definitions, measurable metrics, and clear causal reasoning; organize content with objective analysis and explicit data supports.

Services monitored by SENTRY and similar tools should operate indoors with high quality for significant periods of time while inserting erroneous changes to induce a reaction in the canary. A Canary Orchestrator manages the canary insertion and checking, splitting the operator error budget as required. Fail points can also be triggered and checked automatically to maintain service quality in these cases. The Canary Orchestrator dynamically calculates when to insert canaries based on risk appetite and acceptable budget allocation for the affected operations and is built on definitions of temporal error budgets and successive safety constraints. The implementation uses Canaries for impact checking. There are possible speedups through shared evaluation of canaries on similar beta groupings and through automated rollback after sufficient impact monitoring time has passed.

Keywords: Error Budget, Causal Canary Analysis, Kubernetes Orchestration, Reinforcement Learning, DevOps Automation, Continuous Deployment, Progressive Delivery, Rollback Optimization, SLA Violation Detection, Cloud Reliability Engineering

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Abstract 80 – Paper ID: 075

Fixed points of some contractive mappings in S_b metric space

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Abstract

In this paper, first we discuss about various generalizations of metric space. Our discussion gives emphasis on S_b-metric space on how it is obtained after introduction of various forms of generalized metric spaces. Secondly, we discuss about various generalizations on Banach contraction principle. In this case our discussion is limited to S_b-metric spaces. This paper will serve as a sizable survey on fixed points of contraction mappings on S_b-metric spaces.

Keywords: Fixed point, Banach contraction principle, metric space, S-metric space, Sb-metric space

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Abstract 81 – Paper ID: 088

Fixed Point Theorems for convex contraction mappings on Partially E-Cone Metric Spaces

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Abstract

In this paper, we investigate fixed point theorems for convex contraction mappings defined on partially E-cone metric spaces, a structure that extends classical cone metric spaces by incorporating a partial ordering induced by a subcone E. We establish sufficient conditions under which convex contraction mappings admit unique fixed points in this framework. Our results generalize and unify several existing fixed-point theorems in cone metric and ordered metric spaces. Illustrative examples are provided to demonstrate the applicability of our results. The study shows that partially E-cone metric spaces offer a flexible setting for analysing nonlinear mappings that may not satisfy standard contraction assumptions.

Keywords: Convex Contractive Mapping, Partially E-Cone Metric Spaces

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Abstract 82 – Paper ID: 089

Coupled Fixed Point in Partial Modular Metric Space

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Abstract

This work analyses the existence and uniqueness of coupled fixed points in partial modular metric spaces by means of the mixed monotone property. The findings broaden and generalize earlier coupled fixed point theorems, moving from partially ordered modular metric spaces to the more general framework of partial modular metric spaces. The obtained results are applicable to the investigation of nonlinear equations and systems of integral equations, and an illustrative example is included to demonstrate their effectiveness and practical applicability.

Keywords: Coupled Fixed Point, Partial Modular Metric Space, Mixed Monotone Property

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Abstract 83 – Paper ID: 090

Tripled fixed point theorems for non-compatible self-maps in generalized metric spaces

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Abstract

In this paper, we develop a new tripled fixed point theorem for three interacting self-maps by using the notions of R-weak commutativity of type and non-compatibility in generalized metric spaces. We can establish our results without assuming the completeness of the underlying generalized metric space or the continuity of the mappings, thereby removing hypotheses that commonly restrict the applicability of existing tripled fixed point results. To support our findings, a detailed example is provided that illustrates the novelty, validity, and mathematical relevance of the proposed theorem.

Keywords: Generalized metric space, R-weakly commuting mappings of type, non-compatible mapping, tripled fixed point

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Abstract 84 – Paper ID: 091

On the application of partial cone b-metric spaces to boundary value problem

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Abstract

In this study, we investigate the structure of Hausdorff partial cone b-metric spaces and establish several new results relevant to their analytical properties. We present a set of lemmas that characterize the convergence behavior of sequences in these spaces, thereby broadening and strengthening a number of existing fixed-point theorems. To support and clarify the theoretical developments, illustrative examples are provided. Furthermore, utilizing a fixed-point framework, we establish the existence of solutions to an associated boundary value problem, demonstrating the applicability of the obtained results.

Keywords: Fixed point, multivalued almost contractions, partial cone b-metric space, application

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Abstract 85 – Paper ID: 092

On Fixed Figure Problems in Fuzzy Cone Metric Spaces

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Abstract

Fixed circle difficulties correspond to a field of problems in metric fixed point theory. Finding selfmappings that are invariant at every point on the circle in the space is the specific challenge. Recently this topic is thoroughly explored in several metric spaces. Our present effort is in the arena of the expansion of this line of research in the setting of fuzzy cone metric spaces. For our purposes, we first define the concepts of a fixed circle and a fixed Cassini curve. Next, we identify appropriate criteria that guarantee the existence and uniqueness of a fixed circle (or Cassini curve) for the self operators. Additionally, we provide a solution that states that the fuzzy quasinonexpansive mapping's fixed point set is always closed. Our results are supported by examples.

Keywords: Fuzzy cone metric space, Fixed circle, Archimedean t-norm, Mh-triangular fuzzy metric

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Abstract 86 – Paper ID: 093

Non-singular Durgapal–Fuloria gravastar solutions in $f(R, L_m, T)$ gravity

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Abstract

The Gravastar, also known as a Gravitational Vacuum Star, is a compelling alternative to the Black Hole theory, originally proposed by Mazur and Mottola. This paper considers the form $f(R, L_m, T) = R + \alpha T L_m$ and focuses on the gravastar model within the framework of modified $f(R, L_m, T)$ gravity. According to Mazur and Mottola, the gravastar model consists of three distinct regions, each characterized by a different equation of state (EoS). In this study, we examine the interior region using a space-time characterized by $p = -\rho$. In the dark sector of this region, the EoS $\rho = p$, representing an ultra-relativistic fluid, results in a negative matter-energy density that exerts a repulsive force on the adjacent thin shell. Properties such as proper length, total energy, energy density, and entropy have been analysed. The Schwarzschild–de Sitter solution is employed to describe the vacuum exterior region of the gravastar. Furthermore, the junction between the inner and outer surfaces of the gravastar has been studied using the condition.

Keywords: Gravastar, $f(R, L_m, T)$ gravity theory, junction condition, black holes

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Abstract 87 – Paper ID: 095

Dynamical System Approach of Modified $f(R, G, T)$ Gravity and Its Cosmological Implications

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Abstract

We perform a comprehensive phase-space analysis of a generalized modified gravity model characterized by $f(R, G, T) = \alpha R^l + \beta G^m + \gamma T^n$, where α, β, γ and l, m, n denote the model parameters. By introducing suitable dimensionless variables, the modified Friedmann equations are transformed into an autonomous system of ordinary differential equations. The resulting dynamical system admits eight critical points, whose physical properties and stability are studied through linear perturbation analysis. We identify four late-time stable attractors associated with accelerated cosmic expansion. The model predicts a transition redshift of $z_{\rm tr} = 0.616$, a present-day deceleration parameter of $q_0 = -0.50$, and an effective equation-of-state parameter of $\omega_0 = -0.66$, all consistent with current observational bounds. The evolution of density parameters with respect to the e-folding variable $N = -\ln(1 + z)$ further demonstrates that the Universe is presently dominated by an effective dark-energy component. These results indicate that the considered $f(R, G, T)$ gravity framework provides a viable description of late-time cosmological dynamics.

