ICFAI UNIVERSITY
RAIPUR

The ICFAI University, Raipur

International Conference on

19-20, March 2026

Chief Editor
Prof. Dr. G.V.V. Jagannadha Rao

Organized by
Faculty of Science
In Association with IQAC

Sponsored by
Chhattisgarh Council of Science and Technology Raipur, Chhattisgarh

International Conference on Interdisciplinary Research for Innovation and Sustainability (ICIRIS-2026)

March 19-20, 2026

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Faculty of Science,
The ICFAI University, Raipur
Chhattisgarh, India

Sponsored by

Chhattisgarh Council of Science and Technology (CG-COST)
Chhattisgarh
{Letter No. 1518/R&D/CCOST/2026, dated 21/02/2026}

Publisher :

Maa Vaishno Printers & Publication
Badhai Para Road, Lalita Chowk, Raipur, Chhattisgarh, INDIA

International Conference on Interdisciplinary Research for Innovation and Sustainability

March 19-20, 2026

Year : **2026**

Edition – **01**

Prof. (Dr.) G.V.V.Jagannadha Rao
Department of Mathematics
The ICFAI University, Raipur
Chhattisgarh, India

ISBN : 978-93-5782-070-7

Price : Rs. **599/-**

Publisher & Printed by :
Maa Vaishno Printers & Publication
Badhai Para Road, Lalita Chowk, Raipur, Chhattisgarh, INDIA
+91 9039794572, +91 7024677253

ICFAI University
Raipur

Established under the provision of Chhattisgarh Private Universities (Establishment and Operation) Act, 2005 (No 13 to 2005)

Dedicated

to

Shri N. J. Yasaswy ji

Founder ICFAI Group

ICFAI University Raipur

Established under the provision of Chhattisgarh Private Universities (Establishment and Operation) Act, 2005 (No 13 to 2005)

Date : 15 March, 2026

MESSAGE

It gives me immense pleasure to learn that The ICFAI University, Faculty of Science is organizing the International Conference on Interdisciplinary Research for Innovation and Sustainability (ICIRIS–2026), sponsored by the Chhattisgarh Council of Science and Technology (CG-COST), Chhattisgarh, scheduled for 19–20 March 2026.

In today's rapidly evolving world, advancements in science and technology are transforming every aspect of our lives. This conference provides an excellent platform to bring together eminent researchers, academicians, industry experts, and young scholars to exchange ideas, share knowledge, and explore innovative solutions for sustainable development. Such interdisciplinary interactions are crucial for addressing the complex challenges of our time.

I am confident that ICIRIS–2026 will offer valuable exposure to participants, especially the younger generation, by acquainting them with the latest trends and breakthroughs in various fields of science. The deliberations and discussions held during the conference will undoubtedly inspire new perspectives and foster collaborative research.

I extend my heartfelt congratulations to the organizing committee for their efforts in hosting this significant event. I warmly welcome all the participants and wish the conference a grand success.

Best wishes,

Prof. V. R. Shankara
President - ICFAI Group

ICFAI University Raipur

Established under the provision of Chhattisgarh Private Universities (Establishment and Operation) Act, 2005 (No 13 to 2005)

Date : 15 March, 2026

MESSAGE

It is a matter of great pleasure to know that the Faculty of Science, The ICFAI University, Raipur is organizing the International Conference on Interdisciplinary Research for Innovation and Sustainability (ICIRIS-2026) during March 19–20, 2026, with the sponsorship of Chhattisgarh Council of Science and Technology, Raipur, Chhattisgarh, India.

Recent advancements in scientific research play a vital and transformative role in the development of society. Research in diverse fields of science not only broadens the horizons of knowledge but also leads to practical applications, culminating in innovative products and solutions that directly benefit humanity. Conferences such as ICIRIS-2026 provide an excellent platform for scholars, researchers, academicians, and industry experts to share their insights, exchange ideas, and foster interdisciplinary collaborations

I am particularly delighted to learn that the proceedings of the conference will be published in the form of a Souvenir, thereby preserving valuable research contributions and creating a lasting academic record. Such documentation will undoubtedly serve as a reference and inspiration for future research endeavors.

I am confident that the meaningful and applicable outcomes of this conference will be effectively communicated to relevant sectors, including industry and policy-making bodies, ensuring their implementation and contributing significantly to sustainable development and societal progress.

I take this opportunity to congratulate the organizers for their commendable initiative and extend my best wishes for the grand success of ICIRIS-2026.

Chief Patron

Prof. (Dr.) Shiv Dayal Pandey

Hon'ble Vice Chancellor, The ICFAI University Raipur

ICFAI University Raipur

Established under the provision of Chhattisgarh Private Universities (Establishment and Operation) Act, 2005 (No 13 to 2005)

Date : 15 March, 2026

MESSAGE

It gives me immense pleasure to know that the Faculty of Science, ICFAI University, Raipur is organizing the International Conference on Interdisciplinary Research for Innovation and Sustainability (ICIRIS–2026) on 19–20 March 2026. I extend my sincere appreciation to the organizers for taking this valuable initiative.

In the present era, scientific advancements are transforming every aspect of our lives. Interdisciplinary research has become essential for addressing complex global challenges and for promoting sustainable development. Conferences such as ICIRIS–2026 provide an excellent platform for academicians, researchers, industry experts, and students to share their knowledge, exchange innovative ideas, and discuss the latest developments in science and technology.

I am confident that this conference will foster meaningful discussions and collaborations among participants from diverse disciplines. It will also provide young researchers and students with an opportunity to gain exposure to cutting-edge research and inspire them to contribute to innovation and sustainability.

I congratulate the organizing committee for their dedicated efforts in arranging this important academic event. I wish the conference great success and hope that the deliberations will lead to valuable insights and impactful outcomes for the scientific community.

.

Best wishes for the success of ICIRIS–2026

Chief Guest
Dr. Prashant Kawishwar
Director General,
Chhattisgarh Council of Science & Technology
Raipur, Chhattisgarh

ICFAI University Raipur

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Date : 15 March, 2026

MESSAGE

I am pleased to write this message for proceedings of the International Conference on Interdisciplinary Research for Innovation and Sustainability (ICIRIS–2026) being organized by Faculty of Sciences, ICFAI University, Raipur during March 19-20, 2026. In this highly volatile global scenario, Sustainability of mankind on earth has become a real challenge. Global Warming, Climate Change and Food Security were issues of concern for policy makers across the world till the other day. During COP 26 meeting in Glasgow in 2021, hundreds of countries pledged to achieve Net Zero within a targeted date; India committed it by 2070. For last three years, many countries have been at war, emitting so much GHG.

This conference, on a highly topical subject, with comprehensive Themes covering wide areas is quite timely. I must compliment the management, especially the Honorable Vice Chancellor of ICFAI University, for this. I am sure that the conference will be a great opportunity to have global experts sharing their experience and knowledge with students as well as faculty. It will also be a chance to create bridges with industry for research collaboration in different disciplines,essential for improving curriculum for outcome-based education.

I am confident that the conference will be a grand success in terms of achieving its objectives of even national self-sustainability (Atma-Nirbhar Bharat). I must put on record my appreciation for the team of Faculty of Sciences for their efforts.

Guest of Honour

Prof. (Dr.) R.K. Khandal
Ex Vice-Chancellor,
Uttar Pradesh Technical University (UPTU)

ICFAI University Raipur

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Date : 15 March, 2026

MESSAGE

I am delighted to note that the Faculty of Science at The ICFAI University, Raipur, Chhattisgarh, is organizing an International Conference on Interdisciplinary Research for Innovation and Sustainability.

The chosen theme of the conference is both well-conceived and timely. We remain heavily dependent on coal and petrochemical-based energy sources, which are likely to be depleted in the near future. It is, therefore, imperative to shift our focus toward renewable and hydrogen-based energy systems, as we stand on the cusp of transitioning from a carbon-based to a hydrogen-based economy.

Interdisciplinary research opens pathways for the generation of new knowledge. Furthermore, when such knowledge is applied to address the pressing challenges facing humankind, it leads to meaningful innovation.

I congratulate the organizers on their vision and dedicated efforts in bringing together researchers from diverse disciplines and geographical regions. I am confident that this conference will add significant value to all participants.

I wish the conference every success.

Dr. Manwendra K. Tripathi
Associate Professor
Metallurgical and Materials Engineering
National Institute of Technology Raipur

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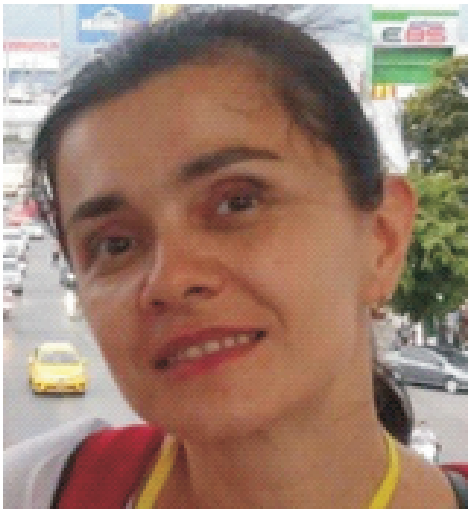

MESSAGE

It is my great pleasure to be associated with the International Conference on Interdisciplinary Research for Innovation and Sustainability (ICIRIS–2026) organized by the Faculty of Science, ICFAI University, Raipur on 19–20 March 2026.

In the modern era, interdisciplinary research has become a powerful approach to addressing global challenges and promoting sustainable development. Scientific innovation today requires collaboration across various disciplines, bringing together knowledge, ideas, and perspectives from different fields. Platforms such as ICIRIS–2026 play an important role in encouraging dialogue, sharing research findings, and fostering collaborations among academicians, researchers, industry professionals, and students.

I am confident that this conference will provide an excellent opportunity for participants, especially young researchers, to gain insights into the latest scientific developments and explore new avenues for research and innovation. Such interactions are essential for nurturing creativity, critical thinking, and scientific progress.

I congratulate the organizing committee for their dedicated efforts in organizing this important event and wish the conference a grand success.

Guest Speaker

Prof. Ariana Pitea

Professor, National University of Science & Technology,
POLITEHNICA Bucharest, ROMANIA

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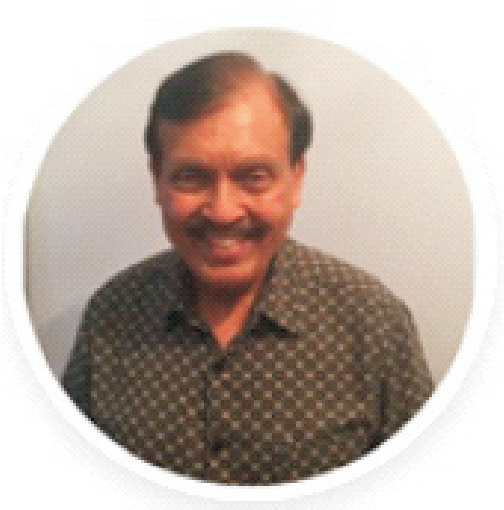

MESSAGE

It gives me great pleasure to know that the Faculty of Science, ICFAI University, Raipur is organizing the International Conference on Interdisciplinary Research for Innovation and Sustainability (ICIRIS–2026) on 19–20 March 2026.

In today's rapidly advancing world, scientific progress and innovation are closely linked with interdisciplinary research. Conferences such as ICIRIS–2026 provide an excellent platform for researchers, academicians, industry experts, and students to come together, exchange ideas, and discuss the latest developments in science and technology. Such interactions play a vital role in promoting collaborative research and generating innovative solutions for sustainable development.

I believe that this conference will offer valuable opportunities for participants, particularly young researchers and students, to broaden their knowledge and gain exposure to emerging trends in various scientific disciplines.

I congratulate the organizing committee for their sincere efforts in organizing this significant academic event and extend my best wishes for the grand success of the conference.

Guest Speaker

Prof. Ram Narayan Mohapatra

Professor of Mathematics,

University of Central Florida, Orlando, USA

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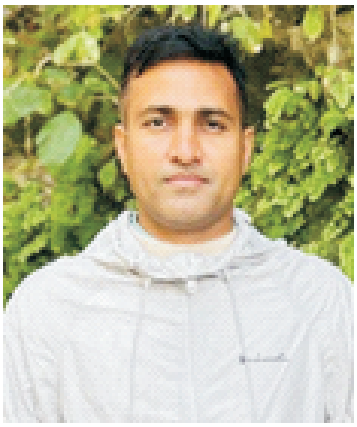

Date : 15 March, 2026

MESSAGE

Dear Changemakers ,

Warm greetings to all of you at ICIRIS-2026, hosted by The ICFAI University, Raipur! This conference's theme **"Interdisciplinary Research for Innovation and Sustainability"** could not be more timely, as we stand at a critical juncture where global challenges demand collaborative, cross-cutting solutions. It is my great pleasure to address you at ICIRIS–2026 on the vital and fastgrowing field of hydrogen energy. As a clean, abundant, and renewable energy carrier, hydrogen stands at the core of global green and sustainable development, powering the future of transportation, industry, and low carbon infrastructure

Recent advances in hydrogen storage, the bottleneck for large scale hydrogen utilization. It have brought transformative opportunities. On one hand, Mg-based solid state hydrogen storage offers high density, safety, low cost, and recyclability. On the other hand, liquid organic hydrogen storage based catalysts achieves highly efficient dehydrogenation, excellent stability, and strong anti-coking performance for long-term operation. Despite these breakthroughs, challenges remain, including further lowering operation temperatures, scaling up material preparation, optimizing catalyst design, and demonstrating full industrial systems.

Therefore, I sincerely encourage every researcher here to continue exploring innovative materials, advanced manufacturing technologies, and integrated hydrogen storage systems. Let us strengthen academic exchanges, interdisciplinary cooperation, and industry-academia partnerships to turn lab discoveries into real-world applications. Together, we can accelerate the reliable, efficient, and affordable hydrogen economy and build a cleaner, more sustainable world

.

.....Let's build a sustainable future together.

Thank you

Guest Speaker

Dr. Santosh Verma

Associate Professor,

Yulin University, China

ICFAI University Raipur

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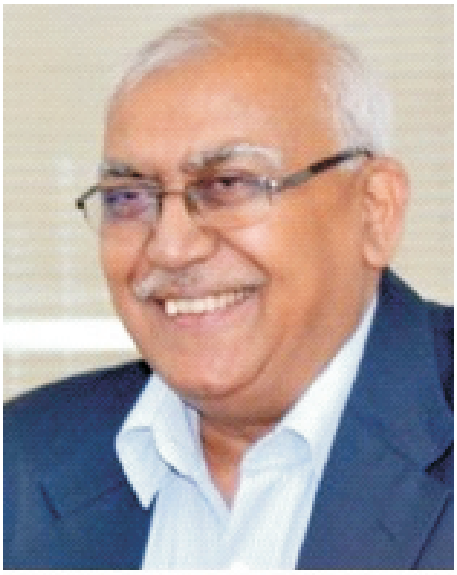

MESSAGE

It gives me immense pleasure to extend my greetings on the successful completion of the International Conference on Interdisciplinary Research for Innovation and Sustainability (ICIRIS–2026), organized by the Faculty of Science, The ICFAI University, Raipur, on 19–20 March 2026.

Over the course of this conference, scholars, researchers, academicians, and industry experts from diverse fields came together to share their valuable insights, innovative ideas, and research findings. Such academic gatherings play a vital role in fostering interdisciplinary collaboration, promoting a scientific temper, and addressing contemporary challenges through innovative and sustainable approaches

I am confident that the deliberations, discussions, and knowledge shared during ICIRIS–2026 will inspire new research directions and strengthen collaboration among institutions and researchers. The exchange of ideas at this conference will undoubtedly contribute to the advancement of science and the promotion of sustainable development.

I congratulate the organizers, speakers, and participants for their dedicated efforts in making this event a grand success and wish them continued achievements in their future academic and research endeavors.

Valedictory Speaker

Prof. S. K. Pandey
Ex. Vice Chancellor,
Pt. Ravishankar Shukla University,
Raipur, Chhattisgarh

ICFAI University Raipur

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MESSAGE

It is a great privilege for me to be associated with the International Conference on Interdisciplinary Research for Innovation and Sustainability (ICIRIS–2026) being organized by the Faculty of Science, ICFAI University, Raipur on 19–20 March 2026. I sincerely congratulate the organizing committee for arranging such an important academic platform.

In the present era, scientific research is increasingly driven by interdisciplinary approaches that integrate knowledge from various fields to address complex challenges. Conferences like ICIRIS–2026 play a crucial role in bringing together scholars, researchers, industry experts, and students to share their ideas, present innovative research, and discuss emerging trends in science and technology.

I believe that this conference will promote meaningful academic interactions and encourage collaborative research among participants from diverse disciplines. It will also provide young researchers and students with valuable exposure to current scientific developments and inspire them to contribute actively toward innovation and sustainability.

I appreciate the efforts of the organizers and extend my best wishes for the grand success of this conference.

Guest Speaker
Dr. Amit Dubey
Sr. Scientist,
Chhattisgarh Council of Science & Technology
Raipur, Chhattisgarh, India

ICFAI University Raipur

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Date : 15 March, 2026

MESSAGE

It is a matter of great pleasure for me to know that the Faculty of Science, ICFAI University, Raipur is organizing the International Conference on Interdisciplinary Research for Innovation and Sustainability (ICIRIS–2026) on 19–20 March 2026. I extend my heartfelt congratulations to the organizing committee for initiating this significant academic event.

In today's rapidly evolving world, interdisciplinary research plays a vital role in addressing complex scientific and societal challenges. Such conferences provide a valuable platform for researchers, academicians, industry professionals, and students to come together, exchange ideas, and discuss recent developments in science and technology. They also encourage collaboration across different disciplines, which is essential for fostering innovation and sustainable solutions.

I am confident that ICIRIS–2026 will provide meaningful exposure to the participants, particularly young researchers and students, and inspire them to explore new avenues of research and innovation. The interactions and deliberations during the conference will certainly contribute to the advancement of knowledge and promote a culture of scientific inquiry.

I extend my best wishes to the organizers and participants for a highly successful and fruitful conference.

Guest Speaker

Dr. Dhananjay Sharma

Principal Scientist, Indira Gandhi Krishi Vishwavidyalaya,
Raipur, Chhattisgarh, India

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Date : 15 March, 2026

MESSAGE

Dear Distinguished Delegates,

It gives me immense pleasure to welcome distinguished academicians, researchers, industry experts, and students to the *International Conference on Interdisciplinary Research for Innovation and Sustainability* ***(ICIRIS–2026)***. The conference is being organized by the Faculty of Science, The ICFAI University, Raipur, and sponsored by the Chhattisgarh Council of Science and Technology (**CG-COST**), Chhattisgarh, on 19–20 March 2026. The event aims to provide a vibrant platform for researchers and professionals from diverse disciplines to share innovative ideas, recent research findings, and practical experiences.

In today's era of rapid technological advancement and interdisciplinary collaboration, such academic gatherings play a crucial role in promoting research culture and meaningful collaboration. ICIRIS–2026 seeks to bring together experts and young researchers to discuss emerging technologies, contemporary challenges, and sustainable solutions for societal development. I sincerely thank CG-COST for sponsoring this conference and extend my appreciation to the organizing committee, speakers, and volunteers for their dedicated efforts.

I warmly welcome all participants to **The ICFAI University, Raipur**, and wish you a productive, insightful, and memorable conference experience.

Let us work together to build a sustainable future.

Convenor
Prof. (Dr.) G.V.V.Jagannadha Rao
Department of Mathematics
Faculty of Science
The ICFAI University, RaipurBest wishes.

ICFAI University Raipur

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Date : 15 March, 2026

MESSAGE

It is indeed a privilege to extend a warm welcome to all participants attending the International Conference on Interdisciplinary Research for Innovation and Sustainability (ICIRIS–2026). The conference is being hosted by the Faculty of Science, The ICFAI University, Raipur, and supported by the Chhattisgarh Council of Science and Technology (CG-COST), Chhattisgarh, on 19–20 March 2026.

This conference provides an excellent opportunity for academicians, researchers, industry professionals, and students to come together and exchange ideas, present innovative research, and discuss contemporary issues related to science, technology, and sustainability. In today's rapidly evolving world, interdisciplinary research plays a crucial role in addressing complex global challenges and promoting sustainable development.

ICIRIS–2026 aims to facilitate knowledge sharing and collaboration among experts and young researchers, encouraging discussions on emerging technologies and innovative solutions for societal progress. I express my sincere gratitude to CG-COST for their generous support and appreciate the efforts of the organizing committee, speakers, and volunteers who have contributed to the successful organization of this conference.

I welcome all delegates to The ICFAI University, Raipur, and wish you a productive, insightful, and memorable conference.

Convenor
Dr. Shanti Swarup Dubey
HoD, Faculty of Science
The ICFAI University, Raipur

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Established under the provision of Chhattisgarh Private Universities (Establishment and Operation) Act, 2005 (No 13 to 2005)

Date : 15 March, 2026

MESSAGE

It gives me immense pleasure, as a Co-Convenor, to share that the Faculty of Science, The ICFAI University, Raipur is organizing the **International Conference on Interdisciplinary Research for Innovation and Sustainability (ICIRIS-2026)** during March 19–20, 2026, with the generous sponsorship of the Chhattisgarh Council of Science and Technology, Raipur, Chhattisgarh, India.

In the present era, scientific advancement increasingly depends on interdisciplinary collaboration and the integration of knowledge across diverse domains. Challenges related to environmental sustainability, emerging technologies, healthcare innovation, and resource management require a collective scientific approach that bridges traditional disciplinary boundaries. Conferences such as ICIRIS-2026 provide an excellent academic platform for researchers, academicians, scientists, industry experts, and young scholars to exchange ideas, present cutting-edge research, and foster collaborative networks that can drive transformative solutions.

I am confident that this conference will stimulate meaningful discussions on innovative scientific approaches and sustainable technologies, while also encouraging young researchers to explore new frontiers of knowledge. The deliberations and outcomes of this conference are expected to contribute significantly to the advancement of interdisciplinary research and to the development of sustainable strategies that benefit society and the environment.

I extend my sincere appreciation to the organizing committee, keynote speakers, participating scholars, and sponsors for their valuable support in making this international event possible. I wish ICIRIS-2026 a grand success and hope that it will serve as a catalyst for impactful research and long-term scientific collaboration.

Co-Convener

Dr. Piyush Kumar Thakur,
Co-Convenor, ICIRIS-2026
Faculty of Science,
The ICFAI University, Raipur, Chhattisgarh.

