

WORLD TRADE CENTER®
JAIPUR



5th Global Conference

On

EMERGING TRENDS IN RESEARCH & DEVELOPMENT

(ETRD-26)



July 17 – 18, 2026



Hybrid Mode

ABSTRACT BOOK

ORGANIZED BY

Faculty of Science

PM GoE Govt. Vivekanand PG College, Maihar (M. P.)

IN COLLABORATION WITH

World Trade Center Jaipur

&

Scientific And Humanities Research Society, Jaipur

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ABOUT THE GOVT. VIVEKANAND PG COLLEGE



This college was established in the year 1972 and was subsequently made a govt. college in 1986. In 1995 post graduate classes in arts, science and commerce faculty were started and proved tremendously beneficial to students. It is affiliated to Awadhesh Pratap Singh University, Rewa and is the preferred exam center for different university examinations. It is recognized under section 12B of UGC Act and hence has been receiving developmental grants for the last 13 years. This college enjoys a leading position in sports at district and state level. NCC unit for girls and NSS units are functional and doing well. There is one career counselling cell which, with different innovative and student-friendly modes and methods, guide the students and helps them chart out their career graphs. Citizen Charter is given importance to and Proctorial Board keeps a constant vigil on all the activities on the college campus.

ABOUT SCIENTIFIC AND HUMANITIES RESEARCH SOCIETY

The Scientific and Humanities Research Society is a leading research and educational organization that is committed to the development and dissemination of cutting-edge knowledge in science and humanities. We specialize in offering high-quality training programs, workshops, conferences, FDPs and certification courses in emerging areas of technology, engineering, science and humanities etc.

As part of our ongoing mission to promote research, education and innovation in the field of sciences and humanities, we provide a dynamic platform for scholars, researchers, scientists and enthusiasts from diverse fields to collaborate, innovate, and share knowledge. We are committed to conduct conferences, seminars, symposia, FDP etc. in collaboration with reputed institutions. We aim to bridge the gap between scientific inquiry and humanistic understanding, recognizing that the most pressing challenges of our time require interdisciplinary approaches. Through a variety of initiatives, including conferences, publications, workshops, and public engagement activities. We strive to advance knowledge, promote ethical research practices, and contribute to a more informed and connected global community.



PUBLISHED BY

NATIONAL PRESS ASSOCIATES

Publishers and Distributors of Books and Journals

ADMIN OFFICE: C-24, GROUND FLOOR, PANCHSHEEL VIHAR, MALVIA NAGAR, NEW DELHI (INDIA)

REGIONAL OFFICE: 79, GURU ANGA DEV NAGAR, FLOWER ENCLAVE, DUGRI, LUDHIANA, (PUNJAB), INDIA.

BRANCH OFFICE: G-1003, PRAKRITI SOCIETY, BALEWADI PUNE, MAHARASHTRA, INDIA.

E-MAIL: npapublishing@gmail.com Website: www.npapublishing.in

ISBN: 978-93-7343-006-5



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(ETRD-26)

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ISBN No: 978-93-7343-006-5

The responsibility for the facts or opinions expressed in the book is entirely of the authors. Neither the publisher nor the editors are responsible for the same.

Printed & Published By:

National Press Associates

Head Office: C-24, Ground Floor, Panchsheel Vihar, Malviya Nagar, New Delhi-110017, India

Regional Office: 79, GAD Nagar, Flower Enclave, Dugri, Ludhiana, Punjab-141013, India

Branch Office: G-1003, Prakriti Society, Baner-Balewadi Road, Balewadi Pune, 411045 Maharashtra, India

Email: npublishing@gmail.com www.npublishing.in

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MESSAGE FROM THE GOVERNOR OF M.P.



मंगुभाई पटेल
MANGUBHAI PATEL



राज्यपाल, मध्यप्रदेश
GOVERNOR OF MADHYA PRADESH

लोक भवन
भोपाल-462052
LOK BHAVAN
BHOPAL-462052

क्रमांक 1136/लोकभवन/2026
भोपाल, दिनांक-25 जून, 2026

संदेश

हर्ष का विषय है कि शासकीय विवेकानंद स्नातकोत्तर महाविद्यालय, मैहर द्वारा “**International Conference on Emerging Trends in Research and Development 2026**” के अवसर पर **स्मारिका** का प्रकाशन किया जा रहा है।