Keywords: Dynamical system, modified $f(R, G, T)$ gravity, density parameters, cosmic evolution

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Abstract 88 – Paper ID: 097

Non-singular Vaidya–Tikekar gravastar model in $(3+1)$ dimensions

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Abstract

In this manuscript, we have examined an isotropic, spherically symmetric non-singular gravastar modeled using the Vaidya–Tikekar metric potential. Mazur and Mottola first introduced the concept of the gravastar or gravitational vacuum star, and their work laid the foundation for its structural development. In recent years, gravastars have gained attention as viable alternatives to Black Holes (BHs), as they avoid key problems associated with event horizons and central singularities. Within a gravastar's interior, the pressure equals the negative energy density, generating a repulsive effect that impacts the adjacent region – a thin intermediate shell composed of ultra-relativistic plasma. The exterior region is described by the Schwarzschild geometry. In this work, we analyze the junction conditions connecting these spacetime regions and explore several physical characteristics of the thin shell, including its energy density, proper length, total energy, and entropy. We also investigate the stability properties of our stellar model.

Keywords: Black holes, non-singular gravastar model, Vaidya–Tikekar metric potential

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Abstract 89 – Paper ID: 098

Dynamical system approach of viscous fluid in $f(T)$ gravity theory

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Abstract

In this paper, using the recently introduced $f(T)$ gravity framework, we have analyzed the viscous fluid cosmological model in FLRW cosmological model by assuming a specific form of the bulk viscosity coefficient as, $\zeta = \zeta_0 + \zeta_1 H + \zeta_2 \left(\frac{\dot{H}}{H} + H\right)$ and a non-linear $f(T)$ model particularly, $f(T) = T - \alpha\sqrt{-T}$ where α is the model parameters. Using the phase space technique, we examine the asymptotic behaviour of our cosmological bulk viscous model. We found one stable critical point. Phase space analysis and the geometrical interpretations are given. We discover that according to our model, the Universe evolved from a matter-dominated decelerated phase (a past attractor) to a stable de-Sitter accelerated epoch (a future attractor). The evolution of EoS parameter shows the acceleration phase of the cosmic expansion whereas the negative behavior of viscosity-induced pressure indicates the accelerated expansion of the Universe. Our $f(T)$ cosmological model, with the influence of bulk viscosity successfully describes the expansion history of the Universe and provides a good fit to recent observational data.

Keywords: $f(T)$ gravity field equations, Viscous model, Dynamical system analysis, Energy conditions

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Abstract 90 – Paper ID: 102

Steinhaus Graphs and Its Application in Cryptography

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Abstract

The concept of an adjacency matrix in graph theory stems from the inherent structure of a graph. Mullunzzo derived a graph from a Steinhaus matrix, characterized by being $(0, 1)$–symmetric with a zero diagonal, by extending a Steinhaus triangle into an adjacency matrix.

The Steinhaus graph, a representation of this process, behaves akin to an XOR logical gate, lending itself to applications in cryptography alongside graph theory. This paper delves into the notion of a Steinhaus complement within the realm of Steinhaus graphs, introducing the concept of Steinhaus self–complementary graphs.

Exploring vertex set partitions of Steinhaus graphs, particular focus is placed on identifying 2–partitions that yield the Steinhaus graph as their 2–complement. Utilizing the notion of a 2–self–complement of a graph, the characterization of Steinhaus self–complementary graphs is elucidated.

The paper also outlines insights from Steinhaus graphs that contribute to the advancement of symmetric cryptography.

Keywords: Steinhaus graph, Adjacency matrix, Self-complementary graph, XOR operation, Cryptography

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Abstract 91 – Paper ID: 108

Optimizing Semantic-Driven Sentiment Analysis and Text Classification Using Rivoli's Hummingbird Optimization in ERNIE (RHO–ERNIE)

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Abstract

This paper presents RHO–ERNIE, a Natural Language Processing model enhanced by Rivoli's Hummingbird Optimization and knowledge representation. RHO–ERNIE is built for complex and developing social media use cases to support semantic-driven sentiment analysis and text classification. The model employs optimization methods inspired by biological mechanisms to enhance structured knowledge and semantic relationships. The goal of the model is to maximize classification accuracy and precision while minimizing error. In summary, processing data in this manner is more effective, as social media data are typically large-scale and unstructured. RHO–ERNIE exhibits improved clustering and correlation measures, indicating its capability to suitably handle intelligently added complexities in real-time applications. This novel solution can extract information from social media and generate insights useful for analysis. RHO–ERNIE can serve as a new standard for natural language processing.

Keywords: Sentiment analysis, Text classification, Semantic analysis, ERNIE, Optimization algorithms

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Abstract 92 – Paper ID: 109

Construction of fractals with Picard–CR iteration equipped with s-convexity for a complex rational function

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Abstract

Fractal sets like Julia set and Mandelbrot set are generated through iterative function systems. Our study proposes Picard–CR iteration equipped with s-convexity to generate some derivatives of Julia and Mandelbrot fractals for a complex rational function $az^m + \frac{b}{z^n} + c$ where $m, n \in \mathbb{N}$, $a, b, c \in \mathbb{C}$, $m \geq 2$ and $|a| \geq 1$. The escape criterion for our proposed iterative scheme is derived via the complex rational function. We investigate how alterations in parameters influence fractals structures. The graphical depictions are scrutinized to verify alterations.

Keywords: Picard–CR iteration, s-convexity, escape criterion, Julia sets, Mandelbrot sets

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Abstract 93 – Paper ID: 110

Fixed points of some F-contractions using Mann's iteration in (θ, δ)-convex b-metric spaces

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Abstract

This paper presents some fixed-point results in b-metric spaces using Mann's iterative process with (θ, δ)-convex structure. We establish some fixed-point theorems by defining new contraction conditions, namely the F-Kannan type contraction in (θ, δ)-convex b-metric spaces and the F-Hardy Rogers type contraction in (θ, δ)-convex b-metric spaces.

Keywords: Fixed point, b-metric spaces, Mann's iteration, (θ, δ)-convex structure, F-Kannan type contraction, F-Hardy Rogers type contraction

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Abstract 94 – Paper ID: 111

$(\alpha - \psi)$-interpolative Kannan and Ćirić–Reich–Rus-type cyclic contraction in b-metric spaces

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Abstract

In this paper, we introduce the concept of $(\alpha - \psi)$-interpolative Kannan and Ćirić–Reich–Rus-type cyclic contraction. Further, we investigate the existence and uniqueness of fixed points in b-metric space by using $(\alpha - \psi)$-interpolative Kannan and Ćirić–Reich–Rus-type cyclic contraction. Our results generalize various earlier results in the literature.

Keywords: Fixed point, b-metric space, α-admissible, $(\alpha - \psi)$-interpolative Kannan cyclic contraction, $(\alpha - \psi)$-interpolative Ćirić–Reich–Rus-type cyclic contraction

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Abstract 95 – Paper ID: 112

Lattice Homomorphisms on L^p-Spaces

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Abstract

Let (Ω, Σ, μ) be a complete σ-finite measure space and let $1 \leq p \leq \infty$. We study bounded lattice homomorphisms $T : L^p(\mu) \to F$ into a Banach lattice F. To avoid the obstruction $1 \notin L^1(\mu)$ when $\mu(\Omega) = \infty$, we work on the δ-ring $\Sigma_f = \{A \in \Sigma : \mu(A) < \infty\}$ and the dense sublattice S_f of simple functions with finite-measure support. For $1 \leq p < \infty$ we show that every bounded lattice homomorphism induces a local Boolean set function $\nu : \Sigma_f \to F_+$ via $\nu(A) = T(\chi_A)$, and that T is the unique bounded extension of the associated simple-function integral I_ν from S_f to $L^p(\mu)$. We introduce a p-variation functional $\|\nu\|_{(p)}$ and prove the intrinsic norm identity $\|T\| = \|\nu\|_{(p)}$ together with a converse construction theorem. When F is an AL-space, boundedness is characterised by a Radon–Nikodým derivative $g \in L^q(\mu)$ and $\|T\| = \|g\|_q$. For $p = 1$ on finite measure spaces we also present an order-integral (Kantorovich–Wright type) formulation and show it agrees with the norm-density approach. Finally, we treat the case $p = \infty$ under σ-order continuity.