ICFAI University Raipur

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Date : 15 March, 2026

MESSAGE

As the Organizing Secretary, it is my distinct privilege to welcome you to the International Conference on **Interdisciplinary Research for Innovation and Sustainability (ICIRIS 2026)**, hosted by the **Faculty of Science at The ICFAI University, Raipur, on March 19 and 20, 2026**.

Bringing a conference of this magnitude to life has been a deeply rewarding journey. Our primary goal from the very beginning was to create a vibrant and inclusive environment where diverse scientific minds could comfortably converge. Today, solving complex global challenges requires more than just isolated expertise; it demands the seamless blending of different disciplines. ICIRIS 2026 is designed to be exactly that intersection, providing a dynamic forum for academicians, industry leaders, and bright young scholars to collaborate on sustainable solutions.

We are profoundly grateful to the **Chhattisgarh Council of Science and Technology** for their generous sponsorship and unwavering belief in our academic vision. I also want to express my deepest gratitude to our dedicated organizing committee, whose tireless behind the scenes efforts have shaped every detail of this event.

To our esteemed delegates, we are absolutely thrilled to host you here in Raipur. I encourage you to engage actively in the sessions, forge new partnerships, and share your insights freely. I wish you all a highly productive conference and a truly memorable experience.

Organizing Secretary

Dr. Animesh Kumar Sharma
Assistant Professor, Faculty of Science,
The ICFAI University, Raipur, Chhattisgarh

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Editorial Board Member's
of
International Conference on Interdisciplinary Research for Innovation and Sustainability

March 19-20, 2026

Faculty of Science,
The ICFAI University, Raipur
Chhattisgarh, India

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Dr. Animesh Kumar Sharma
Dr. Piyush Kumar Thakur
Faculty of Science
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ICIRIS 2026 - INDEX

FIXED POINTS RESULTS ON METRIC-LIKE STRUCTURES

Prof. Ariana Pitea
Professor, National University of Science & Technology,
Politehnica Bucharest, Romania

ABSTRACT

The talk presents some metric-like structures, the connections between them, based on examples and counterexamples. Fixed point results are presented from the point of view of their existence and/or uniqueness, with emphasis on the way changing the structure imposes modifications in the hypotheses of the main theorems.

ADVANCED MATERIALS AND TECHNOLOGIES FOR SOLID-STATE AND LIQUID ORGANIC HYDROGEN STORAGE

Santosh Kumar Verma
Chemistry and Chemical Engineering, Yulin University, Yulin 719000, China
vermasantosh08@yulinu.edu.cn
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ABSTRACT

Hydrogen energy, as a clean, abundant, and renewable energy carrier, plays a pivotal role in promoting green and sustainable development for transportation and industrial sectors. Magnesium-based materials represent a highly promising option for solid-state hydrogen storage owing to their high storage density, favorable safety profile, low cost, and good recyclability. This study investigates Mg-based alloys through mechanical alloying and micro alloying strategies. $Mg_{10}Co$ alloys ball-milled for 14 hours display optimized hydride nucleation and enhanced hydrogen sorption kinetics. Doping Mg/MgH_2 with yttrium and nickel generates YH_3 and Mg_2NiH_4, reduces activation energy, and improves cyclic stability; the $Mg_{10}Y_5Ni$ alloy performs reliably at 250–350 °C. Backed by abundant hydrogen resources in Yulin, Mg-based storage shows strong industrial potential for hydrogen vehicles, vessels, and fuel cells, while materials modification alleviates high dehydrogenation temperatures and safety concerns.

For organic liquid hydrogen storage, petal-like Pt/Co-Al layered double hydroxides were synthesized via a hydrothermal route and converted into Pt/Co-Al-O catalysts by hydrogen reduction. Cobalt incorporation regulates surface acidity, enhances platinum dispersion, and strengthens the metal-support interaction. The Pt/Co_3-Al_1-O catalyst delivers MCH conversion up to 99.57% and a high hydrogen release rate at 330 °C, with exceptional stability and anti-coking resistance over 100 hours. This work advances both solid and liquid hydrogen storage technologies, providing a scientific basis for large-scale production, catalyst development, and industrial demonstration of high-efficiency hydrogen energy systems.

Keywords: Hydrogen energy, Solid-state hydrogen storage, Mg-based alloys, Liquid organic hydrogen storage, Catalyst, MCH dehydrogenation

QUEUEING THEORY MODELS FOR OPTIMIZING PUBLIC TRANSPORT OPERATIONS

Shubhashish Biswas, Rajoo
Professor and Dean, Faculty of Science, ISBM University, Gariyaband (C.G.) Asstt. Prof.,Deptt of Mathematics, Dr.J.P.M. Govt Science College Mungeli(C.G.)

ABSTRACT

Public transport performance is strongly shaped by stochastic passenger arrivals, variable dwell times, and service-time uncertainty, which collectively generate queues at stops, terminals, and station access points. This study develops a queueing-theory-based modeling and optimization framework to support both tactical planning (frequency and capacity decisions) and operational control (headway regulation and delay recovery) in high-demand public transport corridors. The framework represents passenger accumulation and vehicle service processes using single- and multi-server queue formulations (e.g., stop berths as servers; boarding/alighting as service), extended to finite-capacity and networked settings where spillback and blocking can occur.

Methodologically, passenger arrivals are treated as random processes, while service times incorporate dwell-time components and downstream berth-blocking effects to quantify bus queue delay and stop congestion. Stop-level models are embedded into a corridor-level reliability layer that links headway variability to passenger waiting-time distributions and crowding risk. To improve service regularity, the study evaluates control policies such as holding and coordinated headway-based regulation, optimizing trade-offs between operational cost, passenger waiting, and reliability. Prior research motivating these elements includes headway/timetable reliability control strategies in public transport operations, stop-level bus queue delay modeling under berth blocking, and holding-based approaches to reduce bunching and waiting time.

Keywords: Queuing theory, vehicle dispatching strategies, public transportation optimization.

ARTIFICIAL WOMB TECHNOLOGY AND THE RIGHT TO ABORTION: A MEDICO-LEGAL INQUIRY INTO WOMEN'S REPRODUCTIVE AUTONOMY IN INDIA

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ABSTRACT

Artificial Womb Technology (AWT), or ectogenesis, represents a significant medico-legal and ethical development with far-reaching implications for women's reproductive rights. While scientific advances in partial ectogenesis suggest the future possibility of extra-uterine gestation in humans, the emergence of this technology necessitates a critical re-examination of abortion rights, bodily autonomy, and fetal viability. This paper explores whether AWT may interfere with or dilute women's right to abortion within the Indian legal framework. Situating the discussion within constitutional protections under Article 21 of the Constitution of India and the statutory regime of the Medical Termination of Pregnancy Act, 1971 (as amended in 2021), the study analyses how expanding notions of viability through artificial gestation may challenge existing legal thresholds governing abortion access.

Drawing upon international human rights principles, including CEDAW and reproductive justice theory, the paper argues that AWT does not offer a technological "solution" to abortion. Instead, it introduces complex medico-legal concerns regarding consent, parental rights, state control over reproduction, and unequal access to emerging technologies. The study contends that without careful legal safeguards, artificial womb technology risks undermining women's decisional autonomy and hard-won reproductive freedoms in India.

IOT-ENABLED SMART HEALTH AND SAFETY WEARABLE SMARTWATCH WITH GPS-ASSISTED FALL LOCALIZATION AND GSM-INDEPENDENT EMERGENCY ALERTING

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ABSTRACT

Continuous health monitoring and rapid emergency response are critical challenges in modern geriatric and remote healthcare. The aging global population is increasingly susceptible to accidental falls and silent hypoxemia, conditions that demand immediate intervention but frequently go undetected until secondary complications arise. This paper presents the design, implementation, and experimental validation of an IoT-based smart health and safety wearable smartwatch built using the ESP32 microcontroller. The proposed system integrates the MAX30102 optical biosensor for photo plethysmography-based heart rate and blood oxygen saturation (SpO2) monitoring, the MPU-6050 six-axis inertial measurement unit (IMU) for kinematic fall detection, a NEO-6M GPS module for real-time location acquisition, and a SIM800L GSM module for Wi-Fi-independent SMS-based emergency alerts. Fall detection employs a deterministic three-stage state machine that sequentially identifies free fall, impact, and post-fall stillness using Sum Vector Magnitude (SVM) thresholds and gyroscopic angular velocity verification. Upon fall detection, the system simultaneously dispatches a push notification via the Blynk IoT platform (Wi-Fi path) and an SMS containing GPS coordinates via the SIM800L (GSM path), creating a dual-redundant alerting mechanism that is operable in both indoor and outdoor environments. The experimental results demonstrate SpO2 accuracy within ±4% of a commercial reference oximeter across four subjects and heart rate accuracy within ±3–5 beats per minute (BPM) across three subjects. Fall detection achieved an overall sensitivity of approximately 91% and a specificity of approximately 93% across 120 controlled trials spanning forward, backward, and lateral fall types, and multiple activities of daily living. The complete prototype was realized at a component cost of less than 2000 INR, making it a compelling low-cost alternative to proprietary commercial smartwatches for monitoring vulnerable populations.

AN OPTIMIZED INVENTORY MODEL FOR PERISHABLE BIOANALYTICAL REAGENTS USING AI-BASED DEMAND FORECASTING

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ABSTRACT

Efficient management of bioanalytical reagents is a critical operational challenge for pharmaceutical and clinical laboratories, as these materials are highly perishable, expensive, and sensitive to storage and handling conditions. Inadequate inventory control often leads to reagent expiration, increased operational costs, and delays in analytical testing, which may directly affect laboratory performance and data reliability. To address these challenges, this study proposes an optimized inventory model for perishable bioanalytical reagents by integrating classical inventory theory with artificial intelligence (AI) based demand forecasting. A continuous review inventory system is developed in which reagent deterioration is modelled as a constant decay rate representing expiry and loss of analytical potency. Laboratory testing demand is uncertain and is forecasted using a long short-term memory (LSTM) neural network trained on historical sample-testing data. The predicted demand is incorporated into a mathematical cost minimization framework that includes ordering cost, holding and refrigeration cost, deterioration cost, and shortage cost under partial backlogging. Analytical optimization techniques are applied to derive the optimal order quantity and replenishment cycle that minimize the total expected inventory cost. Numerical experiments based on realistic bioanalytical laboratory parameters demonstrate that the proposed model significantly reduces reagent wastage and total inventory cost compared to traditional deterministic inventory approaches. Sensitivity analysis further reveals the robustness of the model with respect to changes in deterioration rate, holding cost, and demand variability. The proposed framework provides a practical decision support tool for laboratory managers to improve reagent availability, reduce expiry related losses, and enhance operational efficiency in pharmaceutical bioanalysis environments.

Keywords: Bioanalytical reagents; Perishable inventory; Inventory optimization; Demand forecasting; LSTM neural network; Reagent deterioration; Pharmaceutical laboratories; Cost minimization

TRAFFIC FLOW ANALYSIS IN DIFFERENT WEATHER CONDITIONS

ABSTRACT

Among the most challenging problems in modern transport infrastructure is traffic congestion, which leads to increased travel times, increased fuel consumption, and reduced road safety. Weather is a factor that affects traffic flow behavior significantly among the many external factors that affect it. However, the effect of weather is either not considered in modern traffic forecasting models or is represented in a manner that is far too simple and unintelligible. To examine the effect of congestion behavior under different weather conditions, this study proposes a weather-sensitive framework for traffic flow analysis using historical traffic and weather data. The effect of traffic volume on meteorological factors such as precipitation, rainfall, snowfall, cloud cover and visibility is examined using the Metro Interstate Traffic Volume dataset. Several machine learning regression models such as Linear Regression, Decision Tree, Random Forest, AdaBoost, and Gradient Boosting are compared using historical traffic data to develop a data-driven congestion index. The experimental results show that for modeling the non-linear effect of weather on traffic flow, ensemble learning algorithms—more specifically, Gradient Boosting—are superior to other models. The results show the relevance of unintelligible data-driven approaches for intelligent transport systems and the need to incorporate weather variables in traffic analysis models.

Keywords—Traffic flow analysis, weather-aware traffic modeling, intelligent transportation systems, machine learning, traffic congestion prediction.

EVEN MINIMIZATION OF MULTIPLICATIVE LABELLING- OPEN PROBLEMS AND RESEARCH DIRECTIONS

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ABSTRACT

Graph labelling has long been a fertile ground for mathematical curiosity and practical innovation. Among its many variants, multiplicative labelling with even minimization emerges as a subtle yet powerful construct: assigning integers to vertices so that edge labels, derived multiplicatively, remain distinct, even, and minimized. This delicate balance between algebraic structure and combinatorial optimization opens new pathways for both theory and application.

In this work, we explore the frontiers of open problems from characterizing graph families that admit such labelling's to establishing algorithmic bounds for efficient computation. Beyond pure mathematics, the framework resonates with real-world systems: encoding dependencies in scheduling, optimizing bandwidth in networks, designing secure cryptographic schemes, and compressing data through minimal distinct codes. By bridging abstract labelling rules with applied optimization, we argue that even minimization of multiplicative labelling is not merely a theoretical curiosity but a strategic tool for resource-efficient problem solving**.**

Key words: Graph labelling, Multiplicative labelling, Even minimization, combinatorial optimization, Network optimization.

PHYSICS-CONSTRAINED NEURAL LAPLACE DIGITAL TWIN FOR CERTIFIED ANALYSIS AND RECONSTRUCTION OF ELECTRICAL CIRCUITS

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ABSTRACT

The trend toward faster transient response, nonlinear loadings and reconfigurable topologies creates an urgent need for physically meaningful, accurate Laplace-domain models that are valid outside the textbook assumptions. The application of the Laplace transform in circuit analysis is traditionally based upon either symbolic derivation or numerical transformation that degrades due to arbitrary excitations, uncertainty in the initial condition and complexity in the network. While there have been recent neural approaches to this challenge, they typically represent a black box regression approach that violates one or more of the fundamental laws of circuit behavior including passivity, stability and conservation of charge and current. This paper presents a fully analytical neural framework that views the Laplace domain mapping as a constrained operator learning problem as opposed to the traditional view of a signal conversion problem. A causal series of five innovative modules are presented. LORENZO (Laplace-Operator Residual Encoder with Neural Zero-Order Constraints) is used to generate rational s-domain representations directly from time signals and circuit graphs, while simultaneously minimizing the residual error associated with KVL & KCL constraints. PRISM ID (Pole-Residue Inference with Structured Mode Identification) enables the extraction of physically meaningful modal behavior and sensitivity information associated with each component in order to provide physically meaningful interpretations. CROWN-PFC (Causal Rational Operator Weighting with Passive Frequency Constraints) constrains the learned operator to be passive, causal and to satisfy frequency bounds that guarantee physically-realizable responses. LAPLACE-MPC (Laplace-domain Model Predictive Control) is used to perform model predictive calibration against measured or simulated data in the Laplace domain and preserve stability certificates. Finally, NEURO ILTsafe is used to safely invert the Laplace domain and reconstruct time-domain waveforms without introducing nonphysical artifacts. The combination of all of these modules produces a physically-certified Laplace digital twin that can accurately predict future behavior, rapidly validate the accuracy of predictions, and can be used in real-time to monitor and control the behavior of future generations of electronic and power systems. The framework presented represents a significant improvement over prior-art in terms of spectral fidelity, reduced model inconsistencies during variations in parameters, and the ability to bridge analytical circuit theory with modern operator learning. The results of this paper establish a new paradigm for the physics-aware neural analysis of electrical networks.

AN INTEGRATED TECHNIQUE FOR MEASURING CRITERIA WEIGHTS TO ENHANCE MULTI-CRITERIA DECISION MAKING

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ABSTRACT

This study presents an integrated method for improving multi-criteria decision making through advanced criteria weighting, known as Integrated Measurement of Ranking Quality Enhancement Criteria (MERC) - Criteria Importance through Inter-Criteria Correlation (CRITIC), collectively known as IMC (Integrated MERC- CRITIC). Multi-criteria decision analysis is a popular method in operations research and addresses problems with multiple objectives and criteria. The IMC approach measures the criteria for the improvement of ranking quality and the importance of each criterion through correlations between the criteria, thus avoiding the limitations of purely qualitative or quantitative methods. This unorthodox approach refines weight allocation by blending subjective insights with quantitative precision and introduces a new facet to decision making by assessing the effect of removing criteria from the overall results. The method is explained with an example. The comparative analysis takes into account different criteria weighting methods. An efficiency, effectiveness, and reliability test were carried out through a simulation-based study. The way proposed is tested and the results seem to turn it stable and reliable to increase the differential of evaluation factors' weight to support a decision in different situations. In this development, the author offers a detailed and neutral understanding of the importance of criteria in numerous contexts for solving problems with multiple objectives, which can be essential in multiple aspects of multi-criteria decision-making subcategories.

Keywords: Multi-criteria decision – making; Criteria weights; Measurement of ranking quality enhancement criteria; Criteria importance through inter-criteria correlation; Methodological integration

BIOGENIC AG/AGCL NANOCOMPOSITES FROM *CARISSA CARANDAS*: CHARACTERIZATION AND APOPTOTIC ACTIVITY AGAINST SK-MEL-3 MELANOMA CELLS

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ABSTRACT

The need for biocompatible anticancer agents has driven the development of green nanotechnology. This study reports the eco-friendly synthesis of silver/silver chloride nanoparticles (Ag/AgCl NPs) using *Carissa carandas* leaf extract and evaluates their efficacy against human skin melanoma (SK-MEL-3). Characterization was performed via UV-Vis, FTIR, XRD, and FESEM-EDX. Anticancer potential was assessed using MTT assay and AO/EB dual staining for apoptosis. The NPs demonstrated potent dose-dependent cytotoxicity, reducing cell viability from 89.78% (2.5 µg/mL) to 27.34% (20 µg/mL), with a significant IC_{50} of 10.5 µg/mL. AO/EB staining revealed classic apoptotic hallmarks, including chromatin condensation and nuclear fragmentation. *Carissa carandas*-mediated Ag/AgCl NPs serve as efficient, sustainable anticancer agents. Their ability to induce programmed cell death in aggressive melanoma cells at low concentrations suggests high potential for skin cancer nanomedicine.

Keywords: Green Synthesis, Carissa carandas, Ag/AgCl NPs, SK-MEL-3, MTT Assay, Apoptosis, IC_{50}.

PHOTO-CATALYTIC AND ANTIBACTERIAL BEHAVIOUR OF ZNO NANOSTRUCTURES: ROLE OF SIZE, SHAPE, AND DEFECTS

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ABSTRACT

Zinc oxide nanoparticles (ZnO-NPs) are emerging as a powerful and versatile class of antimicrobial agents, offering a promising solution to the global crisis of antimicrobial resistance. Their effectiveness stems from a unique combination of physicochemical properties, including a high surface-area-to-volume ratio, potent photocatalytic activity that generates reactive oxygen species (ROS), and the release of toxic zinc ions (Zn^{2+}). These mechanisms work synergistically to disrupt bacterial cell walls, interfere with metabolism, and cause cellular damage, making it difficult for microbes to develop resistance. While ZnO-NPs hold significant potential for applications in food packaging, biomedical devices, and environmental remediation, their use is tempered by concerns over potential toxicity to human cells and ecosystems. The future of this technology hinges on addressing critical research gaps, including the need for standardized synthesis and testing protocols, a deeper understanding of long-term biological and environmental impacts, and the development of "safer-by-design" strategies to maximize their benefits while minimizing their risks. This review summarizes the physicochemical properties of ZnO NPs, including size, shape, crystallinity, surface charge, and defect structures, alongside environmental factors like pH, ionic strength, and light exposure.

APPROXIMATION AND MODULI OF CONTINUITY FOR FUNCTION BELONGING TO HÖLDER CLASS H^A [0, M) BY GENERALIZED CHEBYSHEV WAVELETS OF FIRST KIND AND APPLICATIONS IN SOLUTION OF FREDHOLM INTEGRAL EQUATIONS

Narendra Singh Yadav[1], Dr. Shanti Swarup Dubey[2] , Prof. Shyamlal[3]

ABSTRACT

In this paper, generalized first kind Chebyshev wavelet has been introduced. The first kind Chebyshev wavelet is a particular case of generalized Chebyshev wavelet. The generalized Chebyshev wavelet series is verified by example. The convergence analysis, condition of this wavelet has been studied. The orthogonality, the moduli of continuity and approximation of functions belonging to Hölder's class are estimated and several corollaries have been derived from the theorems of this paper.

ENHANCING NUMERICAL COMPUTATION EFFICIENCY USING MACHINE LEARNING ALGORITHMS

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ABSTRACT

Efficient computing methods are required by the increasing complexity of numerical calculations in engineering and scientific applications. Time complexity, convergence problems, and scalability are common difficulties for conventional numerical techniques. By use of predictive modelling, adaptive optimisation, and intelligent approximation, machine learning (ML) algorithms provide a promising way to improve the efficiency of numerical computations. This work investigates the combination of ML methods neural networks, regression models, and reinforcement learning to speed up numerical calculations while preserving accuracy. Presented is a comparative study of conventional and ML-based approaches emphasising gains in computational speed, resource use, and accuracy. The results show that ML-driven numerical computation techniques can greatly improve efficiency, hence being useful for many fields including physics, engineering, and finance.

Keywords: Machine Learning, Numerical Computation, Computational Efficiency, Optimization

GRAPH NEURAL NETWORKS FOR COMPLEX SYSTEMS MODELING

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ABSTRACT

Complex systems such as transportation networks, power grids, and biological systems involve highly interconnected components whose interactions are difficult to model using traditional machine learning techniques. The purpose of this study is to explore how Graph Neural Networks (GNNs) can effectively model and analyze complex systems by leveraging the structural properties of graph theory. In this approach, system entities are represented as nodes and their relationships as edges, enabling the learning of both local and global dependencies within the network. The study investigates the capability of GNN-based models to capture hidden patterns, improve predictive performance, and support decision-making in large-scale interconnected environments. The proposed framework integrates graph construction, feature representation, and message-passing mechanisms to extract meaningful insights from structured data. Results from recent applications indicate that graph-based deep learning methods provide higher accuracy, better scalability, and improved interpretability compared to conventional models. This research highlights the growing importance of graph-theoretic techniques in artificial intelligence and machine learning for modeling real-world complex systems and advancing intelligent data-driven solutions.

Keywords: Graph Neural Networks, Graph Theory, Complex Systems Modeling, Artificial Intelligence, and Machine Learning.