अंतर्राष्ट्रीय सम्मेलन की स्मारिका का प्रकाशन शोध, नवाचार और ज्ञान-विनिमय को समर्पित एक अत्यंत सराहनीय एवं दूरदर्शी पहल है। यह सम्मेलन में उपस्थित प्रतिभागियों के मौलिक विचारों, गहन शोध निष्कर्षों तथा महत्वपूर्ण अकादमिक उपलब्धियों को व्यवस्थित रूप से संरक्षित करने का सशक्त माध्यम है। वर्तमान ज्ञान का दस्तावेजीकरण करने से शोधकर्ताओं को मार्गदर्शन मिलता है। भावी पीढ़ियों के लिए वैज्ञानिक चिंतन, रचनात्मक दृष्टिकोण और नवाचार की नई दिशाएं खुलती हैं। युवाओं को राष्ट्र के समग्र विकास एवं निर्माण में अनुसंधानात्मक योगदान देने की प्रेरणा मिलती है।

आशा है, सम्मेलन की स्मारिका शोधार्थियों, वैज्ञानिकों, शिक्षाविदों और विद्यार्थियों के ज्ञान को प्रकाशित कर समाज में वैज्ञानिक को बढ़ावा देने में सफल होगी। युवाओं को नवाचार के द्वारा विकास में सार्थक योगदान देने में सहयोगी होगी।

शुभकामनाएं,

मंगुभाई पटेल
(मंगुभाई पटेल)

MESSAGE FROM THE EDUCATION MINISTER M.P.



इन्दर सिंह परमार

मंत्री

उच्च शिक्षा, तकनीकी शिक्षा एवं आयुष
मध्यप्रदेश शासन

दिनांक: २३-०६-२०२६

ज्येष्ठ शुक्ल पक्ष दशमी, वि.स. २०८३

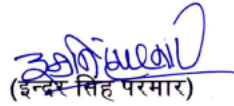
//संदेश//

अत्यंत हर्ष का विषय है कि शासकीय विवेकानंद स्नातकोत्तर महाविद्यालय, मैहर द्वारा दिनांक 17-18 जुलाई 2026 को “इंटरनेशनल कॉन्फ्रेंस ऑन इमर्जिंग ट्रेंड्स इन रिसर्च एंड डेवलपमेंट (ETRD 2026)” विषय पर अंतर्राष्ट्रीय कॉन्फ्रेंस का आयोजन किया जा रहा है।

आज के ज्ञान-आधारित युग में अनुसंधान, नवाचार एवं तकनीकी विकास किसी भी राष्ट्र की प्रगति के प्रमुख आधार हैं। ऐसे अंतरराष्ट्रीय सम्मेलन शिक्षाविदों, वैज्ञानिकों, शोधार्थियों, उद्योग विशेषज्ञों एवं विद्यार्थियों को एक साझा मंच प्रदान करते हैं, जहाँ नवीन विचारों, शोध निष्कर्षों एवं समसामयिक चुनौतियों पर सार्थक विमर्श संभव हो पाता है। आशा है कि यह सम्मेलन अनुसंधान संस्कृति को सुदृढ़ करने, नवाचार को प्रोत्साहित करने तथा शिक्षा एवं विकास के नए आयाम स्थापित करने में महत्वपूर्ण भूमिका निभाएगा।

ETRD 2026 जैसे कार्यक्रम विद्यार्थियों एवं शोधकर्ताओं को वैश्विक दृष्टिकोण प्रदान करने के साथ-साथ उन्हें उत्कृष्टता की ओर अग्रसर करने में सहायक सिद्ध होंगे।

महाविद्यालय द्वारा आयोजित अंतर्राष्ट्रीय कॉन्फ्रेंस के सफल आयोजन हेतु मेरी हार्दिक शुभकामनाएँ।


(इन्दर सिंह परमार)

कार्यालय : कक्ष क्रमांक ई-206, वल्लभ भवन-III, मंत्रालय, धोपाल, दूरभाष : 0755-2708685

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MESSAGE FROM THE VC APS UNIVERSITY



Dr. Rajendra Kumar Kuraria
M.Sc., Ph.D., PGDCA, M.Sc.(IT), MBA (HR & IT)

Vice-Chancellor

डॉ. राजेन्द्र कुमार कुड़रिया
कुलगुरु



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Date

दिनांक 23 जून 2026
विक्रम संवत्-2083

संदेश

यह जानकारी अत्यन्त प्रसन्नता हुई कि दिनांक 17-18 जुलाई 2026 को पीएमसीओई, शासकीय स्नातकोत्तर महाविद्यालय, मैहर में **इंटरनेशनल कॉन्फ्रेंस ऑन इमर्जिंग टेण्डेंस इन रिसर्च एण्ड डेवलपमेंट** पर एक सम्मेलन का आयोजन किया जा रहा है।