Keywords: Lattice homomorphisms, Boolean δ-ring measures, p-variation functional, L^p-spaces

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Abstract 96 – Paper ID: 116

Some fixed point theorems on complete (α, β, c)-interpolative S-metric spaces

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Abstract

There are various generalizations of metric space. S-metric space is one of the important generalisations of metric space. In this paper, we use the concept of (α, β, c)-interpolative S-metric space to study the existence of fixed point. Our results in the form of new fixed point theorems generalize and unify various results in the literature.

Keywords: Fixed point, S-metric space, Metric space, Complete (α, β, c)-interpolative S-metric space

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Abstract 97 – Paper ID: 121

Transfer Learning Approach for Handwritten Character Recognition of Meitei Mayek Script Using Deep CNNs

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Abstract

The digitization of low-resource scripts poses a significant challenge including structural uniqueness and limited computational support. This work aims to present an OCR System for the Meitei Mayek script using deep learning techniques, specifically transfer learning with the VGG16 Convolutional Neural Network. It uses a fine-tuned VGG-based convolutional architecture to perform the recognition of characters by modelling the spatial and geometric properties of handwritten symbols.

The system uses a VGG-based convolutional architecture adapted for the Meitei Mayek characters, where convolution layers detect fundamental visual elements such as strokes, curves, intersections, and spatial orientations. Images are passed through successive layers in which low-level features are combined into abstract representations that describe the overall form of each character, while pooling operations reduce sensitivity to minor handwriting variations.

One limitation of the study is the small dataset of handwritten samples, which is addressed through data augmentation using image transformations such as variations in brightness, contrast, noise, and stroke appearance to improve generalization to unseen inputs. Training is guided by gradient-based optimization with gradual adjustment of internal parameters to minimize recognition errors across character classes.

The recognition model is integrated into a simple graphical application that accepts scanned images and camera input for practical and educational purposes. Although the current implementation operates on isolated characters, the underlying design allows future extension to word-level and document-level recognition.

In short, the study demonstrates how convolutional modelling and optimization methods can be applied to the preservation of a low-resource script, contributing both a practical OCR model and a meaningful application of mathematical methods for linguistic preservation.

Keywords: Optical character recognition, Meitei Mayek, convolutional neural network, VGG16, low-resource scripts, handwritten character recognition

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Abstract 98 – Paper ID: 123

Detection of Attacks in Wireless Sensor Networks Using Unsupervised Learning Approach

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Abstract

This paper presents an unsupervised machine learning based attack detection approach for wireless sensor networks (WSNs). Two unsupervised methods, namely Fuzzy–c–means (FCM) and K–means clustering, are employed. Principal Component Analysis (PCA) is implemented in both methods as a feature selection technique. The models are trained and tested on the WSN–DS and KDD Cup 99 datasets. These datasets are originally labeled, and by removing the labels they are transformed into unlabeled datasets. The proposed unsupervised learning approach is then applied to these unlabeled datasets, and the number of clusters is finally validated using the original labeled datasets. The attack types considered include blackhole, grayhole, flooding, TDMA, probe, U2R, and R2L.

Unsupervised learning methods present several constraints when compared with attack detection models based on supervised learning paradigms. These limitations include explicit reliance on label–free techniques such as FCM and K–means, making comprehensive performance evaluation challenging. The lack of labeled data reduces accuracy and other critical performance metrics. In addition, the K–means clustering algorithm exhibits high sensitivity to initial conditions, where different initializations may lead to varying and unstable clustering results. Despite these limitations, unsupervised learning methods such as clustering algorithms can identify anomalies without labeled data, which is particularly important in WSNs where obtaining labeled data for all possible attack scenarios may not be feasible. The proposed models are evaluated using metrics such as TPR, NPV, PPV, TNR, FPR, FDR, and FNR. The results indicate that the model employing Fuzzy–c–means clustering outperforms the model based on K–means clustering.

Keywords: Wireless sensor networks, Unsupervised learning, Attack detection, Fuzzy–c–means, K–means clustering

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Abstract 99 – Paper ID: 125

On the Compactness of Higher Order slant Hankel and slant Toeplitz Operators

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Abstract

Here, we study k^{th} order slant Hankel and k^{th} order slant Toeplitz operators on Hardy spaces. Contrary to the behavior of the classical Toeplitz operators, the symbol of the compression of a k^{th} order slant Toeplitz operator cannot be determined uniquely by the operator. Likewise, the symbol of the compression of a k^{th} order slant Hankel operator is also not unique. The nature of the boundedness of these operators has also been studied to compare their spectral properties and compactness criteria.

Keywords: k^{th} order slant Hankel, k^{th} order slant Toeplitz, Compression, Compactness

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Theme: Plenary and Invited Presentations

Paper ID: PT–01

Phytochemicals of Liverworts: Biological Activity and Their Application to Cosmetics, Foods and Medicines

Plenary Talk

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Abstract

There are 6000 species of liverworts in the world. Almost all liverworts possess beautiful cellular oil bodies. Many species of liverworts possess characteristic fragrant odors and an intense pungent, sweet, or bitter taste. Generally, liverworts are not damaged by bacteria, fungi, insect larvae and adults, snails, slugs, and other small mammals. Although liverworts possess such bioactive products, their isolation and structural elucidation were neglected for almost a century. Since 1972, we collected more than 800 species of liverworts around the world and chemically analyzed them with respect to their chemistry, pharmacology, and application as sources of cosmetics and human diets, and as medicinal or agricultural agents. The biological activities of liverworts are due to the terpenoids and aromatic compounds which are present in the oil bodies in each species. Several hundred new compounds have been isolated from the essential oils and solvent extracts of liverworts, and more than 60 new carbon skeletal terpenoids and aromatic compounds such as bis–bibenzyls, marchantin A (1) and riccardin A (2), which are very rare natural products, were found. Most of the liverworts studied elaborate characteristic scent, pungent, and bitter tasting compounds, many of which show antimicrobial, antifungal, antiviral, allergenic contact dermatitis, cytotoxic, insecticidal, anti–HIV, superoxide anion radical release, plant growth regulatory, neurotrophic, NO production inhibitory, muscle relaxing, antiobesity, piscicidal, nematocidal activity, and many others. The most characteristic chemical phenomenon of the liverworts is that most of the sesqui– and diterpenoids are enantiomers to those found in higher plants. It is very noteworthy that different liverwort species of the same genus like *Frullania tamarisci* and *F. dilatata* (Frullaniaceae) each produces sesquiterpene lactone enantiomers, (+)–frullanolide (3) and (–)-frullanolide (4). When the large thalloid liverwort, *Conocephalum conicum*, was completely sealed into a plastic sac which was covered by a glass plate for 1, 6, and 9 months, its morphology and each chemical profile were dramatically changed. The major monoterpene, (+)–bornyl acetate (5) included in the original thallus, disappeared and menthyl cinnamate (6) was newly created. The chemical profiles of the cultured *C. conicum* are very similar to that of the Japanese most expensive mushroom *Tricholoma matsutake*, which is used as consommé soup in Japan. Thus, the production of the volatiles of *T. matsutake* can be produced limitless from the liverwort on laboratory and industry scales.

When the thalloid liverwort *Marchantia paleacea* subsp. *diptera* was cultured under the same conditions as mentioned above, (S)–(–)-perillaldehyde (7), which is the most important aroma

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for *Perilla frutescens* (Lamiaceae) and is used in Japanese cuisine and herbal medicines, and is not included in the original liverwort, was elaborated in 50% yield, along with 1–perillyl alcohol (8) and shisool (9). Thus, (S)–(–)-perillaldehyde (7) can be created limitless for a year in this simple manner.