EVEN MINIMIZATION OF MULTIPLICATIVE LABELLING- OPEN PROBLEMS AND RESEARCH DIRECTIONS

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ABSTRACT

Graph labelling has long been a fertile ground for mathematical curiosity and practical innovation. Among its many variants, multiplicative labelling with even minimization emerges as a subtle yet powerful construct: assigning integers to vertices so that edge labels, derived multiplicatively, remain distinct, even, and minimized. This delicate balance between algebraic structure and combinatorial optimization opens new pathways for both theory and application.

In this work, we explore the frontiers of open problems from characterizing graph families that admit such labelling's to establishing algorithmic bounds for efficient computation. Beyond pure mathematics, the framework resonates with real-world systems: encoding dependencies in scheduling, optimizing bandwidth in networks, designing secure cryptographic schemes, and compressing data through minimal distinct codes. By bridging abstract labelling rules with applied optimization, we argue that even minimization of multiplicative labelling is not merely a theoretical curiosity but a strategic tool for resource-efficient problem solving**.**

Keywords: Graph labelling, Multiplicative labelling, Even minimization, combinatorial optimization, Network optimization.

ENHANCED EFFICIENCY OF HIGH-PERFORMANCE TANDEM PHOTOVOLTAIC CELLS WITH PEROVSKITE ACTIVE LAYER AND ETL LAYER

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ABSTRACT

Perovskite-based tandem photovoltaic cells represent a paradigm shift in solar energy conversion technology, offering unprecedented efficiency gains that surpass the Shockley-Queasier theoretical limit of single-junction solar cells. This comprehensive review examines the recent advancements in organic-inorganic hybrid and all-inorganic perovskite tandem solar cells, with a particular emphasis on perovskite active layer optimization and interface engineering strategies. Current state-of-the-art perovskite/silicon tandem devices have achieved certified power conversion efficiencies (PCE) exceeding 34.85%, marking a significant milestone in photovoltaic research. This paper systematically analyses the fundamental mechanisms underlying enhanced efficiency in tandem configurations, explores critical optimization techniques for perovskite active layers, evaluates charge transport layer engineering approaches, and examines interface modification strategies that minimize recombination losses. Furthermore, we discuss the comparative advantages of organic-inorganic hybrid versus all-inorganic perovskite materials, addressing stability challenges and pathways toward commercial viability. The integration of advanced interface passivation techniques, conformal charge transport layers, and optimized perovskite composition has demonstrated substantial improvements in both efficiency and long-term stability, positioning tandem photovoltaic as the next generation of ultra-efficient solar technology.

Keywords: Perovskite solar cells, tandem Photovoltaic, organic-inorganic Perovskite, interface engineering, charge transport layers, PCE,

FIXED POINT THEOREM IN M-FUZZY METRIC SPACES WITH S_F-CONTRACTION

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ABSTRACT

This study proposes a novel extension of the SF-contraction and establishes a new fixed point theorem in the setting of fuzzy metric spaces. The approach builds upon the basic concepts developed by Surjeet Singh et al. and extends them further. The proposed extension widens the applicability of contraction principles and provides a more effective framework for dealing with uncertainty and vagueness in practical systems.

Keywords: Fixed point, Fuzzy metric spaces, S_F-Contraction.

Mathematics Subject Classification: 54H25, 47H10.

NOVEL INDOLE-DERIVED NITROGEN HETEROCYCLES: SYNTHETIC APPROACH AND ANTIOXIDANT INVESTIGATION

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ABSTRACT

The development of novel nitrogen-containing heterocycles remains a central focus in medicinal chemistry due to their diverse biological activities. Among various heterocyclic frameworks, the indole nucleus is recognized as a privileged structural motif because of its structural versatility, chemical stability, and broad pharmacological significance. In this work, a novel indole-derived nitrogen heterocycles were designed and synthesized using an efficient synthetic approach. The synthesized compounds were structurally characterized and subsequently evaluated for their antioxidant potential using standard in vitro free radical scavenging assays. The results demonstrated significant antioxidant activity, indicating the ability of these indole-based derivatives to neutralize reactive oxygen species (ROS). Since oxidative stress plays a crucial role in the onset and progression of numerous pathological disorders, the observed antioxidant properties suggest potential therapeutic relevance of the synthesized molecules. Overall, this study highlights the successful synthesis of novel indole-derived nitrogen heterocycles and supports their potential as promising antioxidant agents for future medicinal applications.

Keywords: Novel indole derivatives; nitrogen-containing heterocycles; synthetic approach; antioxidant investigation; reactive oxygen species (ROS).

LIFE CYCLE ANALYSIS OF SOLAR VS. WIND ENERGY SYSTEMS

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ABSTRACT

Life Cycle Analysis (LCA) is an important method used to evaluate the environmental impacts of energy systems throughout their entire life cycle. This includes stages such as raw material extraction, manufacturing, transportation, installation, operation, maintenance, and disposal or recycling. Solar and wind energy are two major renewable energy sources widely used to reduce dependence on fossil fuels. The life cycle analysis of solar photovoltaic systems shows that most environmental impacts occur during the manufacturing stage due to the use of materials like silicon, metals, and energy-intensive processes. However, during operation, solar systems produce electricity with almost zero greenhouse gas emissions.

Keywords: Life Cycle Analysis (LCA), Solar Energy, Wind Energy, Renewable Energy, Environmental Impact, Carbon Footprint, Energy Payback Period, Sustainability.

CHARACTERIZING SUPER CONTINUITY AND SUPER COMPACTNESS WITH WEAK Ω-OPEN SETS

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ABSTRACT

In this paper, we investigate the notions of super continuity and super compactness in topological spaces, extending classical concepts through the framework of weak forms of Ω-open sets. By introducing appropriate weak Ω-open structures, we characterize super continuous functions and super compact subsets, establishing their interrelations with standard topological properties. Several new results illustrate how these generalized forms preserve or extend fundamental properties such as continuity, compactness, and closure under weak Ω-open operations. Examples are provided to demonstrate the distinctions between classical and super notions, highlighting the utility of weak Ω-open sets in refining our understanding of continuity and compactness in generalized topological spaces. This study contributes to the broader exploration of weak topological structures and their implications in advanced topological analysis.

Keywords: Super continuity, Super compactness, Weak Ω-open sets, generalized topology, Topological characterization, Weak forms of openness, Continuity in generalized spaces, Compactness in weak topologies.

LIFELINES IN PERIL: THE ECOLOGICAL AND SOCIO-ECONOMIC SIGNIFICANCE OF INDIAN RIVER SYSTEMS AND THE GROWING CRISIS OF CONTAMINATION

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ABSTRACT

Rivers are the biological and cultural arteries of India, supporting the world's largest irrigation network and providing a spiritual foundation for millions. This paper explores the multifaceted importance of Indian rivers, ranging from their role in food security and hydroelectric power to their function as primary habitats for diverse flora and fauna. However, these vital ecosystems are facing unprecedented degradation. We examine the critical factors affecting river pollution, specifically the discharge of untreated urban sewage, industrial heavy metal runoff, and the leaching of chemical fertilizers from intensive agriculture.

The study further highlights the biodiversity dependent on these lotic systems, focusing on flagship species such as the Ganges River Dolphin (Platanista gangetica), the Gharial, and various migratory waterfowl whose survival is intrinsically linked to water quality. By synthesizing the current state of river health with the escalating threats of toxicity and habitat fragmentation, this abstract underscores the urgent need for integrated river basin management to preserve India's hydraulic heritage and the many lives human and animal that rely upon it.

Keywords: Indian rivers, river pollution, biodiversity, Ganges River Dolphin, water quality, ecosystem degradation, river basin management, aquatic habitats, sustainable water resources.

STUDY OF COMMON FIXED POINT THEOREMS FOR (Ψ–Φ) WEAK QUASI-CONTRACTION MAPPINGS

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ABSTRACT

Fixed point theory is a fundamental tool in nonlinear analysis with applications in differential equations, optimization, and dynamic systems. In this study, we investigate **common fixed points** of a class of mappings known as **(ψ–φ) weak quasi-contractions** in metric spaces. These mappings generalize classical contraction mappings by incorporating altering distance functions (ψ, φ) that provide greater flexibility in analyzing nonlinear structures.

We establish several existence and uniqueness results for common fixed points under appropriate conditions, extending and improving many well-known results in the literature. The theoretical results are illustrated with examples to demonstrate their applicability. This study contributes to the advancement of fixed point theory by providing a unified framework for weak quasi-contractive mappings and offers potential applications in solving complex nonlinear equations and models in applied mathematics.

Keywords: Common Fixed Point, (ψ–φ) Weak Quasi-Contraction, Metric Space, Nonlinear Analysis, Fixed Point Theorem.

FIXED POINT THEOREMS IN FUZZY METRIC SPACES AND THEIR APPLICATIONS

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ABSTRACT

Fixed point theory in fuzzy metric spaces has emerged as an important area of research due to its potential applications in modeling uncertainty and imprecision in real-world problems. A fuzzy metric space generalizes classical metric spaces by incorporating a degree of closeness between points, providing a natural framework for dealing with uncertain data in mathematics, engineering, and computer science.

This study focuses on establishing new fixed point results for contractive and generalized contractive mappings in complete fuzzy metric spaces. The existence and uniqueness of fixed points are proved under suitable conditions, extending several classical results in fixed point theory. Illustrative examples are provided to demonstrate the applicability of the obtained results in solving nonlinear equations, optimization problems, and dynamic systems under uncertainty. The research contributes to the theoretical development of fixed point theory in fuzzy metric spaces and opens avenues for practical applications in modeling, decision-making, and computational mathematics.

Keywords: Fuzzy Metric Space, Fixed Point Theorem, Contractive Mapping, Nonlinear Analysis, Uncertainty Modeling.

ENHANCING NUMERICAL COMPUTATION EFFICIENCY USING MACHINE LEARNING ALGORITHMS

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ABSTRACT

Efficient computing methods are required by the increasing complexity of numerical calculations in engineering and scientific applications. Time complexity, convergence problems, and scalability are common difficulties for conventional numerical techniques. By use of predictive modelling, adaptive optimisation, and intelligent approximation, machine learning (ML) algorithms provide a promising way to improve the efficiency of numerical computations. This work investigates the combination of ML methods—neural networks, regression models, and reinforcement learning to speed up numerical calculations while preserving accuracy. Presented is a comparative study of conventional and ML-based approaches emphasising gains in computational speed, resource use, and accuracy. The results show that ML-driven numerical computation techniques can greatly improve efficiency, hence being useful for many fields including physics, engineering, and finance.

Keywords: Machine Learning, Numerical Computation, Computational Efficiency, Optimization

RECENT ADVANCES IN FIXED POINT THEORY AND ITS APPLICATIONS

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ABSTRACT

Fixed Point Theory is an important branch of nonlinear analysis with wide applications in mathematics, engineering, economics, and computer science. A fixed point of a mapping is a point that remains invariant under the given transformation, and the study of such points plays a significant role in solving nonlinear equations and optimization problems. Over the years, various fixed point theorems have been developed in different mathematical settings such as metric spaces, Banach spaces, and partially ordered sets.

This paper discusses recent developments in fixed point theory and focuses on the existence and uniqueness of fixed points for certain classes of nonlinear mappings in complete metric spaces. The study extends classical results by establishing new fixed point conditions under generalized contractive mappings. The proposed results improve and generalize several well-known fixed point theorems available in the literature. Furthermore, the applicability of the obtained results is demonstrated through examples and potential applications in differential equations and optimization problems. The findings contribute to the theoretical advancement of fixed point theory and provide a foundation for further research in nonlinear analysis and applied mathematics.

Keywords: Fixed Point Theory, Metric Space, Contractive Mapping, Nonlinear Analysis, Differential Equations.

FIXED POINT RESULTS IN G-METRIC SPACES FOR GENERALIZED CONTRACTIVE MAPPINGS

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ABSTRACT

Fixed point theory plays a significant role in nonlinear analysis and has wide applications in differential equations, optimization, and mathematical modeling. In recent years, the concept of G-metric spaces has attracted considerable attention as a generalization of classical metric spaces. A G-metric space provides a broader framework for studying the existence and uniqueness of fixed points for various nonlinear mappings.

In this study, we investigate fixed point results for generalized contractive mappings in complete G-metric spaces. By establishing suitable contractive conditions, we prove the existence and uniqueness of fixed points for a class of self-mappings defined on these spaces. The obtained results extend and generalize several well-known fixed point theorems available in the existing literature. Illustrative examples are also provided to demonstrate the applicability of the proposed results. The findings contribute to the development of fixed point theory in generalized metric structures and may be useful for further research in nonlinear analysis and its applications in applied mathematics.

Keywords: Fixed Point Theory, G-Metric Space, Contractive Mapping, Nonlinear Analysis, Fixed Point Theorem.

APPLICATION OF OPERATIONS RESEARCH TECHNIQUES FOR OPTIMAL RESOURCE ALLOCATION IN INDUSTRIAL SYSTEMS

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ABSTRACT

Operations Research (OR) plays a crucial role in improving decision-making and optimizing resource utilization in complex organizational systems. In the current competitive and technology-driven environment, industries require efficient analytical tools to enhance productivity, minimize operational costs, and improve service quality. This study explores the application of Operations Research techniques such as linear programming, transportation models, and queuing theory for effective resource allocation and operational planning. The research focuses on developing mathematical models that assist organizations in making optimal decisions under various constraints. By applying optimization techniques, the study demonstrates how OR methods can help in production planning, supply chain management, scheduling, and inventory control. The results highlight that the implementation of OR models significantly improves operational efficiency and reduces waste in industrial processes.

The findings emphasize the importance of integrating Operations Research methodologies with modern computational tools to support data-driven decision-making. The study contributes to the growing body of research in optimization and provides practical insights for managers and researchers interested in enhancing operational performance through quantitative approaches.

Keywords: Operations Research, Optimization, Linear Programming, Resource Allocation, Decision Making.

OPTIMAL INVENTORY MANAGEMENT STRATEGIES FOR SEQUENTIALLY CONVERTIBLE ITEMS WITH DIFFERENT DISTRIBUTION PATTERNS: A COMPREHENSIVE STOCHASTIC APPROACH

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ABSTRACT

The convertibility of items is a strategic concept that inventory managers wisely utilize for revenue management. In the market, inventory managers convert items from one form to another for two main reasons: (i) the limited life expectancy of the item and (ii) the potential higher demand for the converted item as compared to the original form. The convertibility of items is an optimal strategy for inventory managers to extend the lifespan of deteriorating items and effectively control inventory losses. This research focuses on a multi-item inventory model designed explicitly for convertible items that naturally deteriorate over time. Preservation investments are also incorporated to reduce the deterioration rate. The developed inventory model considers random demand patterns for items, following power distributions while accounting for limited storage capacity. Throughout the inventory cycle, the inventories of multiple items gradually deplete due to market demand and deterioration. As demand declines, a selected subset of items, those with high market demand in their converted form, are converted. An efficient solution procedure is applied to determine the minimum inventory cost, considering three different demand distributions: (i) normally distributed demand for convertible items, (ii) a distribution-free approach for the convertible items, and (iii) demand following a Pareto distribution for the convertible items. The optimal results are discussed and supported by a numerical example to illustrate the model and provide managerial insights. Additionally, convexity figures characterize the proposed model, showcasing the cost function under the three distributions. The paper concludes by offering an outlook for future research in inventory management, highlighting the importance of convertibility strategies for deteriorating items.

Keywords: Sequentially convertible item, Multi-item inventory, Deterioration, Preservation, Stochastic demand.

CONCEPTUAL DESIGN OF A FUTURE SPACECRAFT INSPIRED BY QUANTUM VACUUM ENERGY AND ADVANCED PROPULSION THEORIES

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ABSTRACT

The advancement of space exploration requires propulsion systems that go beyond the limitations of conventional chemical rockets. Current propulsion technologies rely heavily on combustion-based systems, which demand large quantities of fuel and significantly limit the efficiency and range of deep-space missions. This study presents a conceptual spacecraft design named Genesis-X, which explores the potential application of advanced propulsion theories inspired by quantum vacuum energy and hypothetical anti-gravity principles.

The proposed spacecraft is designed with an equilateral triangular configuration containing three propulsion nodes positioned at the vertices. These nodes conceptually represent field-propulsion units capable of generating balanced lift and directional control through distributed force vectors. The triangular symmetry allows improved stability, equilibrium of forces, and potential hovering capability while maintaining a centralized center of mass. The energy architecture of the spacecraft hypothetically draws inspiration from quantum vacuum energy concepts, where fluctuations in empty space could theoretically serve as a future energy source. Although technologies such as anti-gravity propulsion and vacuum energy extraction remain largely theoretical and unproven in practical engineering applications, the Genesis-X model aims to explore a conceptual framework for future propulsion systems and spacecraft stability design. This research contributes to the discussion of advanced propulsion possibilities and highlights the importance of innovative conceptual models in guiding future investigations in space engineering and propulsion physics.

ASSOCIATION CONSTANT OF QUINOLINE IN BINARY SOLVENT AND MICELLAR MEDIUM

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ABSTRACT

Acid-base properties and protonation-deprotonation equilibria are the most easily studied, and the most readily understood, chemical phenomena. Proton transfer has attracted a lot of attention for years. The quantification of proton dissociation and association for the molecules has been used in various chemical, analytical, biochemical and pharmaceutical processes. Quinoline ring has been found to possess antimalarial, anti-bacterial, antifungal, anthelmintic, cardiotonic, anticonvulsant, anti-inflammatory and analgesic activity. The association constant (pK_a) of quinoline have been investigated in various mixtures of Methanol + Water (0%, 20%, 40%, 60% & 80%) medium and in the presence of surfactants (SDS, CTAB, TX- 100) with varying *p*H. The *p*K values of quinoline have been calculated from the plot and using Henderson's equation in acidic *p*H. The results are explained through the base and conjugated acid phenomena.

REVIEW ON STRUCTURAL AND OPTICAL PROPERTIES OF Y_2O_3 PHOSPHORS USING DFT

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ABSTRACT

Yttrium oxide (Y_2O_3) is an important host material for phosphors due to its excellent thermal stability, chemical durability, and wide band gap. In this study, the structural, electronic, and optical properties of Y_2O_3 phosphors are investigated using Density Functional Theory (DFT). The optimized crystal structure confirms the stability of the cubic phase of Y_2O_3. The calculated band structure shows that Y_2O_3 behaves as a wide band gap semiconductor, suitable for luminescent applications. The density of states analysis indicates that the valence band is mainly dominated by oxygen 2p states, while the conduction band is primarily contributed by yttrium 4d states. These results provide useful insights into the electronic structure and optical behavior of Y_2O_3, supporting its application as an efficient host material for phosphors used in lighting, display devices, and optoelectronic applications.

Keywords: Yttrium oxide, DFT, phosphors, band structure, luminescence.

REVIEW ON THEORETICAL STUDY ON YTTRIUM OXIDE BASED PHOSPHORS

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ABSTRACT

Yttrium oxide (Y_2O_3) is an important host material widely used for phosphors due to its excellent chemical stability, high melting point, and wide band gap. Theoretical studies on Y_2O_3-based phosphors have gained significant attention for understanding their electronic structure, optical properties, and luminescence mechanisms. Computational approaches such as Density Functional Theory (DFT) are commonly employed to investigate the band structure, defect states, and energy transfer mechanisms in doped yttrium oxide phosphors. These studies help explain the role of activator ions such as Eu^{3+}, Dy^{3+}, Ho^{3+}, and Bi^{3+} in producing efficient photoluminescence and thermos-luminescence emissions. Theoretical modeling also provides insights into the effects of crystal structure, defects, and dopant concentration on luminescence efficiency. Y_2O_3 exhibits a stable electronic structure and strong luminescent properties when doped with rare-earth ions, making it a promising material for applications in solid-state lighting, display devices, lasers, and radiation dosimetry.

PHYTOGENIC SYNTHESIS OF ZNO NANOPARTICLE FROM *ABUTILON INDICUM* AND THEIR ROLE IN ENVIRONMENTAL CLEANUP

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Abstract

The present study focuses on the **phytogenic synthesis of zinc oxide (ZnO) nanoparticles** using the aqueous leaf extract of *Abutilon indicum* as a green and eco-friendly reducing and stabilizing agent. The biosynthetic approach eliminates the need for hazardous chemicals, offering a sustainable and cost-effective alternative to conventional physical and chemical synthesis methods. The formation of ZnO nanoparticles was confirmed through UV–Visible spectroscopy, FTIR, XRD, and SEM analyses, revealing their nanoscale morphology and crystalline structure. The phytochemicals present in *Abutilon indicum,* such as flavonoids, phenolics, and alkaloids played a crucial role in the reduction of zinc ions and stabilization of nanoparticles. Furthermore, the synthesized ZnO nanoparticles exhibited significant potential in **environmental cleanup**, including **water purification, dye degradation, and antimicrobial activity against waterborne pathogens**. This work demonstrates the dual benefit of utilizing plant-based resources for nanomaterial synthesis and applying the resulting nanoparticles for environmental remediation, highlighting a sustainable route toward green nanotechnology.

Keywords: Phytogenic synthesis, *Abutilon indium*, Zinc oxide Nano particles, Green nanotechnology, Environmental cleanup, Water purification, Dye degradation, Antimicrobial activity

RECENT ADVANCES IN SYNTHESIS STRATEGIES, STRUCTURAL CHARACTERIZATION, AND TUNABLE UP- AND DOWN-CONVERSION LUMINESCENCE MECHANISMS OF RARE-EARTH (RE^{3+})-DOPED $M_2Y_2O_4$ (M = Ba, Sr) PHOSPHOR MATERIALS FOR FUNDAMENTAL PHOTONIC AND OPTICAL APPLICATIONS

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ABSTRACT

The rarity of the earth (Re^{3+})-containing $M_2Y_2O_4$ (M = Ba, Sr) phosphor materials are also good multifunctional hosts to next-generation photonic and optical applications due to their strong structural stability, low phonon energy, and good crystal field environment. The lattices of $Ba_2Y_2O_4$ and $Sr_2Y_2O_4$ have appropriate sites where the trivalent rare-earth ions can substitute and hence, giving it appropriate competence to modulate the electronic transitions in the 4f energy levels. Re^{3+} doping is very crucial in the customization of the emission properties, the ability to achieve sharp line emission, high color purity, longer luminescence lifetimes and increased quantum efficiency. Recent developments in synthesis methods, such as solid-state reaction, sol-gel processing, hydrothermal methods, combustion methods and microwave- assisted methods, have allowed a tight control of crystallinity, particle morphology, location of dopants, and defect engineering. These enhancements have a great impact on luminescence performances and thermal stability. Mechanistically, the principle of down-conversion processes is based on intra-4f radiative transitions and host-to-activator energy transfer, whereas the principle of up-conversion luminescence is established by excited-state absorption processes and energy transfer up conversion processes which are usually enhanced by sensitizer ion strategies and co-doping approaches. The optimization of a dopant concentration and the lattice change in the near-infrared region in the visible allowed obtaining tunable emission. Due to such controllable optical characteristics, the $M_2Y_2O_4$ waveguide phosphor doped with Re3+ holds good potentials in the field of solid-state lighting, display devices, optical temperature Sensing, bio imaging, security coding, and laser applications. Further development of structure-property relationships and nanoscale engineering should allow extending their usefulness in the next- generation photonic platforms.