ज्ञान आधारित विकास और तीव्र तकनीकी परिवर्तन के वर्तमान युग में अनुसंधान एवं नवाचार सतत विकास तथा सामाजिक उन्नति के प्रमुख आधार बनकर उभरे हैं। उच्च शिक्षण संस्थान वैश्विक जिज्ञासा को प्रोत्साहित करने, वैज्ञानिक दृष्टिकोण विकसित करने तथा विद्वानों एवं विशेषज्ञों के मध्य विचार-विमर्श के लिये प्रभावी मंच उपलब्ध कराने में महत्वपूर्ण भूमिका निभाते हैं। ETRD-2026 जैसे सम्मेलन इन उद्देश्यों की पूर्ति में अत्यन्त महत्वपूर्ण योगदान देते हैं, क्योंकि ये विभिन्न विषयों एवं भौगोलिक क्षेत्रों से जुड़े शिक्षाविदों, शोधकर्ताओं, वैज्ञानिकों, उद्योग विशेषज्ञों तथा विद्यार्थियों को एक मंच पर लाते हैं।

इस सम्मेलन की विषय वस्तु अत्यन्त प्रासंगिक एवं सामयिक है, क्योंकि इनका उद्देश्य अनुसंधान एवं विकास के क्षेत्र में उभरती प्रवृत्तियों तथा समकालीन प्रगतियों का अन्वेषण करना है, जो भविष्य की दिशा निर्धारित कर रही है। ऐसे शैक्षणिक आयोजन बहुविषयक संवाद को प्रोत्साहित करते हैं, शोध सहयोग को सुदृढ़ बनाते हैं तथा राष्ट्रीय एवं वैश्विक चुनौतियों के समाधान हेतु नवोन्मेषी दृष्टिकोण विकसित करने के लिये प्रेरित करते हैं।

मैं महाविद्यालय के प्राचार्य, समस्त संकाय सदस्यों, आयोजन समिति तथा विशेष रूप से प्रोफेसर पी.एल. वर्मा जिनके समर्पित मार्गदर्शन में यह सम्मेलन आयोजित हो रहा है, के प्रयासों की सराहना करता हूँ। मुझे पूर्ण विश्वास है कि यह सम्मेलन विद्यतापूर्ण चर्चाओं, सार्थक सहयोगों तथा अत्याधुनिक शोध निष्कर्षों के प्रसार हेतु एक प्रेरणादायक वातावरण प्रदान करेगा।

मैं इस सम्मेलन के सफल आयोजन हेतु अपनी हार्दिक शुभकामनायें प्रेषित करता हूँ।

(डॉ. राजेन्द्र कुमार कुड़रिया)
कुलगुरु

प्रोफेसर पी.एल. वर्मा
कॉन्फ्रेंस चेयर ETRD-2026
पीएमसीओई, शासकीय स्नातकोत्तर महाविद्यालय
मैहर, म०प्र०

MESSAGE FROM THE CHIEF GUEST



*I*t is a great honor and a sincere pleasure for me to convey my warm greetings and best wishes for the 5th Global Conference on Emerging Trends in Research and Development, ETRD-26, to be held at Government Vivekanand PG College, Maihar, Madhya Pradesh, India.

I feel deeply honored to participate in this important academic event as Chief Guest. ETRD-26 brings together researchers, academicians, scientists, innovators, industry experts, faculty members, and students from different parts of the world, creating a valuable meeting place for dialogue, collaboration, and the exchange of ideas.

Conferences such as ETRD-26 are much more than formal academic events. They are spaces where ideas circulate, disciplines meet, collaborations begin, and new questions are born. They also remind us that learning is not a one-way process: experienced scholars can guide younger generations, but we also learn from their questions, their energy, their enthusiasm, and their capacity to imagine new possibilities.

In a world facing complex and urgent challenges, science and research must not only advance knowledge. They must also help us build more collaborative, inclusive, peaceful, and beautiful societies. As a scientist from Chile, I am especially interested in strengthening scientific collaboration among countries of the Global South. I believe that ETRD-26 offers a meaningful opportunity to promote friendship, cooperation, and shared learning among people, institutions, and nations.

I warmly thank and congratulate Prof. P. L. Verma, the organizing committee, Government Vivekanand PG College, all collaborating institutions, and everyone who has contributed to making this conference possible. I extend my best wishes for the grand success of ETRD-26.

Leopoldo Soto, PhD

Plasma Physics and Nuclear Fusion

Chilean Nuclear Energy Commission, Chile

MESSAGE FROM THE CHIEF PATRON



**OFFICE OF THE PRINCIPAL GOVT. VIVEKANAND MAHAVIDYALAYA,
MAIHAR, DIST. MAIHAR (M.P.)
"PM COLLEGE OF EXCELLENCE"**

College Code - 1205 Phone No. 07674-232033 Email- gvc.p.g.college.maihar@gmail.com
Letter No. 532.../Std./2026 Maihar, Date. 29.06.2026

Goodwill Message

It gives me immense pleasure to extend my heartfelt greetings and best wishes on the occasion of the **International Conference on Emerging Trends in Research and Development (ETRD-2026)** being organized by the **PM College of Excellence (PMCOE), Government Vivekanand P.G. College, Maihar, Madhya Pradesh, India**, in collaboration with **World Trend Centre, Jaipur**, the **Scientific and Humanities Research Society, Jaipur, Rajasthan, India**, and the **International Journal of Innovative Research and Growth (IJIRG)**, on 17-18 July 2026.