Almost all of the *Radula* liverwort species mainly produce bibenzyls and prenyl bibenzyls. It is noteworthy that *R. perrottetii* and *R. marginata* biosynthesize perrottetinene (PET) (10) and perrottetinenic acid (11), the structures of which are very similar to that of the well–known psychoactive compound tetrahydrocannabinoid (THC) (11) obtained from *Cannabis sativa*. PET (10) showed the same psychoactivity as that of THC and more potent antiinflammatory activity than THC (11).

In this paper, the bio– and chemical diversity of liverworts and their bio– and pharmacological activities, including characteristic odor and taste, as well as the possibility of liverworts as cosmetics, foods, and medicals, are surveyed.

Keywords: Liverworts, marchantins, riccardins, perrottetinene, *Radula*, *Conocephalum conicum*

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Paper ID: PT–02

Number Theory and Science of Secure Communications

Plenary Talk

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Abstract

Number theory plays an important role in making our communications secure. In fact almost all Public Key Cryptosystems are based on number theoretic ideas. In this talk, I will give an overview of cryptography from the perspective of number theory and challenges in the threat of AI and Quantum computers and the way forward.

Keywords: Public Key Cryptography, Computational Number Theory, Post-Quantum Cryptography, Cryptographic Security, AI and Quantum Threats

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Paper ID: PT–03

Antarctica: Exploring the Frontiers of Nature and Science

Plenary Talk

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Abstract

Antarctica is one of the most significant frontiers in nature and science, exerting disproportionate influence on global climate stability, sea level, ocean circulation, atmospheric dynamics, ecosystems, and planetary observation systems. This comprehensive review synthesises multi–disciplinary research works on cryospheric, oceanic, atmospheric, ecological, technological, and cosmological aspects conducted across Antarctica. Drawing on satellite remote sensing, in situ observations, artificial intelligence, numerical modelling, and astrophysical experiments, the article integrates peer–reviewed findings for MSc and PhD students and faculty.

Keywords: Antarctica, Global Climate System, Cryosphere Dynamics, Remote Sensing, Multidisciplinary Research

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Paper ID: PT–04

Magnetic Oxides: Materials for Potential Applications

Plenary Talk

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Abstract

In recent years, magnetic oxide materials have attracted considerable attention due to their significant potential for a wide range of applications in innovation and technology. Ferrites are an important class of magnetic materials that have been extensively utilized for several applications like memory devices, energy production, shielding technology, biomedical applications etc. The use of ferrites is shifting to the upper end of the recurrent range due to mechanical advancements made in the last several years. To mitigate the growing dverse effects of electromagnetic pollution in everyday life, the shielding abilities of ferrite nanoparticles, multiwalled carbon nanotubes, and graphene oxide based hybrid composites are actively explored. Recent developments in generation of green electrical energy using porous oxide materials offer promising pathways towards economic and sustainable energy source. Ferrites based hydroelectric cells with mesoporous structure are capable of producing green electrical energy with zero carbon emission through dissociation of water molecules. Additionally, some ferrites exhibit encouraging application in the field of thermoelectric applications. Overall, magnetic oxide materials are promising materials for current and future technological applications.

Keywords: Magnetic Oxide, Energy Production, Electromagnetic Pollution, Ferrites

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Paper ID: PT–05

Genetic Basis of Anti-Tuberculosis Drug-Induced Liver Injury (AT-DILI)

Plenary Talk

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Abstract

Anti-tuberculosis drug-induced liver injury (AT-DILI) is a severe adverse drug reaction associated with using anti-tuberculosis medications. Isoniazid, rifampicin, and pyrazinamide are potentially hepatotoxic drugs used in TB treatment. The rate of AT-DILI ranges from 2 to 28%, and this is also attributed to genetic factors. Drug metabolism genes are the major targets for association studies with AT-DILI. Some of the major genes that have been reported to be associated with DILI are N-acetyltransferase 2 (*NAT2*), glutathione S-transferase gene (*GSTM1, GSTT1*), Pregnane X receptor (*PXR*) etc. The present study aims to determine the prevalent genotypes of *NAT2*, *PXR*, *ABCB1*, *GST*s, and their association with AT-DILI in the Manipuri population of India. About 450 individuals, including both controls and cases, were recruited, and genotyping of *NAT2*, *PXR*, *ABCB1*, and *GST* genes was performed using the Taqman allelic discrimination assay. Liver function tests (LFT) were also conducted to assess the liver injuries. Ten genotypes of *NAT2* were observed in the population. About 51.2% of the population were of the intermediate acetylator genotype of *NAT2*, and the variant allele 'T' of the *PXR* and *ABCB1* genes were observed to be 21.0% and 58%, respectively. The null genotypes of *GSTT1* and *GSTM1* were found to be 37.8% and 68.0%, respectively. LFT analysis in 32 follow-up patients showed that about 75% of patients developed mild AT-DILI after two months of TB treatment. Case-control analysis showed that the null genotypes of *GSTT1* and *GSTM1*, and the slow acetylator genotype of *NAT2* were associated with AT-DILI. The study revealed that most Indian Manipuri populations were carriers of ancestral alleles for *NAT2*, *PXR*, and *ABCB1*. However, the null mutation of the *GSTT1* and *GSTM1* genes was highly prevalent in the population, and they could be significant contributors to AT-DILI in TB patients along with the slow acetylator genotype of *NAT2*.

Keywords: Genetic polymorphism, Drug-induced liver injury, Liver function test, Drug metabolism genes, N-acetyltransferase 2, Glutathione S-transferase

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Paper ID: PT–06

Evidence-Based Perspectives on Traditional Medicine in the Management of Lifestyle Diseases

Plenary Talk

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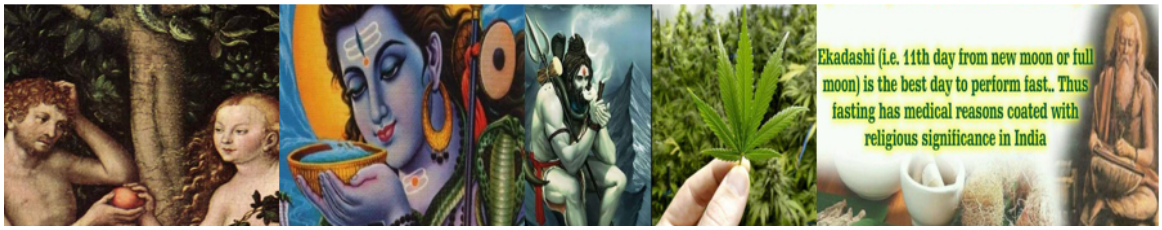
Abstract



- Does Adam and Eve's original sin have to do with "Apple"?
- To protect the creation, did Lord Shiva consume the poison and then encounter Cannabis (*Cannabis sativa*)?
- Fasting has existed in India since time immemorial, but many Indians believe that it is unscientific and illogical, is it unscientific?

Certain statement we must prove that they are true. Sometimes they are based on ignorance, prejudices and mistaken interpretation. Common sense knowledge based on accumulated experience, prejudices and belief of people. It is often contradictory and inconsistent. Scientific observations are based on verifiable evidence and systematic proof that can be cited.

In the lecture, the discussion will be made that despite Indian Systems of Medicine (ISM) being one of the world's oldest medical systems and although we have a wealthier history of bioresources and traditional medicine (TM) but still translational potential with global acceptability is a real need. ISM and TM are encountering acceptability challenges because of inconsistency in efficacy due to a lack of authenticated and quality botanical raw material, lack of information on their chemical composition(s), quality is not assured, and safety is a major concern as defined by the current standards in regulatory affairs and healthcare industry.