Keywords: Rare-earth doping; $M_2Y_2O_4$ phosphors; $Ba_2Y_2O_4$; $Sr_2Y_2O_4$; up-conversion luminescence; down-conversion emission; energy transfer mechanisms; photonic materials; optical applications.

SMART CRASH SHIELD: IOT-BASED ACCIDENT DETECTION & HIT-AND-RUN EVIDENCE SYSTEM

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ABSTRACT

Road accidents remain one of the leading causes of fatalities worldwide, with a significant number of victims unable to seek timely help due to remote locations, lack of witnesses, or hit- and-run incidents. This paper presents Smart Crash Shield, an IoT-based in-vehicle system designed to address two critical challenges: automatic emergency response for accident victims and digital evidence collection for hit-and-run cases.

The proposed system integrates an ESP32 microcontroller with an MPU-6050 gyroscope/accelerometer, NEO-6M GPS module, and SIM800L 2G GSM module. Upon detecting a sudden jerk indicative of a collision, the system employs a dual-mode response mechanism. In the first mode, if the vehicle comes to a halt post-impact, an audible alarm is triggered, and in the absence of manual intervention, an automated SOS call is placed via GSM while the GPS coordinates, timestamp, and vehicle owner details are transmitted to cloud storage and emergency services. In the second mode, if the vehicle continues moving after the impact — characteristic of a hit-and-run scenario — the system silently logs the jerk intensity, location, speed, and timestamp to the cloud database, creating a verifiable digital trail that law enforcement can query to identify and prosecute the offending vehicle. Data is stored on cloud platforms such as Firebase or AWS IoT, ensuring accessibility, reliability, and tamper-resistant evidence preservation. The system operates autonomously, requiring no manual activation from the driver, making it effective even when the occupant is unconscious or incapacitated. Smart Crash Shield offers a low-cost, scalable solution to significantly reduce accident fatality rates and improve judicial outcomes in hit-and-run cases.

A NEW FAMILY OF GENERALIZED BOUBAKER WAVELETS: THEIR APPROXIMATION CAPABILITY AND CONVERGENCE ANALYSIS

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ABSTRACT

This paper introduces a class of **generalized Boubaker wavelets** constructed by combining Boubaker polynomials with smooth, compactly supported window functions. The proposed wavelets improve smoothness, admissibility, and frequency localization compared to classical polynomial-based wavelets. A continuous and discrete family is generated via scaling and translation, and theoretical properties including **admissibility, orthogonality, stability, and energy normalization** are established. Approximation and convergence theorems demonstrate that any square-integrable function can be represented accurately, with error decreasing according to function smoothness. A practical **algorithm for wavelet construction** is presented to facilitate numerical implementation. Numerical examples, including the 1D heat equation and function approximation, illustrate the efficiency, stability, and multi-resolution capability of the generalized Boubaker wavelets, highlighting their potential for **signal processing and numerical solutions of differential equations.**

Interdisciplinary Approaches to Mathematics for Solving Real-World Problems

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ABSTRACT

Mathematics is often seen as a subject for theory only, but it is very useful in solving real-world problems. This paper looks at how working together with other fields like physics, biology, computer science, economics, and engineering helps us understand problems better and find new solutions. Using examples, we show how math helps with climate change, the spread of diseases, financial risks, and engineering challenges. The study shows that working across subjects improves problem-solving, encourages scientific discovery, and should be an important part of future research and education.

Keyword: Bastar art, Ethnomathematical, Cultural symbolism, Radial symmetries.

SYSTEMATIC APPROACHES TO WASTE MANAGEMENT USING INNOVATIVE TECHNOLOGIES

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ABSTRACT

Effective waste management has become a critical global concern due to rapid urbanization and industrial growth. This study explores systematic approaches to waste management supported by innovative technologies that improve efficiency, sustainability, and environmental protection. Modern solutions such as smart waste monitoring systems, recycling technologies, waste-to-energy conversion, and artificial intelligence–based sorting methods are examined to understand their role in reducing landfill dependency and promoting circular economy practices. The study highlights how technological integration can enhance waste segregation, optimize collection processes, and minimize environmental impact. By analyzing current practices and technological advancements, the paper emphasizes the importance of adopting structured waste management systems supported by innovation. These approaches not only improve resource recovery but also contribute to sustainable development and environmental conservation.

Keywords: Waste Management, Innovative Technology, Smart Waste Systems, Recycling Technology, Waste-to-Energy, Sustainable Environment

INNOVATIVE TECHNOLOGIES FOR ACHIEVING SUSTAINABLE DEVELOPMENT

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ABSTRACT

Sustainable development has emerged as a key objective for balancing economic growth, environmental protection, and social well-being. This paper examines the role of innovative technologies in supporting sustainable development across various sectors such as energy, agriculture, industry, and urban planning. Technologies including renewable energy systems, smart infrastructure, digital monitoring tools, and green production methods are analyzed to understand their impact on reducing environmental degradation and improving resource efficiency. The study also highlights how innovation encourages responsible consumption, promotes cleaner production processes, and enhances long-term ecological balance. By integrating technological advancements with sustainability goals, societies can address major global challenges such as climate change and resource depletion. The findings suggest that innovation-driven strategies are essential for achieving inclusive and sustainable development in the modern technological era.

Keywords: Sustainable Development, Green Technology, Innovation, Renewable Energy, Environmental Sustainability, Smart Infrastructure

EDUCATIONAL TECHNOLOGY IN THE DIGITAL ERA: OPPORTUNITIES AND CHALLENGES

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ABSTRACT

The rapid advancement of digital technologies has significantly transformed the landscape of education. This study explores the role of educational technology in enhancing teaching and learning processes in the digital era. Digital tools such as online learning platforms, virtual classrooms, artificial intelligence, and interactive multimedia resources have made education more accessible, flexible, and learner-centered. The paper examines how these technologies improve knowledge delivery, encourage collaborative learning, and support personalized education. At the same time, it discusses key challenges including digital divide, technological adaptation, and data privacy concerns. By analyzing current trends and practices, the study highlights the importance of integrating technology thoughtfully into educational systems to improve learning outcomes. Educational technology, when implemented effectively, has the potential to reshape the future of education and expand learning opportunities worldwide.

Keywords: Educational Technology, Digital Learning, Online Education, Virtual Classroom, Artificial Intelligence in Education, Digital Transformation

INNOVATION IN HIGHER EDUCATION: TRENDS AND FUTURE PERSPECTIVES

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ABSTRACT

Innovation has become a driving force in transforming higher education institutions to meet the demands of a rapidly evolving global society. This paper provides an overview of innovative practices in higher education, focusing on new teaching methodologies, technology-enhanced learning environments, interdisciplinary research, and industry collaboration. Universities are increasingly adopting digital platforms, blended learning models, and skill-based curricula to improve academic quality and student engagement. The study also highlights the role of innovation in promoting research development, entrepreneurship, and global academic partnerships. Furthermore, it emphasizes the importance of institutional support and policy frameworks in fostering an innovative educational ecosystem. By embracing creative approaches and technological advancements, higher education institutions can better prepare students for future challenges and contribute to social and economic development.

Keywords: Higher Education, Educational Innovation, Blended Learning, Digital Education, Academic Research, Skill Development

माध्यमिक विद्यालय के विद्यार्थियों के लिए प्रभावी शिक्षण–अधिगम रणनीतियों के निर्माण में वैज्ञानिक नवाचार की भूमिका

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सारांश
(ABSTRACT)

वर्तमान शिक्षा व्यवस्था में वैज्ञानिक नवाचार ने शिक्षण–अधिगम प्रक्रियाओं को अधिक प्रभावी, रोचक और छात्र-केंद्रित बनाने में महत्वपूर्ण भूमिका निभाई है। माध्यमिक विद्यालय स्तर पर विद्यार्थियों की जिज्ञासा, तर्कशीलता और रचनात्मक सोच के विकास के लिए नवीन वैज्ञानिक दृष्टिकोण और तकनीकों का समुचित उपयोग आवश्यक है। इस अध्ययन में यह विश्लेषण किया गया है कि किस प्रकार वैज्ञानिक नवाचार, जैसे कि डिजिटल उपकरण, प्रयोगात्मक अधिगम, प्रोजेक्ट आधारित शिक्षण तथा इंटरैक्टिव तकनीकों के माध्यम से शिक्षण रणनीतियों को अधिक प्रभावशाली बनाया जा सकता है। ये नवाचार विद्यार्थियों की सक्रिय भागीदारी को बढ़ावा देते हैं तथा जटिल विषयों को सरल और समझने योग्य बनाते हैं। अध्ययन यह भी दर्शाता है कि नवाचारी शिक्षण पद्धतियाँ विद्यार्थियों की समस्या-समाधान क्षमता, आलोचनात्मक सोच तथा व्यावहारिक ज्ञान को विकसित करने में सहायक सिद्ध होती हैं। अतः माध्यमिक शिक्षा में वैज्ञानिक नवाचार का समुचित समावेश गुणवत्तापूर्ण शिक्षा की दिशा में एक महत्वपूर्ण कदम है।

Keywords: वैज्ञानिक नवाचार, शिक्षण-अधिगम रणनीतियाँ, माध्यमिक शिक्षा, डिजिटल शिक्षण, छात्र-केंद्रित अधिगम, रचनात्मक सोच

WASTE MANAGEMENT AND RECYCLING PRACTICES IN DEVELOPING COUNTRIES

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ABSTRACT

Waste management has become a major environmental challenge in many developing countries due to rapid population growth, urbanization, and changing consumption patterns. Large amounts of municipal solid waste are generated daily, while limited infrastructure and financial resources often make proper waste handling difficult. Inefficient collection systems, open dumping, and uncontrolled landfills contribute to soil contamination, water pollution, and public health risks. Therefore, improving waste management and promoting recycling practices are essential steps toward sustainable development. This research examines the current waste management systems in developing countries and evaluates the role of recycling in reducing environmental impacts. The study explores common practices such as waste segregation, composting of organic waste, and recycling of materials like plastic, paper, glass, and metals. It also highlights the important contribution of informal waste collectors who play a significant role in recovering recyclable materials in many urban areas. In addition, the research discusses the challenges faced by developing countries, including lack of public awareness, insufficient policy implementation, and limited technological support. The study suggests that effective waste management requires integrated strategies such as community participation, government regulations, investment in recycling infrastructure, and educational campaigns to encourage responsible waste disposal.

The findings indicate that adopting efficient recycling systems and sustainable waste management policies can significantly reduce environmental pollution, conserve natural resources, and create economic opportunities through green jobs. Strengthening waste management frameworks will not only improve environmental quality but also support healthier and more sustainable communities in developing countries.

INTERDISCIPLINARY RESEARCH FOR INNOVATION AND SUSTAINABILITY: A LITERARY REFLECTION THROUGH MARGARET ATWOOD'S THE MOMENT

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ABSTRACT

Interdisciplinary research has emerged as a crucial approach for addressing complex global challenges related to innovation and sustainability. By integrating insights from the humanities, sciences, technology, and social sciences, interdisciplinary frameworks enable a holistic understanding of human interaction with nature and society. This study explores the significance of interdisciplinary thinking through a literary lens, drawing conceptual inspiration from Margaret Atwood's poem *The Moment*. The poem reflects the illusion of human ownership over nature and highlights the fragile relationship between humanity and the environment. Using literary analysis alongside environmental and cultural perspectives, the paper examines how Atwood's poetic narrative symbolically questions human dominance over land, resources, and identity. The sudden reversal in the poem—where nature withdraws its belonging—illustrates the need for sustainable thinking that transcends disciplinary boundaries. Literature, therefore, becomes a powerful medium for fostering ecological awareness and ethical responsibility.

The study argues that innovation for sustainability cannot rely solely on technological solutions but must also incorporate cultural, ethical, and philosophical insights. Interdisciplinary research encourages dialogue between scientific progress and human values, enabling more balanced and sustainable development. By connecting literary interpretation with sustainability discourse, this paper demonstrates how humanities-based perspectives can meaningfully contribute to contemporary environmental and innovation studies.

Keywords: Interdisciplinary Research, Sustainability, Environmental Ethics, Literary Ecology, Innovation Studies

ECOCRITICISM AND RENEWABLE FUTURES: LITERARY NARRATIVES OF SUSTAINABILITY

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ABSTRACT

The growing environmental crisis and the urgent need for sustainable development have encouraged scholars to explore new interdisciplinary approaches that connect the humanities with environmental studies. This paper examines how literary narratives contribute to ecological awareness and the imagination of renewable and sustainable futures through the theoretical framework of ecocriticism. Ecocriticism investigates the relationship between literature and the natural environment and challenges anthropocentric perspectives that position humans at the centre of ecological systems. By analyzing selected texts such as *The Overstory* by Richard Powers and *The Great Derangement: Climate Change and the Unthinkable* by Amitav Ghosh, this study explores how contemporary literature critiques environmental exploitation and foregrounds the interconnectedness between human life and the natural world. The paper argues that literary narratives play a significant role in shaping environmental consciousness by questioning industrial growth models, excessive resource consumption, and fossil-fuel dependency. Through the depiction of ecological degradation, climate anxiety, and environmental activism, these works encourage readers to reconsider humanity's relationship with nature and to imagine alternative models of development rooted in sustainability. Furthermore, the study highlights how literature can function as a cultural medium that supports global conversations about renewable energy transitions and ecological responsibility. Ultimately, the paper emphasizes that interdisciplinary engagement between literature and sustainability studies can contribute to a deeper ethical understanding of environmental stewardship and inspire collective efforts toward building resilient and renewable futures.

Keywords: Sustainability. Ecocriticism, Renewable Futures, Environmental Humanities, Climate Change, Anthropocene

SUSTAINABILITY IN ENGLISH LANGUAGE TEACHING: A STUDY TO ESTABLISH PARAMETERS TO ATTAIN SUSTAINABLE DEVELOPMENT GOALS

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ABSTRACT

Sustainability in English Language Teaching (ELT) is essential with an environment awareness and UN Sustainable Development Goals (SDGs). This article caters to the study the participation of sustainability into English Language Teaching (ELT). Through English Language Learning the challenges laid by critical role of education in addressing global environmental challenges can be studied. An extensive literature review encompassing empirical studies, theoretical articles, and case studies from 2015 to 2025, this article presents the methodologies for incorporating sustainability in ELT, identify the challenges faced by educators, and propose practical solutions. Key findings demonstrate various effective approaches, such as interdisciplinary curriculum designs, innovative classroom activities, specialized teacher training, and novel assessment methods, which enhance language proficiency and significantly raise students' language-learning awareness. Despite challenges such as limited resources and alignment issues between sustainability topics and language-learning objectives, strategies like developing open educational resources and professional development programs have shown promise in overcoming these obstacles. The review underscores the importance of embedding sustainability in ELT to foster informed, responsible global citizens and highlights future research directions to further this aim. It calls for continued innovation, research, and policy support to fully realize the potential of ELT in contributing to a more sustainable future.

Keywords: English Language Teaching, Sustainable Development Goals, Environmental Challenges, Sustainable Education, Sustainability in English Language Teaching.

DEVELOPING SUSTAINABLE HUMAN RESOURCE MANAGEMENT AT BANKS

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ABSTRACT

An every organization's future growth and success is depends on the sustainability of human resource management (HRM). This research looks into how banks can achieve sustainable HRM. We examine the variables influencing HRM sustainability at banks using a quantitative research method design. As the study's statistical population included 245 employees, a sample size of 62 employees was calculated using the Cochran formula. The information was gathered using a questionnaire with 32 assertions using a 5-point Likert scale, and it was then examined using PLS3 software. The findings show that human resource practices, social factors, psychological factors, employer branding, and economic factors have positive and significant effects on HRM sustainability at banks. Findings indicate that it is essential to consider the implementation of adequate HRM practices and related socio-economic and psychological supports for HRM sustainability in banks that can lead to the competitiveness of the financial sector such as banks.

Keywords: Sustainability management, Human resource management sustainability, Competitive advantage, Socio-economic, Psychological supports

EXPLORING THE MEDIATING ROLE OF WORK-LIFE AND FAMILY-LIFE BALANCE IN THE LINK BETWEEN ORGANIZATIONAL CULTURE AND EMPLOYEE SATISFACTION: A STUDY ON NURSES

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ABSTRACT

Purpose/Objective: This research examines the mediating role of work-life and family-life balance on organizational culture and employee satisfaction among the female and male nursing professionals.

Research Design: The research was conducted with female and male nurses working in public and private hospitals with over 200 beds in Raipur. Data were collected from 124 valid responses using convenience sampling through email and WhatsApp. The analysis was performed using IBM SPSS 26.0 and Hayes' PROCESS v4.1 with Model-4.

Findings: The findings reveal that family-work balance partially mediates the relationship between organizational culture and employee satisfaction. Additionally, organizational culture has a significant positive impact on work-life balance, family-work balance, and employee satisfaction.

Implications: The study highlights the importance of fostering a supportive organizational culture and promoting family-life balance in healthcare settings to enhance job satisfaction and improve employee retention. It also recommends that policymakers should consider family-friendly initiatives, such as flexible work arrangements, parental leave, and childcare support.

Limitations: The study is limited to nurses in Raipur hospitals, restricting its generalizability in other sectors and region. Future research should include diverse sectors and regions to enhance external validity.

Keywords: Organization Culture, Work-life balance, Family-work balance, Employee Satisfaction, nurses.

DIGITAL MARKETING STRATEGIES AND CONSUMER ENGAGEMENT: EXAMINING THE INFLUENCE OF SOCIAL MEDIA ON CONTEMPORARY CONSUMER BEHAVIOR

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ABSTRACT

The rapid advancement of digital technologies has significantly transformed the traditional marketing landscape and the way organizations interact with consumers. With the widespread adoption of the internet, smartphones, and social media platforms, businesses are increasingly shifting from conventional marketing practices to digital and interactive marketing strategies. Social media, in particular, has emerged as a powerful tool for communication, brand promotion, and consumer engagement, allowing organizations to reach wider audiences and build stronger relationships with customers.

This paper aims to examine the role of digital marketing strategies in influencing consumer behaviour and enhancing brand engagement in the digital era. The study focuses on various digital marketing practices such as social media advertising, influencer marketing, personalized content, and user-generated content that contribute to shaping consumer perceptions and purchase decisions. These strategies enable brands to create meaningful interactions and foster trust and loyalty among consumers.

The research adopts a conceptual and analytical approach by reviewing existing literature related to digital marketing and consumer engagement. It highlights how digital platforms facilitate two-way communication between brands and consumers, thereby increasing participation and involvement in the brand experience. The study concludes that effective digital marketing strategies play a crucial role in enhancing brand visibility, strengthening consumer relationships, and influencing purchase intentions in an increasingly competitive marketplace.

Keywords: Digital Marketing, Consumer Behaviour, Social Media Marketing, Brand Engagement, Influencer Marketing, Online Consumer Interaction.

OPTICAL SPECTROSCOPY AND JUDD–OFELT ANALYSIS OF DY^{3+}-DOPED $BATIO_3$ PHOSPHORS

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ABSTRACT

Dy^{3+}-doped $BaTiO_3$ phosphors were investigated to understand their excitation-dependent luminescence behavior and local structural environment using photoluminescence spectroscopy and Judd–Ofelt (J–O) analysis. The excitation spectrum monitored at the dominant blue emission reveals intense bands in the near-UV region, with a strong peak centered at ~395 nm, indicating suitability for near-UV LED excitation. Under 395 nm excitation, the emission spectra exhibit characteristic Dy^{3+} transitions at ~484 nm ($^4F_{9/2} \rightarrow {}^6H_{15/2}$) and ~550 nm ($^4F_{9/2} \rightarrow {}^6H_{13/2}$), corresponding to blue and yellow emissions, respectively. The emission intensity increases with Dy^{3+} concentration up to an optimum level, followed by a reduction due to concentration quenching. Judd–Ofelt intensity parameters were evaluated from excitation transitions, revealing a dominant Ω_2 parameter, which indicates strong asymmetry and covalent interaction between Dy^{3+} ions and the $BaTiO_3$ host lattice. The yellow-to-blue intensity ratio confirms the presence of Dy^{3+} ions at non-centrosymmetric sites within the perovskite structure. The combined spectroscopic and Judd–Ofelt results demonstrate that Dy^{3+}-activated $BaTiO_3$ is a promising single-activator phosphor for near-UV-excited white and warm-white lighting applications.

Keywords: Photoluminescence, Up-conversion, Phosphors, Judd – Ofelt analysis, Photonic, LED.

INNOVATIVE GOVERNANCE FOR A SUSTAINABLE FUTURE: INTEGRATING INNOVATION AND SUSTAINABILITY IN POLITICS AND PUBLIC ADMINISTRATION

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ABSTRACT

Innovation and sustainability have emerged as crucial themes in contemporary politics and public administration, particularly in the context of global challenges such as climate change, resource depletion, social inequality, and rapid technological transformation. Governments across the world are increasingly required to adopt innovative governance practices to ensure sustainable development and effective public service delivery. This research paper examines the relationship between innovation and sustainability within political systems and administrative structures, emphasizing how innovative policies, digital governance, participatory decision-making, and institutional reforms can promote long-term sustainable outcomes. The study investigates how administrative procedures, public institutions, and political leadership may promote innovation-oriented governance that strikes a balance between social justice, environmental preservation, and economic growth. Additionally, it emphasizes how crucial policy innovation, e-government, collaborative governance, and sustainable public management practices are to enhancing administrative efficiency, accountability, and openness. The study also examines important obstacles that could prevent the integration of innovation and sustainability in governance, including institutional limitations, policy implementation gaps, and bureaucratic opposition. The study emphasizes the necessity for adaptable governance models that promote innovation, citizen participation, and responsible policymaking by looking at theoretical stances and real-world instances. In order to achieve inclusive development, robust institutions, and long-term societal well-being, the article finds that integrating innovation with sustainability in politics and administration is crucial.