Keywords: Natural product, traditional medicine and drug discovery

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Paper ID: PT–08

Recent Approaches in Natural Products Research for Drug Discovery

Plenary Talk

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Abstract

The Indian subcontinent has a vast coastal belt along with a wide range of forest environments, which host a large number of unexplored plant and marine species. This diversity has been the source of unique chemical compounds with the potential for industrial development as pharmaceuticals, cosmetics, nutritional supplements, molecular probes, fine chemicals, and agrochemicals. In recent years, a significant number of novel metabolites with potent pharmacological properties have been discovered from natural sources, including marine and terrestrial plants. The recent move of society towards nature for the treatment of various diseases, where there is no satisfactory cure in modern medicine, has diverted the attention of natural and medicinal chemists and biologists to unravel their chemical characteristics and biological activities together in order to define their therapeutic potential in the light of modern pathobiological understanding. This move has collectively led to rediscover, design, and refine the therapeutic application of medicinal plants and marine sources.

During the last eight years, we have studied several medicinal plants and marine organisms guided by *in vitro*–based bioassays to delineate the chemistry of natural products responsible for biological activities. This effort has led to the identification of several potent multiple–active medicinal plants and marine sponges, their active fractions, and synergistic molecular compositions. We have identified, in particular, several free radical scavengers, xanthine oxidase, and α–glucosidase inhibitory principles present in substantial yields. The presence of multiple active phytochemicals in rich concentrations in some medicinal plants therefore offers an exciting opportunity for the development of novel therapeutics and also provides scientific justification for their use in traditional medicines. Therefore, biologically activity–based chemical characterization of these medicinal plants may provide scientific explanation for their use in traditional medicines and also redesign and develop preparations for novel therapeutic applications.

Keywords: Natural Products Chemistry, Medicinal Plants, Marine Bioactive Compounds, Bioassay-Guided Isolation, Novel Therapeutics

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Paper ID: PT–09

Synergistic Nanocomposite Photocatalysts for Photodegradation of Organic Pollutants in Water

Plenary Talk

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Abstract

The discharge of industrial effluents containing dyes and toxic chemicals into aquatic ecosystems poses a potential threat to environmental quality and community health. Addressing this challenge, the present work focuses on the development of novel nanocomposite materials with enhanced photocatalytic properties for the effective removal of organic contaminants from aquatic systems. The nanocomposites are synthesized by combining semiconductor materials with metal or non–metal, or metal oxide compounds. This strategy maximizes visible–light absorption, improves charge separation, and enhances surface interactions. The photocatalytic performance of the synthesised nanocomposites was systematically evaluated, demonstrating their ability to degrade a range of organic contaminants found in aquatic environments. Upon light irradiation, the nanocomposites generate reactive oxygen species that efficiently diffuse into the aqueous solution, creating an oxidative environment capable of breaking down complex organic pollutants. Furthermore, the photocatalysts exhibit good structural integrity and reusability over multiple cycles, indicating their potential as a viable, sustainable, and cost–effective solution for wastewater treatment and environmental remediation applications.

Keywords: Nanocomposites, photocatalysis, wastewater treatment, organic pollutant degradation, water purification, sustainable remediation

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Paper ID: PT–10

Fixed Points by Iterative Methods and Applications

Plenary Talk

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Abstract

Fixed point theory is a fundamental concept in Mathematics with applications across various fields. It focuses on expressing problems as equations involving operators and finding solutions by locating fixed points of these operators. This theory integrates principles from functional analysis, topology, and geometry, making it possible to translate complex theoretical or practical problems into fixed point tasks. Iterative methods are one of the widely used techniques to locate fixed points. In this talk, we present some iterative methods and related results. Our discussion covers results of classical works of Picard, Mann, Ishikawa, etc. Some recent results based on our published works are also presented. Our discussion also includes application works related to our results.

Keywords: Fixed point, iterative method, Picard iteration, Mann iteration, Ishikawa iteration

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Paper ID: PT–11

A Brief Retrospective History and Advancement on the Fuzzy Metric Fixed Point Theory

Plenary Talk

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Abstract

In this talk, we discuss on the history and recent developments of fuzzy metric fixed point theory. We also discuss on some of the recent existing problems in this field.

Keywords: Fuzzy metric spaces, fixed point theory

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Paper ID: IT–01

Disorder Induced Localization in Optical Lattices

Invited Talk

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Abstract

We examine localization of ultracold bosonic atoms in a 2D disordered optical lattice in the presence of long-range interactions. The interplay of disorder, hopping, and long-range interactions lead to the emergence of localization. An enhancement of localization occurs in the domain where the average filling factor is less than unity. On the other hand, delocalization occurs in the domain where the average filling factor is larger than unity.

Keywords: Optical lattices, disorder-induced localization, ultracold bosonic atoms, long-range interactions, quantum phases

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Paper ID: IT–02

Defect-Engineered Nitride-based MXene/rGO Nanohybrids: A Unified Strategy for High-Performance Energy Storage and Corrosion-Resistant Electrodes

Invited Talk

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Abstract

Two-dimensional MXenes have emerged as transformative materials for high-performance energy storage and corrosion-resistant applications; however, challenges such as restacking, surface instability, and limited electroactive sites restrict their practical deployment. In this invited talk, a comprehensive study on Ti_2NT_x/rGO and V_2NT_x/rGO nanocomposites synthesized through controlled chemical etching and reduction routes is presented. Transmission electron microscopy (TEM) and X-ray diffraction (XRD) analyses confirm the formation of multilayered architectures, expanded interlayer spacing, and Ti_2NT_x/rGO quantum dots arising from quantum confinement. The integration of reduced graphene oxide (rGO) effectively modulates the optical band gaps (Ti_2NT_x: 5.59→4.53 eV; V_2NT_x: 4.75–5.11 eV), suppresses oxidation, and enhances accessible surface area and porosity.

Electrochemical measurements reveal markedly improved charge-storage behaviour, with Ti_2NT_x/rGO achieving a specific capacitance of up to 1203.86 F g^{-1} (galvanostatic charge–discharge), while V_2NT_x/rGO delivers 622.97 F g^{-1} along with outstanding cycling stability (88.3% retention after 10,000 cycles). The optimized composites further exhibit reduced charge-transfer resistance ($R_{CT} = 7.23\ \Omega$) and excellent corrosion resistance, with corrosion rates as low as 1.5×10^{-8} mm y^{-1}. These results underscore the synergistic role of rGO in enhancing electron transport and interfacial stability.

Overall, the findings establish nitride-based MXene/rGO nanohybrids as versatile, defect-engineered, and scalable materials for next-generation supercapacitors and protective coatings, effectively bridging fundamental insights with technological relevance.

Keywords: MXene/rGO composite, Supercapacitor, Electrochemical Measurements, Anti-corrosion property

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Paper ID: IT–03

Ensuring Purity: Analysis and Control of Contaminants and Residues in Herbal Medicines

Invited Talk

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Abstract

Herbal medicines (HMs) and traditional herbal products are widely used worldwide, offering therapeutic benefits often associated with their complex phytochemical compositions. However, there has been limited attention to the quality and safety of medicinal plant raw materials. The growing popularity of medicinal plants, along with their notable environmental characteristics, has raised significant concerns among global organisations regarding their safety and quality assurance. Recently, several pharmacopoeias have been established worldwide for medicinal plants and herbal products, including those in India, the United States, Singapore, China, Canada, Malaysia, Thailand, and Italy. Various countries have developed legal frameworks for these pharmacopoeias at national and regional levels. Key contaminants of concern include heavy metals from soil and environmental pollution, mycotoxins resulting from improper post-harvest storage and fungal growth, and synthetic pesticide residues used during cultivation. Reports indicate that the presence of these contaminants in medicinal herbs often exceeds acceptable limits. This study highlights the current issues related to these risks, including inconsistent regulatory enforcement and the inherent complexity of analysing these products. Effective control methods require the development and implementation of advanced, validated analytical techniques for the accurate identification and quantification of trace substances. To protect patient health and maintain consumer trust in traditional therapies, there is a need for harmonised global standards, stringent Good Agricultural and Collection Practices, and robust Good Manufacturing Practices (GMP).