Keywords: Innovation in Governance, Sustainable Development, Political Innovation, Public Administration, E-Governance, Green Public Administration, Administrative Efficiency, Good Governance

MODELING MEMORY AND DETERIORATION IN INVENTORY SYSTEMS: A FRACTIONAL CALCULUS APPROACH

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ABSTRACT

Traditional inventory management models typically rely on standard integer calculus. This conventional method assumes instantaneous changes and often ignores the cumulative impact of past system conditions. However, practical supply chains frequently exhibit memory effects alongside the variable deterioration of perishable goods. To address this theoretical gap, this paper presents a novel analytical framework utilizing a fractional calculus approach. By integrating fractional order differential equations into inventory control systems, we can accurately capture both historical stock dynamics and time dependent decay rates. The study provides rigorous mathematical solutions that are further validated through comprehensive numerical simulations. Our findings clearly demonstrate that incorporating fractional dynamics yields significantly more realistic cost optimization and replenishment policies compared to classical models. Ultimately, this enhanced predictive accuracy equips supply chain professionals with a highly effective mathematical tool for complex decision making.

Keywords: Fractional calculus, Inventory management, Memory effects, Variable deterioration, Differential equations, Supply chain optimization.

INTEGRATING AI-BASED FORECASTING WITH INVENTORY OPTIMIZATION: A COMPARATIVE EVALUATION OF DEEP LEARNING AND CLASSICAL MODELS

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ABSTRACT

Inventory management is a critical component in supply chain systems, directly impacting cost efficiency and customer satisfaction. Traditionally, the Economic Order Quantity (EOQ) model is employed to determine optimal order size based on fixed demand. However, in today's volatile markets, where demand patterns are nonlinear and affected by various dynamic factors, classical assumptions often fall short. This study addresses this limitation by integrating AI-based and classical forecasting models, Long Short-Term Memory (LSTM), and ARIMA into the EOQ framework to evaluate their impact on total inventory cost. A comparative approach is adopted, wherein both ARIMA and LSTM models are trained on historical demand data to forecast future consumption. These forecasts are then embedded into the EOQ model to derive optimal order quantities and total costs. Sensitivity analysis under ±10% and ±20% demand fluctuations is conducted to test cost robustness. Results indicate that while ARIMA yields a marginally lower cost in the baseline scenario, LSTM demonstrates stronger adaptability in dynamic demand environments. This is particularly beneficial in sectors such as perishables and fast-moving goods, where demand volatility is high. The proposed model offers a practical decision-support tool for managers, enabling data-driven inventory optimization through AI integration. It bridges the gap between predictive analytics and operational execution, contributing to cost efficiency and intelligent automation in supply chain management.

TECHNOLOGY BASED TEACHING LEARNING IN EDUCATION

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ABSTRACT

To achieve the objectives of education, technology is a science which includes the use of machines as well as techniques, principles, curriculum and supporting materials in the field of learning. Modern technology has contributed significantly to the spread of formal as well as informal education. Today technology has become synonymous with effective teaching and no field of education is untouched by its use. Technology refers to technology. Sustainable development includes social welfare, which depends on education. Information technology has emerged to disseminate shared knowledge and is a primary driving force behind education reforms. The introduction of new technology-assisted learning tools such as mobile devices, smart boards, tablets, laptops, simulations, dynamic visualizations and virtual laboratories has transformed education in schools and institutions. Educational technology businesses are constantly striving to create new solutions to increase access to education for individuals who cannot access adequate educational facilities. Social media has come a long way as a teaching tool. A large number of teachers and students use social media as an essential element

Technology is a progressive field. In today's time, all work is incomplete without it. Meaning of technology in simple language is that which makes our work quick, easy and convenient. Like we can easily get every information on internet, YouTube and websites. And with the help of computer, you can do your work easily and quickly. Today, technology is being used in every task. With the passage of time, technology is getting better every day. It plays an important role in our lives. Which makes our daily work and teaching learning easier.

Keywords: Technology, Education, Teaching Learning, Digital education, Multimedia,

योग और ध्यान के माध्यम से समग्र विकास

डॉ. पी. डी. शर्मा
द आई. सी. एफ. ए. आई. वि. वि. रायपुर

सारांश

योग और ध्यान भारतीय संस्कृति की प्राचीन एवं महत्वपूर्ण साधनाएँ हैं, जो व्यक्ति के शारीरिक, मानसिक, बौद्धिक तथा आध्यात्मिक विकास में महत्वपूर्ण भूमिका निभाती हैं। आधुनिक जीवनशैली में बढ़ते तनाव, प्रतिस्पर्धा और मानसिक दबाव के कारण मानव स्वास्थ्य प्रभावित हो रहा है। ऐसी स्थिति में योग और ध्यान संतुलित जीवन के प्रभावी उपाय के रूप में उभरकर सामने आए हैं। योग शरीर को स्वस्थ, लचीला और सशक्त बनाता है, जबकि ध्यान मन को स्थिर और शांत करने में सहायक होता है। इस शोध लेख का उद्देश्य यह स्पष्ट करना है कि योग और ध्यान के नियमित अभ्यास से व्यक्ति के समग्र विकास को किस प्रकार प्रोत्साहन मिलता है। अध्ययन से यह स्पष्ट होता है कि योग और ध्यान केवल शारीरिक स्वास्थ्य तक सीमित नहीं हैं, बल्कि यह व्यक्ति के व्यक्तित्व, मानसिक संतुलन और आध्यात्मिक जागरूकता के विकास में भी महत्वपूर्ण योगदान देते हैं।

शब्द संकेत : योग , ध्यान, समग्र विकास, मानसिक स्वास्थ्य, व्यक्तित्व विकास, आध्यात्मिक विकास

ROLE OF WOMEN ENTREPRENEURS IN ACHIEVING SDG 12 & SDG 13: AN ENVIRONMENTAL IMPACT ASSESSMENT STUDY

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ABSTRACT

Sustainable development has become a global priority as nations seek to balance economic growth with environmental protection. Women entrepreneurs are increasingly playing a vital role in promoting environmentally responsible business practices and contributing to sustainable development. This study examines the role of women entrepreneurs in achieving SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action) through environmentally sustainable business activities. These goals are part of the global sustainability framework established by the United Nations Sustainable Development Goals (SDGs). The research focuses on how women-led enterprises adopt eco-friendly production processes, efficient resource utilization, waste reduction practices, and the use of biodegradable or recyclable materials. By encouraging sustainable production and consumption patterns, women entrepreneurs help reduce environmental degradation and contribute to climate change mitigation. The study employs an environmental impact assessment approach to analyze the sustainability practices adopted by women-led businesses and their contribution to reducing carbon emissions, minimizing waste generation, and promoting green entrepreneurship. Findings indicate that women entrepreneurs significantly influence local sustainability initiatives by integrating environmental awareness with economic activities. Their enterprises not only generate employment and strengthen local economies but also support climate-friendly production systems and responsible consumption patterns. The research highlights that empowering women entrepreneurs through policy support, training, access to green technologies, and financial assistance can enhance their contribution to environmental sustainability. The study concludes that women entrepreneurs represent an important force in advancing sustainable development and environmental responsibility. Strengthening women-led green enterprises can significantly contribute to achieving SDG 12 and SDG 13 while fostering inclusive and sustainable economic growth.

Keywords: Women entrepreneurship, Sustainable Development Goals, SDG 12, SDG 13, environmental impact assessment, sustainable production, climate action.

CHANNEL DIGITAL MARKETING STRATEGIES FOR GI-TAGGED BASTAR DHOKRA ART AS A PILLAR OF THE VIKSIT BHARAT @2047 CREATIVE ECONOMY: AN EMPIRICAL STUDY ON EXPORT GROWTH AND ARTISAN INCOME

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ABSTRACT

Indeed, many think that the artistic economy of India is a crucial stakeholder in realising "Developed India @2047." Bastar Dhokra art of Chhattisgarh is an age-old tradition of the wax casting process. It has a huge cultural and economic potential in India, is one of the GI-tagged handicrafts of the country as well. Yet the industry is under severe stress despite GI tag and historical significance. It suffers from issues like low global visibility, unsettled marketing strategies, low levels of digitization, and artisanal income is not as high. The digital marketing strategies add several promotional channels to reach mass people and make Bastar Dhokra art popular among multi-culture art enthusiasts across the globe. This is because the global handicraft market is growing and the global market is becoming more digital.

The aim of this paper is to examine the influence of digital marketing strategies on improving export presentation and securing income sustainability for artisans in the Bastar Dhokra art region. The study will employ empirical research methodology to examine the correlation between the adoption of digital marketing, international brand identity, export performance, and the income levels of artisans. The primary data will be collected through Intermediaries like artisans, cooperatives, exporters, and digital marketplaces will collect the main data. This will also include secondary data about exports and policy studies. We will employ sophisticated statistical techniques, including structural equation modeling and regression analysis, to ascertain the validity of the proposed relationships between pervasive channel marketing capabilities and their outcomes.

This study provides to the academic literature on ways to grow the creative economy, traditional crafts, digital marketing, and growth that includes everyone. It also helps in a practical way by making a strategic plan for the years 2018 to 2047 on how to turn Bastar Dhokra into a cultural brand that is competitive worldwide and helps artisans make a living. The research aims to educate policymakers, craft organizations, export promotion councils, and digital platforms about the incorporation of traditional handicrafts into India's burgeoning creative economy.

Keywords: Viksit Bharat, traditional handicrafts, Bastar Dhokra art, GI recognition, digital platforms, Marketing Strategies, GI-Tagged

A STUDY ON THE EFFECTIVENESS OF BANKING TECHNOLOGY IN DELIVERING CUSTOMER SERVICE – A SPECIAL REFERENCE TO CHHATTISGARH

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ABSTRACT

The banking sector has undergone a significant transformation with the rapid adoption of modern technologies aimed at enhancing the quality and efficiency of customer services. This study examines the effectiveness of banking technology in delivering customer service with special reference to the state of Chhattisgarh. The primary objective of the research is to evaluate how technological advancements such as Internet banking, mobile banking, Automated Teller Machines (ATMs), debit and credit cards, and electronic payment systems have influenced the overall banking experience of customers.

The study is based on both primary and secondary data. Primary data has been collected through structured questionnaires distributed among bank customers in different regions of the state, while secondary data has been gathered from research journals, bank reports, books, and relevant online sources. The research focuses on key factors such as accessibility, convenience, transaction speed, security, and customer satisfaction associated with banking technologies.

The findings of the study indicate that banking technology has played a crucial role in improving service delivery by making banking services more accessible, faster, and user-friendly. Customers are increasingly adopting digital banking platforms for routine transactions, which reduces the need for physical visits to bank branches. However, certain challenges such as limited digital literacy, network connectivity issues, and concerns related to cybersecurity still affect the effective use of these technologies, particularly in rural areas.

The study in general and with a special reference to Chhattishgarh, concludes that continuous technological development, digital awareness programs, and improved infrastructure are essential to maximize the benefits of banking technology in enhancing customer service.

Keywords: effectiveness, banking technology, delivering customer service, digital awareness, cyber security

EDUCATION OF GIRLS IN INDIA: SITUATION AND CHALLENGES

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ABSTRACT

In our Indian culture, women have been given the highest place since the beginning. It is also mentioned in our scriptures that where women are worshipped, the deity resides there. Even in the Vedic period, women had a respectable position. The role of women in the formation and development of any society depends on this. What is the attitude of men towards women in a culture, this attitude can be positive or negative. What are their rights, what are their functions in different fields, whether the woman of the house is consulted on any important matters in the family or not. Considering all these things, it is known that women had many rights in Hindu society, their social status was high, they were considered a symbol of power, knowledge and wealth and that is why they have been worshipped as Durga, Saraswati and Lakshmi. That is why in Hindu society, a woman is considered to be the wife of a man. Here, in the Vedic and post-Vedic period, the status of women has been equal to that of men and they have been enjoying all the rights at par with men. Gradually, the lust for power grew among men, and as a result, in the Smriti period, the Dharmashastra period and the medieval period, their rights were taken away and they were considered to be lazy, helpless and weak. But time changed, during the British rule, there was an awakening in the political and social field in the country. Many social reformers and leaders turned their attention to improving the condition of women. Women in this country did not have to make as much effort to improve their condition as they did in the West.

CHEMICALS USED IN COSMETICS AND IN DERMATOLOGY

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ABSTRACT

The skin is the largest organ of the human body and acts as a protective barrier against environmental factors such as microorganisms, ultraviolet (UV) radiation, pollution, and harmful chemicals. Protecting the skin is important to maintain overall health, prevent infections, and reduce skin damage and premature aging. Cosmetics and dermatological products contain various chemical compounds that help protect and improve skin condition.

This study highlights 20 commonly used chemicals in cosmetics and dermatology, including moisturizers, preservatives, antioxidants, UV filters, and therapeutic agents. These chemicals help maintain skin hydration, prevent microbial growth, protect the skin from harmful UV rays, and treat common skin problems such as acne, dryness, and pigmentation. Understanding the chemical composition and functions of these compounds is important for evaluating their safety and effectiveness. This poster provides a brief overview of the structures, formulas, and uses of these chemicals and their role in modern skin care and dermatology.

RAINFALL FORECASTING USING DEEP LEARNING TECHNIQUES: A COMPARATIVE STUDY OF BI-LSTM, LSTM, AND GRU MODELS

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ABSTRACT

This article reports the comparative study of results obtained for the rainfall prediction using various deep learning approaches. Keeping this objective, prediction of rainfall in Durg (Chhattisgarh) India was done using different deep learning techniques such as Bidirectional Long Short-Term memory (Bi-LSTM), long short Term Memory (LSTM) and Gated Recurrent Unit (GRU) method. Random window sizes were used for prediction in each of the deep learning algorithms. The performance and the efficiency were evaluated using factors like Mean Square Error (MSE), Root Mean Square Error (RMSE) and Cosine Similarity (CS). The Cosine Similarity which was considered as an index to judge the closeness of actual and predicted data was found to be the maximum for window size 5, 10, 15 and 25 for Bi-LSTM algorithm. The corresponding CS values were 0.9685, 0.9676, 0.9658 and 0.9663 respectively. Whereas, the CS value in case of LSTM and GRU was found maximum for window size 20 and 30 respectively. Therefore, Bi-LSTM may be recommended as the method to be adopted for prediction with smaller window sizes.

Keywords: Forecasting; Bidirectional Long Short-Term memory (Bi-LSTM); long short-term memory (LSTM); recurrent neural networks; Time series; Gated Recurrent Unit (GRU); Performance Evaluation.

AN EFFICIENT DDOS ATTACK DETECTION FRAMEWORK FOR SD-IOT USING MACHINE LEARNING TECHNIQUES

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ABSTRACT

The rapid expansion of Internet of Things (IoT) devices has introduced serious security challenges in modern network environments. Many IoT devices have recently been exploited to launch distributed denial-of-service (DDoS) attacks without the knowledge of their owners, making network protection a critical issue. To address these challenges, the concept of Software-Defined Networking (SDN) has been introduced to provide flexible and secure management of IoT infrastructures. Based on this concept, this study presents a high-level architecture for a Software-Defined Internet of Things (SD-IoT) environment.

The primary aim of this research is to detect DDoS attacks at the controller level of the SD-IoT network. For this purpose, a dataset generated from the control plane of a Software-Defined Network (SDN) environment is used to train several machine learning classifiers, including Light Gradient Boosting Machine (LGBM), Support Vector Machine (SVM), Random Forest, and K-Nearest Neighbours (KNN). The performance of these models is evaluated using different metrics such as accuracy, precision, recall, F1-score, Cohen's Kappa Coefficient (CKC), False Alarm Rate (FAR), and execution time.

The experimental results show that the LGBM classifier performs better than the other models. It achieves accuracy, precision, recall, and F1-score values above 99.72%, while maintaining a low False Alarm Rate of 0.35%. In addition, the model records an execution time of 4.134 seconds and a CKC value of 99.42. A comparison with several existing studies also indicates that the proposed approach provides improved detection performance for DDoS attacks in SD-IoT environments.

Keywords: Software-Defined Internet of Things (SD-IoT), Distributed Denial of Service (DDoS), Attack Detection, Ryu Controller, Machine Learning.

STRATEGIC INNOVATION AND SUSTAINABILITY: NEW APPROACHES FOR RESPONSIBLE BUSINESS DEVELOPMENT

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ABSTRACT

In this rapidly changing business world and dynamic business environment, it is must for every organization to balance between corporate social responsibility, environmental sustainability, and economic success. So strategic innovation is an important strategy for accomplish in long-run competitiveness and sustainable business. It concern about the benefit of both society and business, and believe that organization should come up with new ideas, technologies, processes, and business models that will raise organizational efficiency and create value.

Today most of the organization are integrating sustainability with strategic innovation, and developing responsible environmental practices, which can decrease raw material use and sustainable operation practices. Innovative solutions like green technologies, sustainable supply chain management, eco-friendly product design, and circular economy practices are highly used today, these solutions are not only supporting conservation of environmental but also raise brand reputation, customer trust, and market competitiveness.

Strategic innovation also enables organizations to shift from traditional profit-driven models to stakeholder-oriented approaches that consider the interests of employees, communities, and the environment. By leveraging digital technologies, research and development, and collaborative partnerships, companies can create sustainable products and services that meet the growing demand for responsible business practices.

The study highlights that organizations integrating sustainability into their innovation strategies are better equipped to address global challenges such as climate change, resource scarcity, and social inequality. Such businesses demonstrate greater resilience, adaptability, and long-term growth potential. Therefore, strategic innovation plays a significant role in transforming business practices and promoting responsible and sustainable development.

As social and environmental issues become more pressing, businesses must incorporate sustainability into their fundamental methods of invention. By examining important procedures, results, and difficulties, this study investigates how innovation techniques support sustainable company models. The study looks into how sustainable innovation improves company reputation, boosts competitiveness, and complies with regulations using both qualitative and quantitative methods. According to the report, companies that actively pursue circular economy models, Eco innovation, and stakeholder involvement perform better than those that use traditional approaches.

Keywords: Strategic Innovation, Sustainability, Responsible Business Development, Green Innovation, Sustainable Business Strategies, Corporate Social Responsibility.

UNIVERSAL ACCESSIBILITY IN URBAN BUILT ENVIRONMENTS: CITIES FOR EVERYONE

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ABSTRACT

Urban environments are not just buildings and roads, they play a big role in shaping the daily lives of people. The way cities are designed affects how easily people can move, work, and live independently. However, even with modern development, many cities still have barriers that make life difficult for certain groups. Elderly people, persons with disabilities, and children find it difficult to move around the city because many public places, transport systems, and buildings are not designed for everyone. Because of this, cities should be planned in a way that is fair and easy to use for all people. In this research, universal accessibility is treated as an essential requirement that allows everyone to move safely and independently in the city.

By understanding the basic ideas of universal design, it explores how accessibility can be included from the beginning in urban planning, instead of being added later as an extra feature. It focuses on built environment of Jaipur, where many persons with disabilities face daily difficulties in moving around because proper infrastructure is missing. This aims to show how thoughtful design can help to allow people to participate more actively in society.

Keywords: Disability-Friendly Infrastructure, Accessible Urban Planning, Inclusive Cities, Barrier-Free Environment, Social Inclusion, Disability-Friendly Infrastructure

A NOTE ON FRAMES FOR OPERATORS IN BANACH SPACES

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ABSTRACT

In this paper, we study frames for operators in Banach spaces, namely, Λ-Banach frame. We decompose Λ-Banach frame into block sequences and construct Λ-Banach frame for corresponding block sequences. Further, we prove that the image of a Λ-Banach frame by a bounded linear operator is also a Λ-Banach frame. Finally, we end with an application in regard to find the rank of a given matrix.

MSC(2020) : 42C15, 46B15

Keywords : Banach frame, block sequence, Λ-Banach frame

EVALUATING ACCESSIBILITY OF PUBLIC PLACES IN AJMER CITY

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Accessibility is an important part of inclusive urban area. It ensures that public infrastructure can be used safely and independently by everyone, including persons with disabilities, elderly people, and children in many cities in India still face difficulties in creating an accessible built environment. Throughout this study the level of accessibility in public infrastructure in Ajmer city. Can be Identified.

The study focuses on important places in the city such as public buildings, pedestrian paths, and transportation areas that people use in their daily life. A field-based accessibility result was carried out using the guidelines of the National Building Code of India, principles of universal design and URDPFI guidelines Different parameters such as ramps, tactile paving, pathway width, signage, and accessible entrances were evaluated.

The results show that there is a difference between the recommended accessibility standards and the present condition of the built environment. Many physical barriers were found which make movement difficult for persons with disabilities. The study also suggest some planning and design improvements so that public spaces can become more accessible and inclusive for everyone. It help in understanding the accessibility problems faced by medium-sized cities in India and gives some recommendations for creating barrier-free public infrastructure.

Keywords: Universal Accessibility, Inclusive Design S, Built Environment, Barrier-Free Infrastructure, Urban Accessibility, Ajmer City

THERAPEUTIC POTENTIAL OF PLANT-DERIVED PHYTOCHEMICALS IN HUMAN HEALTH

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ABSTRACT

Medicinal plants are becoming increasingly popular because of their potential therapeutic uses. Phytochemicals are abundant in these plants. The phytochemicals enhance various pharmacological activities. It is possible to make prudent use of these pharmacological properties for therapeutic objectives. It can be applied in a variety of ways to broaden treatment approaches. There is a need to find new therapeutic solutions considering medical advancements and the growing adverse effects of synthetic medications. The finest source for creating novel treatments for a variety of illnesses is medicinal plants. Additionally, these phytomedicines are affordable, safe, effective, and practical. In this review, we provide an overview of the health benefits of phytochemicals and the pros and cons of phytochemicals to develop novel drugs.

Keywords - Medicinal plants, phytochemicals, novel drugs, pharmacological activities.

A NEW ITERATIVE SCHEME FOR REICH–SUZUKI TYPE MAPPINGS WITH APPLICATIONS TO IMAGE RESTORATION

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ABSTRACT

In this paper, we introduce a new iterative scheme and prove weak and strong convergence theorems based on certain assumptions regarding the parameters for a Reich–Suzuki-type mapping. We investigate the problem of image restoration using a proposed new iterative method in a real Banach space. Additionally, we demonstrate the applicability of the proposed new iterative scheme, numerical experiments are carried out on image deblurring problems.