Keywords: Herbal medicines, Contaminants, Residues, Heavy metals, Mycotoxins, Pesticide residues, Quality control, Pharmacopoeia, GMP

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Paper ID: IT–04

Mechanistic Studies on Alicyclic and Heterocyclic Compounds Using Newer Synthetic Methodologies

Invited Talk

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Abstract

An efficient method for the transformation of N-substituted-N′-benzoylthioureas to substituted N-benzoxazol-2-yl-amides using diacetoxyiodobenzene (DIB) will be described in this presentation. The transformation follows C–O bond formation leading to the benzoxazole derivative due to oxidative dehydrogenation by DIB, instead of the expected C–S bond formation of the benzothiazole moiety. The C–O bond formation leading to benzoxazole is due to consecutive acylation and deacylation in conjunction with the reduction of two moles of DIB. A plausible mechanism was proposed for the reaction, and density functional calculations were also performed to study the reaction mechanism. Unexpectedly, the reaction follows a different pathway leading to C–O bond formation between the carbonyl oxygen and the ortho-carbon of the aryl moiety, resulting in oxazole ring formation, which will be presented here.

A new approach for the conversion of aryl amines having no α-methylene group to aryl nitriles using dimethyl carbonimidodithioates by intramolecular stabilization, particularly 1,2-carbon migration to give the products, will also be highlighted. Here, the conversion of a C–N bond to a C–C bond takes place.

Keywords: Heterocyclic synthesis, oxidative cyclization, reaction mechanism, hypervalent iodine reagents, aryl nitriles

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Paper ID: IT–05

Mean Chain Transitivity and Almost Mean Shadowing Property of Iterated Function Systems

Invited Talk

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Abstract

In this paper, we introduce the notions of mean chain transitivity, mean chain mixing, totally mean chain transitivity, and almost mean shadowing property to iterated function systems (IFS). We study the interrelations of these notions. We prove that an iterated function system is chain transitive if one of the constituent maps is surjective, and it has the almost mean shadowing property.

Keywords: Transitivity, shadowing, pseudo-orbits, chains, iterated function systems

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Paper ID: IT–06

Nash Equilibrium Through the Lens of Fixed Point Theory

Invited Talk

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Abstract

Nash equilibria are fixed points of best-response correspondences. This talk shows how Brouwer's and Kakutani's fixed point theorems establish the existence of Nash equilibria in strategic games. We illustrate this through three examples: Prisoner's Dilemma (pure strategy), Matching Pennies (mixed strategy), and Cournot duopoly (continuous strategy). Designed for PhD students and junior researchers, the talk connects nonlinear analysis to game-theoretic equilibrium via Nash's classical 1950–1951 proofs.

Keywords: Nash equilibrium, fixed point theory, Brouwer theorem, Kakutani theorem, game theory

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Paper ID: IT–07

Waste to Wealth: Pineapple Processing Waste for Production of Sustainable Bioenergy and Biochemicals

Invited Talk

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Abstract

Agricultural residues could play a vital role in meeting the ever-growing demand for energy and bulk chemicals while securing an adequate food supply for society. Fossil-based fuels have been viewed with concern due to their unwanted environmental impacts. Biobased fuels have high potential for sustainable energy production and are hailed as fuels for future generations. Agro-industrial waste could be a major source of alternative energy and biochemicals while corroborating a low-carbon economy.

Processing of pineapple generates about 60% waste by weight in the form of peel, core, crown, and pomace, which can be converted to bioethanol, biohydrogen, biobutanol, and biomethane, which are environment-friendly bioenergy sources. Vermicompost, animal feed, and silage could be readily prepared using the waste. Bioconversion to organic acids, bromelain enzyme, and other valued compounds were also extracted to add value and support the bioeconomy.

Keywords: Agricultural waste, pineapple processing, bioenergy, value addition

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Paper ID: IT–08

Illuminating the Microbial Dark Matter in Fermented Foods and Gut: Unlocking Insights for Cardiometabolic Health and Biotherapeutics

Invited Talk

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Abstract

We stand at an extraordinary inflection point in human health research: the convergence of ancient dietary wisdom and cutting–edge microbiome science. For millennia, fermented foods have been the cornerstone of human health and longevity across cultures, yet the mechanistic brilliance of how these foods dialogue with our microbial partners remains largely unexplored. The emerging tragedy of modern cardiometabolic disease lies in dysbiosis: the silencing of gut microbial diversity and the disappearance of keystone metabolic functions. Growing evidence demonstrates that atherosclerosis is not merely a vascular disease—it is fundamentally a disease of microbial dysregulation, where the loss of protective commensals and the proliferation of pathobionts ignite chronic inflammation, increase intestinal permeability, and accelerate the accumulation of atherogenic metabolites. Yet herein lies a profound opportunity: if dysbiosis drives disease, then targeted microbiota remodeling through fermented foods offers a preventive and therapeutic frontier.

This talk sheds light on the "microbial dark matter" that inhabits fermented foods and our gut ecosystems, unveiling transformative evidence that demonstrates how traditional fermented foods could serve as microbiome–targeted therapeutics. While traditional dietary habits of consuming fermented foods (Mediterranean, Japanese Washoku) are established for improving gut health and promoting a healthy lifestyle, the biologically rich fermented foods of Northeast India remain scientifically underexplored despite their potential to restore eubiosis and mitigate cardiometabolic disease. The presentation will focus on recent scientific findings from our preclinical investigations examining the health implications of long–term dietary intake of Indian traditional fermented foods on gut microbiota–immunomodulation and their cardioprotective potential. Through rigorous scientific investigation, our work reveals the mechanisms by which these foods reprogram the gut ecosystem and exert their cardioprotective effects (restoring eubiosis, promoting balance of cardio–protective and cardio–detrimental metabolites, amplifying short–chain fatty acid production, fortifying intestinal barrier integrity, dampening inflammatory signaling and endotoxemia, and suppressing atherogenic lesion formation).

The implications are far–reaching: traditional fermented foods represent a scalable, accessible, and culturally resonant intervention for preventing and managing cardiometabolic diseases.

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This work challenges the field to reconceptualize preventive medicine through the lens of microbiota–targeted nutrition, positioning traditional fermented foods not as folklore, but as evidence–based biotherapeutics.

Keywords: Fermented food microbiome, gut microbiome, dysbiosis, cardiometabolic disease, microbiota–targeted therapeutics

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Paper ID: IT–09

Phenolic compounds from *Cotinus coggygria* Scop.

Invited Talk

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Abstract

Cotinus coggygria Scop, a species of the family Anacardiaceae, is widespread from southeastern Europe, the Mediterranean and the Caucasus, to central China and the Himalayas. It is a frequent species in Serbia, especially on limestone and sedimentary rocks and in the forests of black hornbeam and black pine. This species with longstanding medicinal history has been traditionally employed in Asian ethnomedicine for the management of hepatic disorders and gastrointestinal ailments. In Serbian folk medicine it is used against ovarian, kidney and prostate problems. All parts of the plant are used in folk preparations, leaves, heartwood and bark. Hitherto, over 300 constituents containing 75 purified compounds from *C. coggygria* have been characterized. Phenolic derivatives dominated among the isolated compounds, while terpenoid-rich volatile oils constituted the majority of leaf components. From the Serbian *C. coggygria* 28 compounds (37% of the total isolates) were isolated and chemically characterized, mostly flavonoids, comprising two auronolignans, a new class of flavonolignans, six biflavones and three flavonoid tetramers. Structural characteristic of the flavonoids isolated from the Serbian *C. coggygria* was 7,3',4'–hydroxylation pattern. Bioactivity assessments of *C. coggygria* revealed broad therapeutic potential, including hepatoprotective, antioxidant, cytotoxic, anti-inflammatory, antimicrobial, and anticoagulant effects. Among the phenolic compounds, flavonoids are considered as the most representative and characteristic components in *C. coggygria*. Phytochemical research revealed that various types of flavonoids isolated from *C. coggygria*, such as flavones, flavonols and their glycosides, dihydroflavones, dihydroflavonols, flavanes, chalcones, aurones, anthocyanidins, biflavones and auronolignans. Flavonoid constituents emerged as the primary compounds contributing to bioactivities, supported by mechanistic studies.

Keywords: *Cotinus coggygria* Scop., Auronolignans, Biflavones, Isolation, Structure elucidation, Biological activity

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Paper ID: IT–10

Design of Doped Graphene Quantum Dot Composites for Next-Generation Energy Storage Devices

Invited Talk

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Abstract

The development of cost-effective, high-performance electrode materials is crucial for advancing supercapacitor (SC) technology toward next-generation energy storage applications. This presentation highlights two complementary graphene quantum dot (GQD)–based strategies that leverage heteroatom and rare-earth doping, along with polymer composite engineering, to significantly enhance electrochemical performance.

In the first approach, sulfur- and nitrogen-co-doped graphene quantum dots (SN-GQDs) were synthesized using a rapid and facile microwave-assisted hydrothermal method under mild conditions. The dual heteroatom doping introduced abundant electrochemically active sites and improved electrical conductivity, resulting in an outstanding specific capacitance of 1040 F g^{-1} at 0.5 A g^{-1}. When incorporated into a polyaniline (PANI) matrix, the SN-GQDs/PANI composite exhibited superior device performance, delivering a high energy density of 44.25 Wh kg^{-1} at a power density of 1.227 kW kg^{-1} in a symmetric supercapacitor configuration.

In the second approach, neodymium-doped graphene quantum dots (Nd-GQDs) were synthesized via a microwave-assisted hydrothermal process that enables rapid heating, efficient energy transfer, and reduced reaction time. Nd doping effectively modulated the electronic structure of GQDs, leading to enhanced charge storage behavior and electrochemical activity. Nd-GQDs demonstrated a high specific capacitance of 618 F g^{-1} at a scan rate of 5 mV s^{-1}. Further, Nd-GQDs were integrated with PANI to form composite electrodes. Among various compositions, the symmetric supercapacitor fabricated with 20 mL Nd-GQDs in the PANI matrix exhibited an excellent specific capacitance of 354 F g^{-1} at 1 A g^{-1}, along with a high energy density of 49.15 Wh kg^{-1} and a power density of 2000 W kg^{-1}.

Overall, these studies demonstrate that both heteroatom-doped and rare-earth-doped GQDs, particularly when combined with conducting polymers, offer a powerful and scalable route for designing high-performance supercapacitor electrodes with enhanced capacitance, energy density, and power density.

Keywords: Graphene quantum dots, supercapacitors, heteroatom doping, rare-earth doping, energy storage

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Paper ID: IT–11

How Science and Technology Will Revolutionize the 21st Century

Invited Talk

N Rajmuhon Singh

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Former Vice-Chancellor, Dhanamanjuri University, Imphal, Manipur, India

Abstract

It was 20th Century that split the atom, probe the psyche, spliced the genes and cloned a sheep. It invented plastics, radar and the silicon chip. It built aeroplanes, rockets, satellites, televisions, computers and atom bombs.

We all heard about Wright brothers' aeroplanes, Albert Einstein's theory of relativity & $E = mc^2$, Edwin Hubble's telescope, Alexander Fleming's penicillin, Marie Curie's Radioactivity, J. L. Baird's television, Alan Turing's 'electronic brains', Stephen Hawkins's black body, James Watson and Francis Crick's double helical structure of DNA, Bill Gates Software Computer, Steve Job's Apple Computer, Raymond Tomlinson's e-mail, Chrystiann Barnard's human heart transplant, Ian Wilmot's Dolly & many more.

By the end of the twentieth century science has reached the end of an era, unlocking the secretes of the atom, unravelling the molecules of life, and creating the electronic computer. With the three fundamental discoveries triggered by the quantum revolution, the DNA revolution and the computer revolution, the basic laws of matter, life and computer were, in the main, finally solved.

Klaus Sehwab, Founder and Executive Chairman of the Word Economic Forum and author of the book "The Fourth industrial Revolution 2016", said: "*Characterized by new technologies fusing the physical, digital and biological worlds, the Fourth Industrial Revolution will impact all disciplines, economics and industries and will do so at an unprecedented rate.*"

Scientific American, June 2010 also highlights twelve events that will change the whole world. They are fusion energy, everyday superconductors, asteroid collision, deadly pandemic, polar meltdown, the big one, synthetic life, self-aware machines, extra dimensions, alien intelligence, human cloning, and nuclear war.

By marking 2025 as a milestone in the history of quantum mechanics, the United States (UN) has recognized the transformative potential of quantum science and technology to develop sustainable solutions in energy, education, communications, human health, climate action, industry and infrastructure, and economic growth.

Some quantum technologies which may influence industries:

1. Drug discovery and development using quantum computers.

2. Medical imaging techniques and diagnosis of diseases using quantum sensors.

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3. Genomics dataset analysis using quantum algorithms for understanding genetic disorders.
4. Quantum computers enabling advancements in cryptography, optimization, material science, and artificial intelligence.
5. Quantum information and communication technologies, including Quantum Key Distribution (QKD), quantum cryptography, quantum networks, enhanced bandwidth, and speed.

A thrilling tour through the scientific world of tomorrow examines the ways the great scientific revolutions that have dramatically reshaped the twentieth century—quantum mechanics, biogenetics, and artificial intelligence—will transform the way we live in the 21st century. Some of the breakthroughs will be in the area of Computer Revolution, Biomolecular Revolution, Genetic Therapy, Human Cloning, Designer Genes, Micro Electro Mechanical System (MEMS), Smart Pills, Robot Consciousness, 21st Century Nano Science and Nano Technology, etc.,

Lesser G. Thurow, former dean of MIT's Sloan School of Management, has stressed, in this 21st Century, there will be a historic movement in wealth away from nations with natural resources and capital. He writes:

"*In the twenty-first century, brainpower and imagination, invention and the organization of new technologies are the key strategic ingredients.*"

He further asserts:

"*Today, knowledge and skills stand alone on the only source of comparative advantage.*"

The point is that these three scientific revolutions (Quantum Revolution, Computer Revolution and Biological Revolution) are not only the key to scientific breakthroughs in the 21st century, they are also the dynamic engines of wealth and prosperity.

Nations may rise and fall on their ability to master these three revolutions.

In any activity, there are winners and losers. The winners will likely be those nations which fully grasp the vital importance of these three scientific revolutions. Those who would scoff at the power of these revolutions may find themselves marginized in the global marketplace of the twenty first century.