Keywords: Fixed point; Banach space; iterative scheme; Reich–Suzuki-type mapping, image restoration

MSC2020: 47H06, 47H09, 47J25

IDENTIFYING RESISTANCE GENES IN *VIBRIO CHOLERAE* EL TOR STRAINS USING PHAGE TYPING AND MOLECULAR TECHNIQUES

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ABSTRACT

Introduction: *Vibrio cholerae*, an etiologic agent of Cholera disease poses a major health risk in several countries worldwide particularly in the developing countries in Africa and Asia. Hence, it is very important to continue research in the field for understanding how the dynamics of the bacterial virulence, pathogenesis and survival strategies keep changing for the transmission of cholera disease. In the present study, clinical *V. cholerae* O1 strains isolated from different endemic regions in India between 1961 were investigated to analyse their genotypic and phenotypic dynamicity. **Materials & methods:** All these strains were confirmed by biochemically and serologically and differentiated by phage typing method. Antibiogram was performed for drug resistance pattern. Molecular characterization was performed by PCR and the clonality between the strains was done by PFGE with the help of Bionumeric software for dendogram analysis. Sanger sequencing was performed for genotypic character confirmation. Further strains were undergone for animal model experiment to determine the colonization ability and toxicity traits. **Results:** *V. cholerae* strains isolated from different parts of India in the year 1961 biochemically characterized and serologically identified as El Tor O1 serotype Ogawa predominantly. Multiple drug resistance patterns showed that these strains were sensitive to azithromycin, ceftriazone, norfloxacine, ofloxacine and ciprofloxacine. Being the predominant phage type (T-27), probably one single clone of *V. cholerae* O1 is circulating throughout the country. Characterization of these strains by MAMA PCR showed multiple diversity genotypic character. The dendrogram analysis showed by PFGE, the presence of 14 different clonal patterns. *V. cholerae* strains of the year span was confirmed by Sanger sequencing method and reflects classical genotypic traits. Additionally, rabbit ileal loop assay showed the toxicity of *V. cholerae* strains along with Zebra fish, suckling mice and mice ketamine model showed the colonization ability of *V. cholerae* strains.

Conclusion: This study enables us a glimpse concept of genetic diversity of Indian strains of *V. cholerae* along with antibiotic resistance from across the country.

Keywords: Vibrio Cholerae, El Tor, Phage typing, Multidrug resistance, Rabbit ileal loop assay

GENERALIZED THEOREMS OF FIXED POINT FOR FUZZY CONTRACTIONS IN FUZZY METRIC SPACE

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ABSTRACT

In this paper, we establish a generalized fixed-point theorem for fuzzy contractions in fuzzy metric spaces. The result extends the well-known Banach contraction principle into the setting of fuzzy metric spaces by employing a generalized fuzzy contraction. Examples are provided to demonstrate the applicability and generalization of classical fixed-point results. Fuzzy fixed-point techniques are used in mathematical modelling to solve problems where traditional methods fail due to imprecise or uncertain data. To obtain fuzzy fixed points, different contraction conditions are implemented in a fuzzy context.

Keywords- Fuzzy metric space, fixed point theorem, Fuzzy contraction, generalized fuzzy metric, Banach contraction

MATHEMATICAL MODELLING OF AGRICULTURAL WATER ALLOCATION UNDER COMBINED FUZZY, STOCHASTIC, AND NEUTROSOPHIC UNCERTAINTY

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ABSTRACT

Agricultural water management is increasingly challenged by climate variability, imprecise decision-making processes, and uncertain environmental and policy conditions. Traditional fuzzy and stochastic modelling approaches effectively represent ambiguity and randomness; however, they often fail to capture the indeterminacy arising from incomplete climate information and evolving governance structures. To address this limitation, this study proposes a hybrid fuzzy–stochastic water management framework augmented with neutrosophic uncertainty within a unified mathematical formulation.

In the proposed model, fuzzy parameters describe imprecision in farmer irrigation practices, stochastic processes represent rainfall variability and hydrological fluctuations, while neutrosophic components capture indeterminate climate projections, uncertain groundwater assessments, and potential policy changes. A theoretical investigation is conducted to examine the existence of equilibrium solutions, stability properties, and sustainability conditions of the developed model.

Furthermore, a comparative analysis with classical fuzzy and fuzzy–stochastic models demonstrates that incorporating neutrosophic uncertainty improves the robustness and resilience of the allocation framework. The findings indicate that the proposed triple-uncertainty modelling approach provides an effective analytical tool for supporting sustainable agricultural water management under complex and uncertain environmental conditions.

Keywords: Hybrid fuzzy–stochastic modelling; Neutrosophic uncertainty; Agricultural water allocation; Climate variability; Sustainability analysis; Water resource modelling

APPROXIMATE FIXED POINT THEOREM FOR CIRI´C-TYPE´ CONTRACTION IN FUZZY B-METRIC SPACES VIA MULTIVALUED MAPPINGS

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ABSTRACT

In this paper, we investigate the existence of approximate fixed points for multivalued mappings in the setting of fuzzy b-metric spaces. By introducing a generalized Ciri´c-type contractive condition for multivalued operators, we establish´ sufficient conditions for the existence of the approximate fixed point property in complete fuzzy b-metric spaces. The proposed contraction condition extends several well-known results in fuzzy metric fixed point theory and provides a broader framework for the study of nonlinear mappings with set-valued images. Using an iterative technique and fundamental properties of fuzzy b-metric spaces, we prove that every multivalued mapping satisfying the Ciri´c-type contractive condition ad-´ mits an ε-approximate fixed point for every $\varepsilon > 0$. An illustrative example is also presented to demonstrate the applicability of the main theorem. The obtained results generalize and improve various existing approximate fixed point results in fuzzy metric spaces.

Keywords: Approximate fixed point, Fuzzy b-metric space, multivalued mapping, Ciri´c-´ type contraction.

HEALTH CONCERNS ASSOCIATED WITH HIGH-G-FORCE EXPOSURE IN FIGHTER JET AVIATORS: A COMPREHENSIVE REVIEW

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ABSTRACT

Fighter jet pilots regularly experience extreme gravitational forces during combat and training maneuvers, sometimes reaching up to 9G. Exposure to such forces places significant stress on the human body and can lead to several physiological problems, including G-induced loss of consciousness (G-LOC), visual disturbances, orthostatic intolerance, and long-term musculoskeletal issues. Neck and back pain are among the most frequently reported problems, largely due to repeated high-G exposure and the additional load of modern flight helmets and equipment. This review discusses the major physiological and biomechanical effects of highG environments on fighter pilots and summarizes findings from aerospace medicine studies, including reports from the United States Air Force and the Finnish Air Force. Previous research shows that many pilots experience cervical strain and temporary reductions in performance during demanding maneuvers. These problems can influence operational readiness and may reduce flying capability, leading to costly training losses. Several preventive strategies are currently used, such as Anti-G Straining Maneuvers (AGSM), anti-G suits, and neck strengthening exercises aimed at improving muscular endurance. With the continued development of advanced aircraft, additional solutions such as improved training programs, virtual simulations, and better ergonomic support systems may help reduce injury risk and improve pilot safety and performance.

Keywords: Fighter pilots, High-G forces, G-induced loss of consciousness (G-LOC), cervical strain, Anti-G straining maneuver (AGSM), Aerospace medicine.

ABSTRACT

Multilevel inverters (MLIs) are widely used in modern power electronics applications such as renewable energy integration, electric vehicles, and high-power motor drives. Conventional two-level inverters suffer from high harmonic distortion and switching losses. This paper presents the design and simulation of a 17-level cascaded H-bridge multilevel inverter using the Phase Opposition Disposition Pulse Width Modulation (POD-PWM) technique. The proposed inverter topology generates a stepped output voltage waveform that closely approximates a sinusoidal waveform while reducing Total Harmonic Distortion (THD). The system is modeled and simulated using MATLAB/Simulink. Simulation results demonstrate that the proposed topology achieves improved output waveform quality with voltage THD of approximately 7.26% and current THD of 3.09%. The results indicate that the proposed inverter is suitable for photovoltaic (PV) based power generation systems.

A STUDY ON WASTEWATER TREATMENT AND RECYCLING PRACTICES IN BHILAI STEEL PLANT

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ABSTRACT

Wastewater management is an important aspect of sustainable industrial development, particularly in large steel manufacturing units. This study focuses on the wastewater treatment and recycling practices adopted in Bhilai Steel Plant (BSP), one of the major integrated steel plants in India. The research examines the sources of wastewater generated from different units such as coke ovens, blast furnaces, rolling mills, and cooling systems. It also analyzes the treatment methods employed in the plant, including physical, chemical, and biological processes to remove contaminants. The study highlights the efficiency of wastewater treatment facilities and the strategies implemented for recycling and reuse within the plant operations. Effective recycling practices help in reducing freshwater consumption, minimizing environmental pollution, and promoting sustainable water resource management. The findings emphasize the importance of advanced wastewater treatment technologies and efficient management systems in achieving environmental sustainability in the steel industry.

A STUDY ON STRUCTURAL AND OPTICAL PROPERTIES OF SODIUM CALCIUM PHOSPHORS

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ABSTRACT

Sodium calcium phosphors have attracted considerable attention due to their promising luminescent properties and potential applications in lighting, display devices, and optoelectronic technologies. In this study, the luminescence properties of sodium calcium phosphor were investigated after synthesizing the material through a suitable preparation method. The structural and optical characteristics of the synthesized phosphor were analyzed to understand its emission behavior and efficiency. Photoluminescence studies revealed that the sodium calcium phosphor exhibits strong emission under appropriate excitation, indicating efficient luminescent performance. The emission spectra and intensity were examined to understand the energy transfer processes responsible for luminescence. The obtained results suggest that sodium calcium phosphor is a promising material for applications in solid-state lighting, display systems, and other luminescent devices, contributing to the development of efficient phosphor materials for advanced optical applications.

COMPARATIVE STUDY ON THE EFFECT OF DIFFERENT LUMINESCENT MATERIALS FOR RADIATION DOSIMETRY OF X-RAYS, BETA RAYS, AND GAMMA RAYS

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ABSTRACT

Radiation dosimetry plays a crucial role in monitoring ionizing radiation exposure, ensuring safety in medical, industrial, and environmental applications. This study investigates the comparative performance of various luminescent materials, including thermoluminescent (TLD) and optically stimulated luminescent (OSL) materials, in detecting X-rays, beta rays, and gamma rays. The research focuses on materials such as LiF:Mg,Ti, Al_2O_3:C, $CaSO_4$:Dy, and emerging nanophosphors, analyzing their sensitivity, dose-response linearity, energy dependence, and fading characteristics. Experimental evaluations reveal significant differences in luminescence intensity and charge trapping mechanisms across different radiation sources. The study further explores factors like reusability, stability, and environmental effects on material performance. Comparative analysis highlights the advantages and limitations of each material, guiding the selection of optimal dosimetric materials for specific applications. The findings contribute to the development of high-precision dosimetry systems, improving radiation monitoring efficiency and accuracy. This research is particularly relevant for applications in radiation therapy, occupational safety, space exploration, and environmental radiation assessment. The study concludes with recommendations for future advancements in dosimetric materials, emphasizing the potential of nanostructured phosphors for enhanced radiation detection

IMPACT OF ENVIRONMENTAL HEAVY METALS (LEAD, ARSENIC) VIA AIR POLLUTION IN HUMAN HEALTH

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ABSTRACT

Air pollution in industrial cities contains particulate matter enriched with toxic heavy metals such as lead (Pb) and arsenic (As), which originate mainly from coal combustion, smelting activities, vehicular emissions, and open waste burning. Residents of Raipur, Chhattisgarh—an important industrial hub with numerous steel plants, coal-fired power stations, and dense traffic—are chronically exposed to these airborne contaminants. Previous environmental studies have indicated that coal-based industries are a major source of atmospheric arsenic in the region, while road traffic significantly contributes to metal deposition in urban dust. Once inhaled, Pb and As particles can deposit in the lungs, enter systemic circulation, and accumulate in organs including the liver. A major mechanism underlying heavy-metal toxicity is oxidative stress, where metals promote the generation of reactive oxygen species (ROS) and disrupt antioxidant defense systems such as glutathione, superoxide dismutase (SOD), and catalase. Elevated ROS levels trigger lipid peroxidation, DNA oxidation, and protein damage, producing biomarkers such as malondialdehyde (MDA), F2-isoprostanes, and 8-hydroxy-2′-deoxyguanosine (8-OHdG). These processes activate inflammatory pathways and alter gene expression, potentially leading to liver injury, fibrosis, and hepatocellular carcinoma. Recent epidemiological, experimental, and toxicological studies consistently report associations between Pb and As exposure and increased oxidative stress biomarkers, impaired liver enzyme profiles, and enhanced lipid peroxidation. However, despite growing evidence globally, limited research has explored the mechanistic links between inhaled airborne metals, oxidative stress biomarkers, and liver health in populations living in highly polluted industrial cities such as Raipur. Therefore, this proposed doctoral research aims to investigate the relationship between airborne Pb and As exposure, oxidative stress biomarkers, and lipid peroxidation pathways in humans, with a focus on identifying early biochemical indicators of heavy-metal–induced liver injury and cancer risk in the urban population of Raipur.

Keywords: heavy metals, lead, air pollution, liver disease, Raipur.

SYNTHESIS AND PHOTOLUMINESCENCE INVESTIGATION OF TRIVALENT RARE- EARTH-DOPED $MGY_2AL_4SIO_{12}$ PHOSPHOR

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ABSTRACT

In this study, a series of trivalent europium (Eu^{3+}) doped $MgY_2Al_4SiO_{12}$ garnet phosphors were successfully synthesized using a wet chemical sol-gel method, which offers improved homogeneity and fine particle control compared to conventional solid-state techniques. The phase purity and crystalline structure of the synthesized $MgY_2Al_4SiO_{12}:xEu^{3+}$ phosphors were systematically characterized using X-ray diffraction (XRD) analysis. The diffraction patterns confirmed that all samples were highly crystalline, and the observed peaks were in excellent agreement with the standard JCPDS reference file, indicating successful formation of the garnet structure without detectable secondary phases. The photoluminescence (PL) properties of the phosphors were investigated under near-UV excitation at 394 nm, revealing prominent emission peaks at 592 nm and 612 nm in the orange-red spectral region. These emission bands are characteristic of the $^5D_0 \rightarrow {}^7F_1$ and $^5D_0 \rightarrow {}^7F_2$ transitions of Eu^{3+} ions. The PL intensity was observed to increase with Eu^{3+} concentration, reaching a maximum at 5 mol %, after which concentration quenching effects could occur. The strong orange-red emission and excellent luminescence efficiency indicate that the synthesized $MgY_2Al_4SiO_{12}:Eu^{3+}$ phosphors are promising candidates for application in orange-red light-emitting devices, particularly in solid-state LED lighting, where stable and efficient emission is required for enhanced color rendering.

Keywords: Phosphor, Sol-gel method, Photoluminescence, XRD

STEADY MHD–BUONGIORNO Fe_3O_4 NANOFLUID TRANSPORT WITH NONLINEAR RADIATION FOR MAGNETIC HYPERTHERMIA-BASED TUMOUR ABLATION

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ABSTRACT

Magnetic hyperthermia uses magnetic Nano fluids to raise tumour temperatures for minimally invasive cancer therapy. This study develops a **steady MHD–Buongiorno Nano fluid model with Fe_3O_4 nanoparticles** to analyze heat and mass transfer in a biological medium. The model includes nonlinear thermal radiation, first-order chemical reaction, internal heat generation, Brownian motion, and thermophoresis. The flow over a stretching biological surface with velocity and thermal slip represents tumour micro-interfaces. Using similarity transformations, the governing equations are converted into nonlinear ordinary differential equations and solved numerically through the shooting method with Runge–Kutta integration and MATLAB's **BVP4c** solver. Results show that stronger magnetic fields enhance localized heating, thermophoresis drives nanoparticle migration, and Brownian motion improves temperature uniformity. The findings provide useful insights for optimizing Fe_3O_4 **nanofluid magnetic hyperthermia systems** for efficient tumour ablation.

Keywords: Magnetic hyperthermia, Steady MHD flow, Fe_3O_4 Nano fluid, Non-linear radiation, Buongiorno model, Chemical reaction, Heat generation.

FUNGAL ENDOPHYTES IN MEDICINAL PLANTS: A SUSTAINABLE APPROACH TO MANAGE PLANT DISEASES

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ABSTRACT

Endophytic fungi inhabit all plant parts and do not cause any harmful effects on the host plants. Fungal endophytes are a diverse and ecologically important group of microorganisms that live within plant tissues without causing any visible symptoms of disease under normal environmental conditions. These fungi form complex and frequently mutualistic associations with their host plants, contributing to modifications in plant physiology, improved tolerance to environmental stresses, and increased resistance against pathogenic organisms. The relationship between endophytes and their host plants is regulated through advanced molecular interactions that involve effector molecules, secondary metabolites, phytohormones. Such factors help the fungus to avoid or modulate the host immune response while maintaining a stable and beneficial symbiotic association. Therefore, the symptomless colonization of plant tissues is an active and regulated process mediated by signaling pathways, enabling the endophyte to obtain nutrients and protection from the host without affecting plant health.

A number of studies have reported the isolation of large groups of endophytic fungi from the leaves of medicinal plants that have notable importance. Endophytic fungi represent a highly diverse and adaptable microbial population that is widely distributed across different ecosystems. These microorganisms are known for their ability to synthesize a wide variety of secondary metabolites, many of which are similar to or derived from compounds produced by their host plants and possess significant biological activities. Because of this capability, the interaction between endophytic fungi and plants has gained considerable attention in recent years. The search for novel bioactive compounds from fungal endophytes has become an important area of research in modern biotechnology and natural product discovery.

In the present paper, the diversity of fungal endophytes was examined, and several species were isolated from different medicinal plants. The isolated endophytes showed various biological properties, including notable antifungal activity against plant pathogenic fungi, indicating their potential use in sustainable plant disease management.

APPROXIMATE COMMON FIXED POINT RESULTS IN NEUTROSOPHIC FUZZY B-METRIC SPACES FOR MATHEMATICAL MODELING OF UNCERTAINTY

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ABSTRACT

Fixed point theory is an important area of nonlinear analysis and has wide applications in applied mathematics, engineering, computer science, and optimization problems. In many real-world situations, uncertainty and indeterminacy play a significant role in mathematical modeling. To address such issues, neutrosophic fuzzy structures provide an effective framework for handling uncertain, inconsistent, and indeterminate information. Motivated by these developments, this paper investigates approximate common fixed point results in the setting of neutrosophic fuzzy b-metric spaces.

We introduce suitable contractive conditions for a class of mappings defined on neutrosophic fuzzy b-metric spaces and establish new approximate common fixed point theorems under generalized contraction principles. The obtained results extend and generalize several well-known fixed point results in fuzzy metric spaces and generalized metric structures. The existence and uniqueness of approximate common fixed points are derived under appropriate admissibility and compatibility conditions.

Furthermore, an illustrative example is provided to demonstrate the validity and applicability of the established results. The proposed framework offers a useful mathematical tool for modeling uncertainty in interdisciplinary fields such as decision-making processes, optimization techniques, and computational mathematics. These results contribute to the theoretical development of fixed point theory in neutrosophic environments and open new directions for future research in mathematical modeling under uncertainty.

Key words: Fixed Point Theory, Neutrosophic Fuzzy b-Metric Space, Approximate Common Fixed Point, Mathematical Modeling, Uncertainty.

RECENT ADVANCES IN ELECTRIC VEHICLE ONBOARD CHARGER SYSTEMS: CONVERTER TOPOLOGIES, CONTROL STRATEGIES, AND CHALLENGES

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ABSTRACT

The increasing adoption of electric vehicles (EVs) has significantly increased the demand for efficient and reliable charging systems. The onboard charger (OBC) is a critical component responsible for converting alternating current (AC) from the grid into direct current (DC) suitable for charging EV batteries. However, current ripple, switching losses, and thermal management issues remain major challenges in OBC design. This review paper analyses recent developments in EV onboard charger technologies, focusing on converter topologies, integrated charging architectures, bidirectional charging systems, and ripple suppression techniques. Furthermore, emerging technologies such as renewable energy-assisted chargers, cybersecurity considerations, and multifunctional charging systems are discussed. Special emphasis is placed on the importance of both high-frequency and low-frequency analysis for improving system efficiency, power quality, and reliability. Finally, research gaps related to scalability, thermal management, fault tolerance, and economic feasibility are highlighted to guide future research in EV onboard charger design.

Keywords: Electric vehicles, onboard charger, current ripple suppression, power electronics, DC-DC converter, bidirectional charging, high-frequency analysis, low-frequency analysis.

A STUDY ON THE ROLE OF FINANCIAL LITERACY IN IMPROVING PERSONAL FINANCIAL PLANNING

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ABSTRACT

Financial literacy is really important for making plans about our money. It helps us understand the knowledge we need to make informed choices about budgeting, saving, and investing. We also need to understand insurance, retirement planning, and how to manage debt effectively.

This study looks at how financial literacy affects our ability to plan our finances well. It uses information from books and articles and reports from banks and governments and other organizations. What it found is that people who are good at managing their money are more likely to set goals for what they want to do with their money. They are better at managing the money they have. They think carefully before buying things that have to do with money. They are also better at saving and investing their money.

On the contrary, people with limited knowledge of money management often make poor financial decisions. They get into debt too easily. They are often unprepared for their future financial needs.

So the study suggests that if we can teach people more about managing their money and make them more aware of what they need to know they will be better at planning their finances. Financial literacy is the key to making plans about our money and having a secure future. Financial literacy helps us make decisions about financial things, like budgeting and saving and investing.

Keywords: Financial Literacy, Personal Financial Planning, Financial Decision-Making, Savings and Investment, Financial Well-Being

CYBERSECURITY CHALLENGES IN GLOBALIZED HIGHER EDUCATION

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ABSTRACT

In the age of globalization, to enhance the world of education by incorporating cutting-edge educational technologies and streamlining activities within higher educational institutions. With online platforms and cloud technology offering accessibility to resources, collaborative research, and acquiring knowledge, higher education institutions worldwide are becoming increasingly interconnected. However, the growing dependence on digital technology has resulted in serious cybersecurity issues, such as ransomware attacks, social engineering, phishing, preserving and safeguarding information, and protecting platforms for online learning. Higher education institutions are now at greater risk of ransomware attacks, data breaches, and intellectual property theft as a result of the expansion of the attack surface caused by the incorporation of technologies into educational and organizational procedures. These difficulties are made more difficult by the global character of higher education, since institutions have to deal with a variety of legal frameworks, social standards, and consumer cybersecurity competence levels. Protecting sensitive research and academic information, weaknesses in online educational applications and the increasing risk of phishing and social engineering assaults directed at staff and students from other countries are some of the main concerns. Furthermore, novel weaknesses are introduced by the dependence on outside vendors, outdated systems, and cutting-edge technology like AI and IoT. In order to reduce these risks, organizations need to invest in cutting-edge security infrastructure, improve cybersecurity awareness and training, and implement robust information security policies. International higher education institutions can preserve the confidence of their numerous users, preserve confidential information, and secure their technological environments by taking steps to address these issues. This chapter addresses the various cybersecurity issues facing international higher education and suggests solutions for creating safe and robust learning environments.

Keywords: Cutting-edge Educational Technologies, Cybersecurity issues, Ransomware Attacks, Social Engineering, Phishing.

NANO-ENHANCED PHASE CHANGE MATERIALS FOR SOLAR AND THERMAL ENERGY STORAGE: RECENT PROGRESS, TECHNICAL CHALLENGES, AND EMERGING RESEARCH TRENDS

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ABSTRACT

The growing demand for clean and sustainable energy has increased the need for efficient energy storage technologies, particularly for solar and thermal applications. Phase change materials (PCMs) are widely used in thermal energy storage systems because of their ability to store and release large amounts of heat through latent heat during phase transitions. However, conventional PCMs suffer from a major limitation—low thermal conductivity—which slows down heat transfer during charging and discharging processes. To address this issue, researchers have explored the incorporation of nanoparticles into PCMs, leading to the development of nano-enhanced phase change materials (NEPCMs).

This chapter reviews recent developments in NEPCMs and their role in improving thermal and solar energy storage performance. It discusses different types of nanoparticles, preparation techniques, and the mechanisms through which nano-additives enhance thermal properties. Key performance parameters such as thermal conductivity, latent heat storage, and phase stability are also examined. In addition, the chapter highlights important engineering challenges, including nanoparticle dispersion stability, large-scale production, cost considerations, and system integration. Finally, potential research directions are presented, focusing on advanced nanostructured materials, hybrid enhancement strategies, improved modeling approaches, and sustainable material development. Overall, NEPCMs show strong potential for improving the efficiency and reliability of next-generation thermal energy storage systems.

Keywords: Phase Change Materials (PCM), Nano-Enhanced Phase Change Materials (NEPCM), Thermal Energy Storage, Solar Energy Storage, Nanoparticle Thermal Enhancement, Latent Heat Storage, Renewable Energy Systems

TRADITIONAL KNOWLEDGE OF INDIGENOUS COMMUNITIES ON MEDICINAL PLANTS USES FOR THE TREATMENT OF VARIOUS DISEASE

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ABSTRACT

Traditional knowledge of medical plants has been an important part of healthcare practices in India since ancient times. Indigenous and tribal Communities have developed extensive knowledge about the medicinal properties of local plants through generations of observation and cultural traditions. In Many rural and forest regions, medicinal plants remain one of the most accessible and affordable Sources of primary health care for treating various human aliments.

Chhattisgarh is rich in forest resources and biodiversity and is home to several tribal communities, such as Gond, Baiga, Halba and muria. These indigenous Communities Possess valuable ethno medicinally knowledge and traditionally depend on forest plants to Prepare herbal remedies for common diseases like fever, Cough, cold digestive disorders, skin infections, wounds and other ailments. The knowledge of identifying and preparing medicinal plants is usually passed orally from traditional healers and elders to younger generation.

Balod district of Chhattisgarh also has rich vegetation where local communities use Various Medicinal plants for traditional treatment. some commonly used plants include Neem (*Azadirachta indica*), Bael (*Aegle marmelos*), Mahua (*Madhuca longifolia*), Harra (*Terminalia chebula*), Sarpagandha (*Rauvolfia serpentina*), and Kalmegh (*Andrographis paniculata*). Different parts of these plants such as roots, leaves, bark, seeds and fruits are used to prepare medicines in the form of decoctions, powders and pastes. The present study aims to document and highlight the traditional medicinal knowledge of indigenous communities regarding the use of medicinal plants in Balod district. Documentation of such ethnomedicinal knowledge is important for preserving cultural heritage and promoting future research in plant-based medicine and sustainable healthcare practices.

Key words: Ethnomedicinal plants, Traditional knowledge, Indigenous communities, Herbal medicine, Plant-based medicine.

IMPORTANCE OF ENERGY FOR DEVELOPMENT AND SOCIETY

ABSTRACT

Energy is essential for economic growth, social development, and improving quality of life. However, the traditional dependence on fossil fuels such as coal, oil, and natural gas has led to serious environmental problems, including climate change, air pollution, and depletion of natural resources. Therefore, the integration of advanced technology with sustainable energy systems has become crucial for building a cleaner and more secure future.

Modern technologies are transforming the way energy is produced, stored, and consumed. Renewable energy sources such as solar, wind, hydro, and biomass are increasingly being adopted as alternatives to conventional fuels. Technological innovations like smart grids, energy storage systems, artificial intelligence, and efficient energy management systems help improve the reliability and efficiency of these renewable resources. These technologies allow better monitoring, distribution, and optimization of energy use, reducing waste and enhancing sustainabil.

A sustainable energy future depends on continuous technological advancement, responsible energy consumption, and global cooperation. By integrating renewable energy with innovative technologies, societies can reduce environmental impacts, ensure energy security, and create a more sustainable and resilient world for future generations. Energy and technology together are key drivers of a sustainable future. The adoption of renewable energy and advanced technologies can reduce environmental damage, improve energy efficiency, and ensure a cleaner and more secure world for future generations.

Keywords: Importance of energy for development and society, Environmental problems caused by fossil fuels, Role of renewable energy (solar, wind, hydro, biomass).

GREEN ENERGY SYNTHESIS AND ITS TECHNO-ECONOMIC VIABILITY IN THE INDIAN CONTEXT

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ABSTRACT

India's shift towards green energy is no longer limited to deploying individual renewable technologies but is increasingly focused on building integrated and intelligent energy systems. This study explores major green energy synthesis pathways, including solar photovoltaics, wind energy systems, biomass conversion, and green hydrogen production through electrolysis. It highlights how combining these sources with energy storage and hybrid configurations can address the inherent variability of renewables and improve overall system reliability.

Recent technological improvements—such as more efficient solar cells, advanced wind turbines, and better electrolyzer performance—have enhanced energy output and system efficiency. At the same time, the use of smart grids, data-driven forecasting, and automated control systems is enabling more effective energy management and distribution. Decentralized solutions like micro grids are also gaining importance, especially in improving energy access in rural and remote areas.

From an economic perspective, renewable energy sources in India have become increasingly cost-competitive with conventional power generation. However, practical challenges remain, including grid integration issues, infrastructure limitations, land constraints, and the high initial investment required for storage and hydrogen technologies. Overall, the findings suggest that hybrid renewable systems supported by storage offer better long-term benefits in terms of cost and sustainability. While green energy synthesis in India is both technically feasible and promising, its large-scale success will depend on continued technological innovation, supportive policies, and modernization of the power sector.

Keywords: Green energy synthesis, Techno-economic analysis, LCOE, Hybrid systems, Smart grid, India

TRANSFORMER-BASED SOLAR RADIATION PREDICTION USING METEOROLOGICAL DATA

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ABSTRACT

Accurate prediction of solar radiation is essential for efficient solar energy management and power generation planning. This study proposes a Transformer-based deep learning model for solar radiation prediction using meteorological data obtained from the Indian Meteorological Department (IMD). The dataset contains multiple atmospheric variables including dry bulb temperature, wet bulb temperature, surface temperature, relative humidity, vapor pressure, wind speed, and sunshine hours. Prior to model training, the dataset was normalized using Min-Max scaling to ensure stable learning.

A Transformer encoder architecture with multi-head attention was implemented to capture complex relationships between meteorological variables. The model was trained using the Adam optimizer with mean squared error as the loss function. The dataset was divided into training and testing sets using an 80:20 ratio to evaluate model generalization. The experimental results demonstrate strong predictive capability of the Transformer model. The Actual vs Predicted scatter plot shows a strong linear relationship, indicating high agreement between predicted and observed solar radiation values. The time-series comparison of actual and predicted solar radiation reveals that the model successfully captures temporal fluctuations and trends in solar radiation data. Additionally, the prediction error distribution indicates that most prediction errors are concentrated near zero, suggesting stable and accurate model performance.

Feature correlation analysis further reveals significant relationships between solar radiation and meteorological variables such as temperature, sunshine hours, and humidity, which contribute to improved model prediction capability. Overall, the results demonstrate that the Transformer-based model provides reliable and accurate solar radiation forecasting, making it a promising approach for renewable energy prediction and solar power system optimization.

Keywords: Solar Radiation Prediction, Transformer Model, Deep Learning, Renewable Energy Forecasting, Meteorological Data

A STUDY ON WASTEWATER TREATMENT AND RECYCLING PRACTICES IN BHILAI STEEL PLANT

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ABSTRACT

Wastewater management is an important aspect of sustainable industrial development, particularly in large steel manufacturing units. This study focuses on the wastewater treatment and recycling practices adopted in Bhilai Steel Plant (BSP), one of the major integrated steel plants in India. The research examines the sources of wastewater generated from different units such as coke ovens, blast furnaces, rolling mills, and cooling systems. It also analyzes the treatment methods employed in the plant, including physical, chemical, and biological processes to remove contaminants. The study highlights the efficiency of wastewater treatment facilities and the strategies implemented for recycling and reuse within the plant operations. Effective recycling practices help in reducing freshwater consumption, minimizing environmental pollution, and promoting sustainable water resource management. The findings emphasize the importance of advanced wastewater treatment technologies and efficient management systems in achieving environmental sustainability in the steel industry.

A STUDY ON STRUCTURAL AND OPTICAL PROPERTIES OF SODIUM CALCIUM PHOSPHORS

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ABSTRACT

Sodium calcium phosphors have attracted considerable attention due to their promising luminescent properties and potential applications in lighting, display devices, and optoelectronic technologies. In this study, the luminescence properties of sodium calcium phosphor were investigated after synthesizing the material through a suitable preparation method. The structural and optical characteristics of the synthesized phosphor were analyzed to understand its emission behavior and efficiency. Photoluminescence studies revealed that the sodium calcium phosphor exhibits strong emission under appropriate excitation, indicating efficient luminescent performance. The emission spectra and intensity were examined to understand the energy transfer processes responsible for luminescence. The obtained results suggest that sodium calcium phosphor is a promising material for applications in solid-state lighting, display systems, and other luminescent devices, contributing to the development of efficient phosphor materials for advanced optical applications.

COMPARATIVE STUDY ON THE EFFECT OF DIFFERENT LUMINESCENT MATERIALS FOR RADIATION DOSIMETRY OF X-RAYS, BETA RAYS, AND GAMMA RAYS

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ABSTRACT

Radiation dosimetry plays a crucial role in monitoring ionizing radiation exposure, ensuring safety in medical, industrial, and environmental applications. This study investigates the comparative performance of various luminescent materials, including thermoluminescent (TLD) and optically stimulated luminescent (OSL) materials, in detecting X-rays, beta rays, and gamma rays. The research focuses on materials such as LiF:Mg,Ti, Al_2O_3:C, $CaSO_4$:Dy, and emerging nanophosphors, analyzing their sensitivity, dose-response linearity, energy dependence, and fading characteristics. Experimental evaluations reveal significant differences in luminescence intensity and charge trapping mechanisms across different radiation sources. The study further explores factors like reusability, stability, and environmental effects on material performance. Comparative analysis highlights the advantages and limitations of each material, guiding the selection of optimal dosimetric materials for specific applications. The findings contribute to the development of high-precision dosimetry systems, improving radiation monitoring efficiency and accuracy. This research is particularly relevant for applications in radiation therapy, occupational safety, space exploration, and environmental radiation assessment. The study concludes with recommendations for future advancements in dosimetric materials, emphasizing the potential of nanostructured phosphors for enhanced radiation detection

IMPACT OF ENVIRONMENTAL HEAVY METALS (LEAD, ARSENIC) VIA AIR POLLUTION IN HUMAN HEALTH

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ABSTRACT

Air pollution in industrial cities contains particulate matter enriched with toxic heavy metals such as lead (Pb) and arsenic (As), which originate mainly from coal combustion, smelting activities, vehicular emissions, and open waste burning. Residents of Raipur, Chhattisgarh—an important industrial hub with numerous steel plants, coal-fired power stations, and dense traffic—are chronically exposed to these airborne contaminants. Previous environmental studies have indicated that coal-based industries are a major source of atmospheric arsenic in the region, while road traffic significantly contributes to metal deposition in urban dust. Once inhaled, Pb and As particles can deposit in the lungs, enter systemic circulation, and accumulate in organs including the liver. A major mechanism underlying heavy-metal toxicity is oxidative stress, where metals promote the generation of reactive oxygen species (ROS) and disrupt antioxidant defense systems such as glutathione, superoxide dismutase (SOD), and catalase. Elevated ROS levels trigger lipid peroxidation, DNA oxidation, and protein damage, producing biomarkers such as malondialdehyde (MDA), F2-isoprostanes, and 8-hydroxy-2′-deoxyguanosine (8-OHdG). These processes activate inflammatory pathways and alter gene expression, potentially leading to liver injury, fibrosis, and hepatocellular carcinoma. Recent epidemiological, experimental, and toxicological studies consistently report associations between Pb and As exposure and increased oxidative stress biomarkers, impaired liver enzyme profiles, and enhanced lipid peroxidation. However, despite growing evidence globally, limited research has explored the mechanistic links between inhaled airborne metals, oxidative stress biomarkers, and liver health in populations living in highly polluted industrial cities such as Raipur. Therefore, this proposed doctoral research aims to investigate the relationship between airborne Pb and As exposure, oxidative stress biomarkers, and lipid peroxidation pathways in humans, with a focus on identifying early biochemical indicators of heavy-metal–induced liver injury and cancer risk in the urban population of Raipur.

Keywords: heavy metals, lead, air pollution, liver disease, Raipur.

A STUDY ON A NOVEL MATRIX FORMULATION APPROACH FOR MATHEMATICAL MODELING AND OPTIMIZATION OF MULTI-OBJECTIVE TRANSPORTATION PROBLEMS

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ABSTRACT

The transportation problem is a well-known model for distributing goods from origins to destinations. In practice, multiple conflicting objectives often arise, such as minimizing cost, time, risk, or environmental impact. To address this, we introduce a new four-objective extension of the multi-objective transportation problem (MOTP). In this model, each cell of the transportation table is expressed as a 2×2 cost matrix, which allows four objectives to be considered together. A stepwise algorithm using row maxima, column maxima, and a selection parameter is applied until all supply and demand values are satisfied. A numerical example demonstrates the working of the method. The results show that the approach produces a feasible and balanced solution, providing a practical tool for solving complex transportation problems.

Keywords: Transportation Problem (TP), Multi-Objective Transportation Problem (MOTP), Four-Objective Model, Cost Matrix.

INVENTORY OPTIMIZATION THROUGH THE LENS OF BALANCE AND CONSCIOUS CONSUMPTION: A MATHEMATICAL APPROACH

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ABSTRACT

Sustainable development demands a paradigm shift from purely profit-oriented decision-making toward models that integrate scientific efficiency, ethical responsibility, and human consciousness. This study extends classical inventory optimization by incorporating sustainability and ethical constraints into EOQ-based models.

Keywords: Inventory Optimization, Sustainable Development, Operational Research, Conscious Consumption

A SMART AGRICULTURE APPROACH FOR MANGO RIPENESS DETECTION AND SHELF-LIFE PREDICTION USING IOT

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ABSTRACT

Mango is among the most consumed tropical fruits and it is very sensitive to environmental factors in their storage and transportation and may be easily affected resulting in their quick ripening and spoilage. Fruit ripeness and spoilage must be detected early to avoid post-harvest losses and preserve the quality of fruits. Conventional ways of determining the ripeness of mangoes are largely determined by human eyes of farmers and sellers, which are more than subjective, imprecise and ineffective when dealing with a huge amount of fruits. To eliminate these constraints, the proposed system suggest an Internet of Things based solution to real-time monitoring of mango fruit ripeness and the risk of spoilage and predictive shelf-life estimates. The developed system employs a set of inexpensive sensors consisting of an ethylene gas sensor, temperature-humidity sensors, in order to inexpensively measure the environmental variables that are related to the maturity of fruits. The sensor data is collected and preprocessed by a microcontroller platform, like ESP32, and an initial classification of the data as ripeness is performed. The analyzed data is sent through the Wi-Fi to a cloud-based IoT service where sophisticated analytics are used to categorize mangoes into various ripeness levels such as unripe, ripening, ripe, and spoiled and to compute the remaining shelf life. Farmers and other stakeholders can also receive real-time monitoring, data visualization, and alerts on the mobile or web-based dashboard and when fruits are at the optimal level of ripeness or indicate signs of spoilage. Preliminary testing on stored sets of mangoes proves that the Random Forest model classifies the ripeness of the mangoes with 96% accuracy give predictable shelf-life results. The suggested IoT based system will allow to efficiently manage a post-harvest, minimize losses on fruit, and improve the quality of products delivered to consumers, which indicates the possibilities of IoT technologies in intelligent agriculture and management of fruit supply chains.

Keywords: Internet of Things, Random Forest, Mango Ripeness Detection, Post-Harvest Monitoring, Shelf Life Prediction

ORGANIC HYDROPHOBIC GOLD@RESIN NANOCOMPOSITES FOR DETECTION OF PYMETROZINE INSECTICIDE IN VEGETABLE SAMPLES

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ABSTRACT

The goal of this work was to assess the competence of organic hydrophobic resin bound gold nanocomposites (Au@RNCs) for detection of pymetrozine insecticide from vegetable samples employing surface-enhanced/attenuated total reflectance-Fourier transform infrared (SE/ATR-FTIR) spectroscopy. The adsorption isotherm models, including the Langmuir, Freundlich and Temkin, are tested to reveal the interactive behaviour between the OH/R-AuNCs and pesticide. The characteristic absorption band obtained at 3019.94 cm^{-1} was utilized for the quantitative analysis of pymetrozine insecticide in vegetable samples. The method was found to be accurate and precise, with mean recovery values in the range of 94.5-110 %, correlation coefficient of 0.992 %, and detection limit of 2.65 µg mL^{-1}. The adsorption efficiency of the designed OH/R-AuNCs significantly influences the SE/ATR-FTIR response of the pymetrozine around 90%. The optimized and validated method was applied to determine the residual concentrations of the pymetrozine that had been applied to vegetable samples.

Keywords*:* Pymetrozine insecticide; Au@RNCs; SE/ATR-FTIR; Adsorption isotherms; Analytical validation.

STUDIES TOWARDS THE SYNTHESIS OF ALDGAMYCIN – M

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ABSTRACT

Aldgamycins consist of a 16- membered macrocyclic lactone ring with rare branched octose unit. These aldgarosetype branched octoses are rare in nature. Wide variety of 16- membered macrolide structures can be appreciated in nature due to their significant biological activities. Antibiotic macrolides play a therapeutically significant role in drug discovery program. They are characterized as among the safest of antibiotics and are successfully been used to treat infections caused by gram-positive organisms, certain gram-negative and anaerobic bacteria.The most frequently used antibiotic macrolides, erythromycin and josamycin, belong to the groups of 14-membered and 16-membered ring derivatives, respectively. A convergent and highly stereoselctive synthesis of macrolide framework of aldgamycin – M is described. The salient features of the synthesis are the utilization of enzymatic desymmetrization, Crimmin's non-Evans *syn* aldol reaction, Wittig olefination, Yamaguchi esterification and Ring closing metathesis reaction (RCM).

Key Words: Aldgamycin – M, Synthesis, Enzymatic Desymmetrization, Crimmin's non-Evans *syn* Aldol reaction, Wittig Olefination, Yamaguchi Esterification and Ring closing metathesis reaction (RCM).

PRIME NUMBER DISTRIBUTION IN CRYPTOGRAPHIC ALGORITHMS: A MATHEMATICAL STUDY

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ABSTRACT

Prime numbers play a fundamental role in modern cryptography and form the mathematical foundation of many secure communication systems. Public-key cryptographic algorithms such as RSA and Elliptic Curve Cryptography rely heavily on the properties of prime numbers and their distribution. The generation of large prime numbers and their unpredictability are essential for maintaining the security of cryptographic protocols. This paper presents a mathematical study of the distribution of prime numbers and its significance in cryptographic algorithms. The study focuses on number-theoretic concepts including the Prime Number Theorem, modular arithmetic, and the role of large primes in key generation processes. The analysis also discusses how the distribution of prime numbers influences the efficiency and security of cryptographic systems. The results highlight the importance of prime number theory in modern cryptography and demonstrate how mathematical insights into prime distribution contribute to the development of secure and efficient cryptographic frameworks.

Keywords: Prime Numbers, Number Theory, Prime Number Theorem, Cryptography, Cryptographic Algorithms.

ENHANCED OPTIMIZATION TECHNIQUES FOR MANAGING INVENTORY OF PERISHABLE PRODUCTS

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ABSTRACT

Due to factors such as short shelf life, spoiling risk, demand fluctuations, and quality deterioration over time, managing inventory for perishable items poses particular issues. When these intricacies aren't taken into account by traditional inventory models, it may lead to more waste, greater operating expenses, and unhappy customers. As a result, new methods of optimization have evolved that use smart forecasting, real-time decision systems, and sophisticated mathematical modeling to cut down on losses and increase efficiency. In this work, we take a look at some of the more modern methods, including hybrid algorithms like genetic and simulation-based heuristics, optimization models that use stochastic and fuzzy logic, and techniques for dynamic pricing. Improved automated inventory management and precise product condition monitoring are made possible by technologies like Internet of Things (IoT) sensors, radio frequency identification (RFID) tracking, and predictive analytics. These cutting-edge techniques help with freshness-based demand management, safety stock reduction, and better replenishment scheduling. Furthermore, there is an increasing emphasis on sustainability factors, with a focus on minimizing waste and optimizing resource use using methods like as FEFO and Markdown optimization. Supply chains may be made more robust and responsive via the integration of smart data-driven technologies and adaptive optimization approaches.

Keywords: Perishable Inventory, Optimization Techniques, Dynamic Pricing, Machine Learning Forecasting, Deterioration Modeling.

THE IMPACT OF GREEN BANKING PRACTICES ON ENVIRONMENTAL SUSTAINABILITY AND FINANCIAL PERFORMANCE

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ABSTRACT

Green banking has emerged as an important approach in the banking sector to promote environmental sustainability and responsible financial practices. It refers to the adoption of eco-friendly policies, technologies, and banking operations that reduce the negative impact of banking activities on the environment. The present study examines the impact of green banking initiatives on environmental protection, operational efficiency, and customer awareness in the banking sector.

The study highlights various green banking practices such as online banking, paperless transactions, green loans, energy-efficient infrastructure, and financing of environmentally sustainable projects. These initiatives help reduce carbon emissions, minimize paper usage, and promote sustainable economic development. Furthermore, green banking enhances the corporate social responsibility (CSR) image of banks and encourages customers to adopt environmentally responsible financial behavior.