Keywords: Science and technology, quantum revolution, computer revolution, biological revolution, innovation, 21st century

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Paper ID: IT–12

Dynamical System Analysis of Barrow Holographic Dark Energy

Invited Talk

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Abstract

Dynamical systems theory offers a profound framework for understanding the evolution of various physical systems, including cosmological models. At its core, a dynamical system is a set of functions that describe how the state of a system evolves over time according to specific rules, typically represented by differential equations. We investigate the cosmological implications of the Barrow Holographic Dark Energy (BADE) model within the framework of $f(Q, L_m)$ gravity, specifically considering the model $f(Q, L_m) = \alpha Q + \beta L_m$, where α and β are free parameters. Here, $f(Q, L_m)$ is a general function of the non-metricity scalar Q and the matter Lagrangian L_m. Using a dynamical system approach for both non-interacting and interacting scenarios, we identify critical points corresponding to different phases of the Universe's evolution, including matter domination, radiation domination, and dark energy-driven accelerated expansion. Our analysis reveals two stable critical points in the non-interacting case and three stable critical points in the interacting case, each indicating a transition to a stable phase dominated by BADE. The phase plots clearly demonstrate the evolution of the Universe's dynamics toward these stable points. At these stable points, the deceleration parameter is negative, consistent with accelerated expansion, and the equation-of-state parameter suggests that BADE behaves as a dark energy component. These findings highlight the BADE model's strength as a viable explanation for the Universe's late-time acceleration within $f(Q, L_m)$ gravity and provide novel perspectives on the cosmic development of dark energy–matter interactions.

Keywords: Dynamical systems, Barrow holographic dark energy, modified gravity, phase-space analysis, cosmic acceleration

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Paper ID: IT–13

Obesity-Linked Pancreatic Fat Rewires Tumor Nerves to Promote Cancer Growth

Invited Talk

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Abstract

Obesity, affecting 74% of U.S. adults, is strongly linked to pancreatic steatosis and a 60% increased risk of pancreatic ductal adenocarcinoma (PDAC), with double the mortality rate, yet its mechanisms of aggressiveness remain unclear. Studies show obesity-driven PDAC has a type 2 immune-dominated tumor-immune microenvironment (TIME), characterized by immune-suppressive myeloid cells that suppress $CD8^+$ T cells and promote tumor progression. To unravel these mechanisms, we use GEMMs, pharmacological inhibitors, transcriptomic analyses (RNA-seq, spatial transcriptomics, scRNA-seq), and advanced imaging (3D iDISCO, confocal microscopy). Our mechanistic study, employing the tools mentioned, reveals that obesity-driven PDAC exhibits significantly higher nerve innervation and adipocyte infiltration, which promotes tumor progression. This increased neuronal innervation in obese PDAC tumors is mediated by neurotrophic factors NGF and NrCAM, released by pancreatic adipocytes within the tumor bed. We found that neurotransmitter release regulates cytokine and chemokine expression, causing dramatic remodeling of the tumor-immune microenvironment (TIME). Specifically, obesity-driven innervation-mediated neuro-adrenergic signaling activates the β_2-adrenergic receptor (β_2-AR) on PDAC cells, enhancing the production and secretion of alarmins like IL-33 and chemokines. Importantly, mitigating adrenergic signaling through (i) pharmacological β_2-AR antagonists (β-blockers), (ii) chemical denervation with 6-OHDA, or (iii) a thermoneutral model, reduced obesity-mediated tumorigenesis. These findings suggest that reducing neuro-adrenergic signaling promotes a pro-inflammatory TIME and significantly curtails obesity-driven PDAC tumorigenesis.

Keywords: Obesity, Pancreatic ductal adenocarcinoma, Neuro-adrenergic signaling, Tumor-immune microenvironment, Tumor innervation

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Paper ID: IT–14

Diversity, Bioactivity, Therapeutic Potential, and Future Challenges of Bibenzyls and Bisbibenzyls in Bryophytes

Invited Talk

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Abstract

Bryophytes, particularly liverworts, produce a wide range of metabolites, among which bibenzyls and bisbibenzyls are considered signature compounds. Bibenzyls contain two aromatic rings, while bisbibenzyls consist of four. The first bisbibenzyls, marchantin A and riccardin A, were reported in 1982 and 1983, and since then, around 70 different bibenzyls and bisbibenzyls have been identified. These compounds are isolated using various solvent systems and characterized through spectroscopic techniques. Their content often varies with season, geography, and environmental conditions. Bibenzyls, structurally related to dihydrostilbenoids, occur abundantly in liverworts and serve as chemotaxonomic markers. Lunularin, a pre-bibenzyl, is found in species such as *Marchantia polymorpha* and *Ricciocarpos natans*. Other examples include cavicularin, an optically active cyclic compound from *Cavicularia densa*; radulanin, a seven-membered heterocyclic ring compound; and dihydroresveratrol, a stilbenoid from *Blasia pusilla* with antineoplastic properties. Bisbibenzyls, dimeric forms of bibenzyls, occur in cyclic or acyclic forms across various orders of Marchantiophyta. They are biosynthesized from two lunularin molecules and share a core of four aromatic rings with two ethano bridges. Several series of bisbibenzyls have been discovered, including marchantins (A–H), riccardins, and plagiochins. Both bibenzyls and bisbibenzyls exhibit diverse bioactivities, such as antibacterial, antifungal, antitumor, antioxidant, neuroprotective, muscle relaxant, and cytotoxic effects. Their significance has been demonstrated in vitro and increasingly through in silico studies. Despite their promise, the natural yield of these compounds in liverworts is very low, posing challenges for large-scale production. Future prospects lie in applying advanced biotechnological and synthetic approaches to enhance scalability, enabling potential pharmaceutical and industrial applications.

Keywords: Bibenzyls, Bisbibenzyls, Liverworts, marchantin A, riccardin A

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Paper ID: IT–15

Sampling and Reconstruction via Frames: From Theory to Applications

Invited Talk

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Abstract

In this talk, we study sampling and reconstruction in shift-invariant spaces using frame-theoretic methods, including convolution and average sampling schemes. Random average sampling is analyzed via probabilistic techniques, yielding sampling inequalities and stable reconstruction results, along with selected applications.

Keywords: Frame theory, sampling and reconstruction, shift-invariant spaces, average sampling, stable reconstruction

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Paper ID: IT–16

Nanostructured Catalytic Materials for Efficient Energy Conversion and Storage

Invited Talk

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Abstract

To achieve a sustainable, low-carbon future, we must overcome the critical challenge of efficiently converting and storing renewable energy. Nanostructured materials have emerged as a powerful solution, leveraging their exceptional physical, chemical, and electronic properties to dramatically enhance energy device performance. At the core of this performance breakthrough lies interfacial engineering, where precisely tailored surface chemistry governs electrocatalytic activity, stability, and efficiency. Advances in nanoscale synthesis now enable the rational design of high-performance, noble-metal-free catalysts that are both economical and scalable. We highlight innovative nanocatalysts developed for critical energy-conversion reactions, placing particular emphasis on advanced water-splitting systems for sustainable hydrogen generation. By strategically bridging nanoscale engineering with industrial scalability, we pave a viable pathway toward efficient, cost-effective, and sustainable energy technologies.

Keywords: Nanocatalysts, Water splitting, Hydrogen generation, Photocatalysis, Photoelectrochemical cells, Energy Conversion and Storage

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Paper ID: IT–18

Extension of the Concept of Nilpotency in a Module

Invited Talk

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Abstract

In this presentation, we assert the significance of the terms "nil" and "weak" in generalizing the concepts of symmetric, semicommutative, Armendariz, and reduced modules, focusing specifically on nilpotent elements within these frameworks. We will extend the definitions of these existing modules—symmetric, semicommutative, Armendariz, and reduced—and critically examine their properties. Additionally, we have built upon various established results related to these modules and developed compelling counterexamples that reinforce our generalizations.

Keywords: Reduced module, semicommutative module, symmetric module, Armendariz module

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In an era marked by rapid technological transformation and increasingly interconnected fields of knowledge, meaningful progress often lies at the intersection of disciplines. The contributions compiled here exemplify this spirit by encouraging dialogue beyond conventional boundaries and by fostering the cross-fertilization of ideas. This volume therefore serves not only as a guide to the technical programme of ICAMSE 2026, but also as a permanent academic record of the research presented during the conference.

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