The findings suggest that green banking not only contributes to environmental conservation but also improves the efficiency and reputation of financial institutions. However, challenges such as lack of awareness, technological barriers, and initial implementation costs still exist. The study concludes that with proper policies, awareness programs, and regulatory support, green banking can play a significant role in achieving sustainable development and environmental protection.

ENHANCING SOLID WASTE MANAGEMENT: STRATEGIES FOR EFFICIENT WASTE HANDLING AND DISPOSAL

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ABSTRACT

Environmental pollution has increased significantly due to the growing volume of waste, including solid, liquid, and hazardous waste generated by industrial and human activities. Among these, the management of solid waste has become a major environmental challenge, particularly in India due to its large population and rapid urbanization. Inefficient waste handling and disposal practices contribute to environmental degradation, health hazards, and the depletion of natural resources. Therefore, effective solid waste management is essential to maintaining a clean, sustainable environment.

Recognizing the seriousness of this issue, the Government of India has launched several initiatives to promote environmental cleanliness and responsible waste management. One of the most significant initiatives is the Swachh Bharat Mission, introduced on October 2, 2014, which aims to improve sanitation, encourage waste segregation, and raise public awareness about environmental protection.

This study focuses on strategies to enhance solid waste management by improving waste handling, segregation, collection, and disposal practices. It also emphasizes the importance of public participation and sustainable waste management policies. Implementing effective waste management strategies can help reduce environmental pollution, promote resource conservation, and support sustainable development for future generations.

Keywords – Solid waste, Waste handling, Waste disposal, Solid waste management, Sustainability.

DESIGN AND CONTROL OF CASCADED H-BRIDGE 17-LEVEL INVERTER WITH REDUCED TOTAL HARMONIC DISTORTION

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ABSTRACT

Multilevel inverters (MLIs) are widely used in modern power electronics applications such as renewable energy integration, electric vehicles, and high-power motor drives. Conventional two-level inverters suffer from high harmonic distortion and switching losses. This paper presents the design and simulation of a 17-level cascaded H-bridge multilevel inverter using the Phase Opposition Disposition Pulse Width Modulation (POD-PWM) technique. The proposed inverter topology generates a stepped output voltage waveform that closely approximates a sinusoidal waveform while reducing Total Harmonic Distortion (THD). The system is modeled and simulated using MATLAB/Simulink. Simulation results demonstrate that the proposed topology achieves improved output waveform quality with voltage THD of approximately 7.26% and current THD of 3.09%. The results indicate that the proposed inverter is suitable for photovoltaic (PV) based power generation systems.

APPLICATION OF GRAPH THEORY IN TRAVELLING SALESMAN PROBLEM (TSP)

ABSTRACT

In this paper we have discussed about Travelling Salesman Problem (TSP) closely related with Hamiltonian Circuit. A salesman is required to visit number of cities during a Trip. The distance between the cities in what order should he travel so as to visit every city precisely once and return home, with the minimum mileage traveled.

Keywords: Graphs, Shortest Path, Hamiltonian Circuit, Weighted graph, Travelling Salesman Problem (TSP).

INVESTIGATIONS OF ADVANCED PROPERTIES AND APPLICATIONS OF I-FUNCTION

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ABSTRACT

The I-function represents one of thr most general classes of special functions in modern mathematical analysis. It extends the Fox H-function and the Meijer G-function and provides a unified representation for numerous classical special functions. Because of its flexibility in parameterization and its definition through Mellin–Barnes contour integrals, the I-function has significant applications in fractional calculus, statistical distribution theory, and mathematical physics. This paper investigates several advanced analytical properties of the I-function, including convergence criteria, transformation relations, and integral identities. New theoretical results are derived that extend existing functional relations and demonstrate how the I-function can be applied to generalized differential equations and probabilistic models. Graphical analysis of representative cases is provided to illustrate behavior under parameter variation. The results strengthen the theoretical foundation of generalized special function theory and provide a framework for future analytical and computational applications.

OPTIMAL MEDICAL TREATMENT SELECTION USING A FUZZY MULTI-CRITERIA DECISION-MAKING MODEL

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ABSTRACT

Selecting an appropriate medical treatment often requires evaluating several competing criteria, including therapeutic effectiveness, potential side effects, treatment cost, patient preferences, and clinical risk. These factors are frequently associated with vagueness and uncertainty, making the decision-making process complex. To address this challenge, this study develops a fuzzy multi-criteria decision-making (FMCDM) model for identifying optimal treatment strategies.

The proposed approach utilizes fuzzy set theory to represent imprecise clinical information and subjective expert assessments, enabling both decision criteria and treatment alternatives to be expressed using fuzzy numbers. A structured decision framework is established by integrating fuzzy weighting methods with an appropriate multi-criteria evaluation technique, allowing treatment options to be systematically ranked in uncertain decision environments.

By incorporating uncertainty present in clinical assessments and patient-specific considerations, the model improves the reliability and transparency of the decision-making process. A numerical illustration is provided to demonstrate the applicability and effectiveness of the proposed framework in supporting clinicians and healthcare decision-makers in selecting suitable treatment alternatives. The results indicate that the FMCDM-based approach offers a flexible and robust tool for medical treatment selection under conditions of uncertainty.

Keywords: Fuzzy multi-criteria decision-making; Medical treatment selection; Healthcare decision support; Clinical uncertainty; Risk assessment; Healthcare management

DIAGNOSIS OF SICKLE CELL ANEMIA BY HEMOGLOBIN ELECTROPHORESIS IN PATIENTS FROM DISTRICT BALODABAZAR

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ABSTRACT

Introduction

Sickle cell anemia (SCA) is an inherited hemoglobinopathy caused by a point mutation in the β-globin gene, resulting in the substitution of valine for glutamic acid at the sixth position of the β-globin chain and the production of abnormal hemoglobin S (HbS). Under hypoxic conditions, HbS polymerizes, leading to deformation of erythrocytes into a sickle shape, causing hemolysis, vaso-occlusion, and chronic anemia. Sickle cell disorders are prevalent in many tribal and rural populations of central India, including the state of Chhattisgarh. Early and accurate laboratory diagnosis is essential for disease management and genetic counseling. Hemoglobin electrophoresis is considered a reliable and standard diagnostic technique for identifying hemoglobin variants such as HbA, HbS, and HbF.

Material and Methods

This cross-sectional study was conducted among patients from District Balodabazar who were clinically suspected of anemia or hemoglobinopathies. A total of 200 venous blood samples were collected in EDTA anticoagulant tubes from individuals attending selected health centers. Preliminary hematological parameters, including hemoglobin concentration and red blood cell indices, were analyzed using standard hematological methods. Hemoglobin electrophoresis was performed using cellulose acetate membrane at alkaline pH (8.6) to separate different hemoglobin fractions based on their electrophoretic mobility. The bands obtained were compared with standard controls for identification of hemoglobin variants.

Results

Among the 200 samples analyzed, 160 (80%) individuals showed a normal hemoglobin pattern (HbAA). Sickle cell trait (heterozygous HbAS) was identified in 30 individuals (15%), while 10 individuals (5%) were diagnosed with sickle cell disease (homozygous HbSS). The prevalence of HbS-related disorders was higher in the age group of 15–30 years. Clinical manifestations among affected individuals included pallor, fatigue, joint pain, and recurrent episodes of anemia.

Conclusion

The study demonstrates that hemoglobin electrophoresis is a sensitive, specific, and reliable diagnostic method for the detection of sickle cell anemia and sickle cell trait. Implementation of routine screening programs and early diagnosis in high-risk populations of District Balodabazar can contribute significantly to disease management, genetic counseling, and reduction of morbidity associated with sickle cell disorders.

Keywords: Sickle Cell Anemia, Hemoglobin Electrophoresis, Hemoglobin S, Sickle Cell Trait, Hemoglobinopathy, Hematological Screening

IMPACT OF ENVIRONMENTAL HEAVY METALS (LEAD, ARSENIC) VIA AIR POLLUTION IN HUMAN HEALTH

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ABSTRACT

Air pollution in industrial cities contains particulate matter enriched with toxic heavy metals such as lead (Pb) and arsenic (As), which originate mainly from coal combustion, smelting activities, vehicular emissions, and open waste burning. Residents of Raipur, Chhattisgarh—an important industrial hub with numerous steel plants, coal-fired power stations, and dense traffic—are chronically exposed to these airborne contaminants. Previous environmental studies have indicated that coal-based industries are a major source of atmospheric arsenic in the region, while road traffic significantly contributes to metal deposition in urban dust. Once inhaled, Pb and As particles can deposit in the lungs, enter systemic circulation, and accumulate in organs including the liver. A major mechanism underlying heavy-metal toxicity is oxidative stress, where metals promote the generation of reactive oxygen species (ROS) and disrupt antioxidant defense systems such as glutathione, superoxide dismutase (SOD), and catalase. Elevated ROS levels trigger lipid peroxidation, DNA oxidation, and protein damage, producing biomarkers such as malondialdehyde (MDA), F2-isoprostanes, and 8-hydroxy-2′-deoxyguanosine (8-OHdG). These processes activate inflammatory pathways and alter gene expression, potentially leading to liver injury, fibrosis, and hepatocellular carcinoma. Recent epidemiological, experimental, and toxicological studies consistently report associations between Pb and As exposure and increased oxidative stress biomarkers, impaired liver enzyme profiles, and enhanced lipid peroxidation. However, despite growing evidence globally, limited research has explored the mechanistic links between inhaled airborne metals, oxidative stress biomarkers, and liver health in populations living in highly polluted industrial cities such as Raipur. Therefore, this proposed doctoral research aims to investigate the relationship between airborne Pb and As exposure, oxidative stress biomarkers, and lipid peroxidation pathways in humans, with a focus on identifying early biochemical indicators of heavy-metal–induced liver injury and cancer risk in the urban population of Raipur.

KEYWORDS: heavy metals, lead, air pollution, liver disease, Raipur.

APPROXIMATE COMMON FIXED POINT RESULTS IN NEUTROSOPHIC FUZZY B-METRIC SPACES FOR MATHEMATICAL MODELING OF UNCERTAINTY

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ABSTRACT

Fixed point theory is an important area of nonlinear analysis and has wide applications in applied mathematics, engineering, computer science, and optimization problems. In many real-world situations, uncertainty and indeterminacy play a significant role in mathematical modeling. To address such issues, neutrosophic fuzzy structures provide an effective framework for handling uncertain, inconsistent, and indeterminate information. Motivated by these developments, this paper investigates approximate common fixed point results in the setting of neutrosophic fuzzy b-metric spaces.

We introduce suitable contractive conditions for a class of mappings defined on neutrosophic fuzzy b-metric spaces and establish new approximate common fixed point theorems under generalized contraction principles. The obtained results extend and generalize several well-known fixed point results in fuzzy metric spaces and generalized metric structures. The existence and uniqueness of approximate common fixed points are derived under appropriate admissibility and compatibility conditions.

Furthermore, an illustrative example is provided to demonstrate the validity and applicability of the established results. The proposed framework offers a useful mathematical tool for modeling uncertainty in interdisciplinary fields such as decision-making processes, optimization techniques, and computational mathematics. These results contribute to the theoretical development of fixed point theory in neutrosophic environments and open new directions for future research in mathematical modeling under uncertainty.

Key words: Fixed Point Theory, Neutrosophic Fuzzy b-Metric Space, Approximate Common Fixed Point, Mathematical Modeling, Uncertainty.

IOT-BASED SMART VERTICAL FARMING MONITORING SYSTEM

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ABSTRACT

There are many unprecedented challenges facing the agricultural sector on a global scale, including urbanisation, climate instability, and the reduction of arable land. This document introduces a smart vertical farm that employs Internet of Things (IoT) technology to optimise resource use; hence, the aim of this research paper is to provide an overview of an automated climate and irrigation control system that can ensure efficient resource use via a smart vertical farm (SVF) with IoT capability. The system is based on an ESP32 microcontroller and incorporates a network of high-resolution sensors to record real-time data on environmental parameters, such as: soil moisture, pH, electrical conductivity (EC), and light intensity; NPK data is monitored via an NPK sensor at all times. The gathered data is transmitted wirelessly to the ThingSpeak cloud platform, where Cloud-based predictive analytics prediction and statistical real-time algorithms are used to control the corresponding actuators (water pumps, ventilation, CO_2 enrichment systems, etc.) in order to create optimal growing conditions. The results of the experiments demonstrated that water consumption was reduced by 30% (or more) and that the potential yield of crops was increased due to precise nutrient delivery and atmospheric control of the plants. The use of data-driven solutions reduces human errors and decreases dependence on large-scale traditional farming, thus reducing the risk of being affected by adverse climate-related events. In addition to the above benefits, real-time NPK monitoring allows for precise application of fertilisers, which will minimise soil degradation and runoff while maximising metabolic efficiency of plants. A bi-directional communication interface allows for remote monitoring and manual override of the system enabling higher level agricultural management with minimal labor cost. The combined use of Cloud Computing combined with sensor fusion and automated control creates a scalable and sustainable system for Controlled environment agriculture (CEA) and demonstrates how the implementation of IoT will allow for progress in vertical farming which will significantly help address food security issues and conserve valuable global natural resources to meet the nutritional needs of over 8 billion people worldwide.

COMMON FIXED POINT THEOREMS IN NEUTROSOPHIC FUZZY *B*-METRIC SPACES BY HYBRID MAPPINGS

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ABSTRACT

In this paper, we investigate the existence and uniqueness of common fixed points for hybrid mappings in the framework of neutrosophic fuzzy *b*-metric spaces. By integrating the concepts of neutrosophic theory and fuzzy *b*-metric structures, we establish new common fixed point theorems for pairs of hybrid mappings under suitable contractive conditions. The presented results extend and generalize several well-known fixed point theorems in classical metric spaces, fuzzy metric spaces, and *b*-metric spaces. Our approach is based on iterative techniques and the properties of neutrosophic fuzzy *b*-metrics to obtain common fixed points for mappings involving both single-valued and multivalued operators. An illustrative example is provided to support the applicability of the main results. These findings contribute to the development of fixed point theory in generalized uncertain environments and may have potential applications in nonlinear analysis, optimization, and decision-making problems.

Keywords: Common fixed point, Neutrosophic fuzzy *b*-metric space, Hybrid mappings, Contractive condition.

TRAFFIC FLOW ANALYSIS IN DIFFERENT WEATHER CONDITIONS

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ABSTRACT

Among the most challenging problems in modern transport infrastructure is traffic congestion, which leads to increased travel times, increased fuel consumption, and reduced road safety. Weather is a factor that affects traffic flow behavior significantly among the many external factors that affect it. However, the effect of weather is either not considered in modern traffic forecasting models or is represented in a manner that is far too simple and unintelligible. To examine the effect of congestion behavior under different weather conditions, this study proposes a weather-sensitive framework for traffic flow analysis using historical traffic and weather data. The effect of traffic volume on meteorological factors such as precipitation, rainfall, snowfall, cloud cover and visibility is examined using the Metro Interstate Traffic Volume dataset. Several machine learning regression models such as Linear Regression, Decision Tree, Random Forest, AdaBoost, and Gradient Boosting are compared using historical traffic data to develop a data-driven congestion index. The experimental results show that for modeling the non-linear effect of weather on traffic flow, ensemble learning algorithms—more specifically, Gradient Boosting—are superior to other models. The results show the relevance of unintelligible data-driven approaches for intelligent transport systems and the need to incorporate weather variables in traffic analysis models.

Keywords—Traffic flow analysis, weather-aware traffic modeling, intelligent transportation systems, machine learning, traffic congestion prediction.

STRONG CONVERGENCE OF A HYBRID ITERATIVE ALGORITHM FOR NONEXPANSIVE AND NONSPREADING MAPPINGS

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ABSTRACT

In this paper, we study the approximation of common fixed points of non-expansive and non-spreading mappings in Banach spaces. A hybrid iterative algorithm is proposed to generate a sequence for approximating the common fixed point of these mappings. Under suitable conditions on the control parameters and the underlying Banach space, strong convergence of the generated sequence is established. The obtained results extend several known convergence results for classical iterative schemes in fixed point theory. An example is provided to illustrate the applicability of the proposed method.

Keywords: Fixed Point Theory, Nonexpansive Mapping, Nonspreading Mapping, Hybrid Iteration, Strong Convergence, Banach Space

2020 AMS Subject Classification: 47H10, 47H09, 47J25

STUDY OF TL KINETIC PARAMETERS OF CERIUM DOPED Ba2ZnSi2O7 PHOSPHOR

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ABSTRACT

A series of barium zinc silicate (Ba2ZnSi2O7) phosphors doped with Ce3+ ions are prepared using the conventional solid state reaction method. The structural characteristics of this phosphor were characterized using the XRPD technique. Experiments on thermoluminescence are conducted with varying UV irradiation periods and concentrations. Trap parameters like activation energy, order of kinetics, and frequency factors are also calculated using the peak shape approach. This phosphor's thermoluminescence emission spectra are also shown, with the highest peak at 410 nm. The findings show that this phosphor can be used in low UV dosimetry applications since it has good dosimetry capabilities up to 25 minutes of UV exposure.

RECENT PROGRESS IN GREEN SYNTHESIS OF METAL OXIDE NANOPARTICLES AND THEIR BIOMEDICAL APPLICATIONS

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ABSTRACT

The growing prevalence of antibiotic resistance poses a threat to world health, emphasizing the necessity of finding alternative antimicrobial medicines. Medicinal plants provide a source of bioactive chemicals that may be useful in combating resistant microbes. Additionally, metal-derived nanoparticles show excellent antimicrobial activity owing to their specific chemical and physical characteristics. This work focused on the environmentally friendly synthesis, characterization, and antimicrobial properties of zinc oxide nanoparticles from root extracts of the Ocimum basilicum var. thyrsiflora plant. The standard method was used to carry out the phytochemical screening while an agar diffusion technique was used to measure antimicrobial activity. Zinc oxide nanoparticles were effectively produced by bio-reduction using the root extract and analyzed by FTIR, SEM, EDX, XRD, and UV-Vis spectroscopic methods.

According to the antimicrobial activity result, ZnO NPs and the extract have significant antimicrobial activity against the particular fungus and bacteria. Notable results include a maximum ZOI (2mg/ml) of 15.2 mm for Staphylococcus aureus (S. aureus), 15 mm for Klebsiella pneumoniae (K. pneumoniae) and 16.5 mm for Aspergillus niger (A. niger) fungal strain. These results highlight the potential of green-synthesised zinc oxide nanoparticles from Ocimum basilicum var. thyrsiflora as alternate antimicrobial agents. The successful synthesis of the ZnO NPs was demonstrated by the UV-Vis spectroscopy analysis, which revealed a maximum wavelength of absorption at 373 nm. FTIR data demonstrated that various phytochemicals are present in the root extract which involve the bio-reduction of zinc oxide nanoparticles. XRD analysis showed that ZnO nanoparticles possessed a crystallite structure. FESEM was used to evaluate the morphology of the nanoparticles with a jagged or irregular shape & 16.60 nm in size.

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Keywords: Zinc oxide nanoparticle, Green synthesis, Phytochemicals, Antimicrobial activity.

A STUDY OF BIANCHI TYPE 1 COSMOLOGICAL MODEL WITH EOS PARAMETERS

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ABSTRACT

This study explores the evolution of the Bianchi Type I (B-I) anisotropic universe in the context of General Relativity, focusing on the role of varying Equation of State (EoS) parameters. While the standard cosmological principle assumes large-scale isotropy, small-scale anomalies in the Cosmic Microwave Background (CMB) justify the investigation of directional dependencies during the universe's expansion. Methodology and Theoretical Framework We derive the Einstein field equations for the Bianchi Type I metric, considering a medium filled with a perfect fluid or dark energy component. The analysis centers on the EoS parameter ($\omega = p/\rho$) ,where p represents pressure and ρ represents energy density. To achieve a determinate solution for the field equations, we apply specific physical constraints: A Power-Law or Exponential Law expansion for the scale factors. A constant or time-dependent Deceleration Parameter (DP). The assumption that the shear scalar (σ) is proportional to the expansion scalar (θ), facilitating the transition from anisotropy to isotropy. Key Results The results indicate that the EoS parameter plays a decisive role in the cosmic transition from a decelerated, matter-dominated phase to an accelerated expansion phase. We demonstrate that: In the early universe, anisotropy is significant, but it decays over time, satisfying the Cosmic No-Hair Theorem. The model effectively accommodates different dark energy regimes, including Quintessence ($w > -1$), the Cosmological Constant ($w = -1$), and the Phantom region ($w < -1$).The physical parameters—such as volume, Hubble parameter, and pressure—remain well-behaved and consistent with current observational data from Planck and WMAP. Conclusion our findings suggest that Bianchi Type I models with dynamical EoS parameters provide a more flexible and realistic description of the early universe's geometry while aligning with the late-time accelerated expansion observed in modern cosmology.

Keywords: Bianchi Type I, Anisotropy, Equation of State, Dark Energy, Deceleration Parameter.

RECENT ADVANCES IN MEDICINAL PLANT BIOTECHNOLOGY AND PHYTOCHEMISTRY

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ABSTRACT

Traditional healthcare systems have traditionally relied heavily on medicinal plants, which are still essential to the development of new drugs today. The yield and quality of secondary metabolites like alkaloids, flavonoids, terpenoids, and phenolics have greatly increased due to recent advancements in plant tissue culture, genetic engineering, metabolic engineering, and molecular marker techniques. The exact identification and structural elucidation of bioactive chemicals responsible for medicinal effects have been made possible by advances in phytochemistry, including as high-throughput screening, chromatography, and spectroscopy techniques. The identification of new substances having antibacterial, anticancer, anti-inflammatory, and antioxidant qualities has been expedited by these developments. Furthermore, the application of bioinformatics and nanotechnology has created new opportunities for in silico research of plant metabolites and targeted medicine administration. Through in vitro propagation and sustainable utilization techniques, the integration of biotechnology and phytochemistry also aids in the conservation of endangered medicinal plant species. Standardization, quality control, and regulatory concerns are still major obstacles in spite of these developments. All things considered, contemporary developments in phytochemistry and medicinal plant biotechnology present encouraging prospects for the creation of secure, efficient, and long-lasting plant-based treatments, bridging the gap between conventional wisdom and cutting-edge scientific advancement.

Keyword: Medicinal plants, Plant biotechnology, Phytochemistry, Secondary metabolites, Bioactive compounds

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Publisher :
Maa Vaishno Printers & Publication
Badhai Para Road, Lalita Chowk, Raipur,
Chhattisgarh, INDIA

9 789357 820707

Price : Rs 599/-