Research and innovation are the driving forces behind sustainable development, technological advancement, and societal transformation. I am confident that **ETRD-2026** will provide an outstanding international platform for academicians, researchers, scientists, industry professionals, policymakers, and students to exchange ideas, present cutting-edge research, and foster interdisciplinary collaborations.

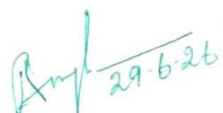
The collaborative efforts of **PM College of Excellence (PMCOE), Government Vivekanand P.G. College, Maihar, Madhya Pradesh, India**, **World Trend Centre, Jaipur**, the **Scientific and Humanities Research Society, Jaipur**, and **IJIRG** reflect a shared commitment to promoting excellence in scientific, technological, social sciences, and humanities research. Such initiatives strengthen academic partnerships, encourage the dissemination of quality research, and inspire scholars to address contemporary global challenges through innovation and knowledge sharing.

I sincerely appreciate the dedicated efforts of the organizing committee, advisory board, collaborators, reviewers, and all stakeholders in organizing this prestigious international conference. I am confident that the deliberations, discussions, and research outcomes of **ETRD-2026** will make valuable contributions to the global academic community and inspire future research endeavors.

I extend my warmest congratulations and best wishes to all the distinguished keynote speakers, invited experts, researchers, faculty members, students, and delegates for the grand success of **ETRD-2026**. May this conference serve as a catalyst for new ideas, meaningful collaborations, and impactful research that contributes to the progress of academia, industry, and society.

I wish the International Conference ETRD-2026 every success and hope that its proceedings will become a valuable source of knowledge and inspiration for researchers across the world.

With best wishes,


Prof. (Dr.) Rajesh Singh
Principal

Government Vivekanand P.G. College, Maihar
Madhya Pradesh, India
&

Chief Patron ETRD 2026

MESSAGE FROM THE PATRON SAHRS



*I*t is with immense pleasure and great honor that I extend my heartfelt greetings and best wishes to all distinguished keynote speakers, researchers, academicians, scientists, industry experts, professionals, scholars, and students participating in the **5th Global Conference on Emerging Trends in Research & Development (ETRD-2026)**, being organized by **PMCOE, Govt. Vivekanand P.G. College, Maihar, Madhya Pradesh, India**, on **17–18 July, 2026**.

We are living in an era of unprecedented scientific, technological, and socio-economic transformation, where research and innovation have become the driving forces for sustainable development and global progress. The complex challenges facing humanity today require interdisciplinary approaches, collaborative research, and the continuous exchange of ideas across institutional and national boundaries. In this context, international conferences play a pivotal role by providing a dynamic platform for intellectual engagement, knowledge dissemination, and the development of meaningful academic and professional networks.

The **5th Global Conference on Emerging Trends in Research & Development (ETRD-2026)** has been conceived with the vision of bringing together eminent researchers, educators, innovators, policymakers, and young scholars from diverse disciplines to deliberate on emerging developments, share pioneering research, and explore practical solutions to contemporary challenges. I am confident that the conference will facilitate stimulating discussions, encourage interdisciplinary collaborations, and inspire innovative research that contributes to scientific advancement and the betterment of society.

I sincerely congratulate the Organizing Committee, faculty members, volunteers, and all associated stakeholders for their dedication, meticulous planning, and tireless efforts in organizing this prestigious international event. Their commitment to academic excellence and collaborative learning will undoubtedly make this conference a memorable and intellectually rewarding experience for every participant.

As the **Chief Patron and Chair of the Conference**, and on behalf of the **Scientific And Humanities Research Society (SAHRS), Jaipur, Rajasthan, India**, I extend my sincere appreciation to all keynote speakers, invited experts, authors, reviewers, session chairs, sponsors, and delegates for their valuable contributions and enthusiastic participation. Your collective efforts are instrumental in fostering an environment of innovation, excellence, and global cooperation.

I firmly believe that the deliberations and outcomes of **ETRD-2026** will not only enrich academic knowledge but also inspire future research, strengthen institutional partnerships, and promote the translation of innovative ideas into practical solutions that benefit humanity. May this conference serve as a catalyst for new collaborations, impactful discoveries, and enduring friendships among scholars from across the world.

I wish the **International Conference on Emerging Trends in Research & Development (ETRD 2026)** every success and hope that all participants have an intellectually enriching, professionally rewarding, and memorable experience.

With my best wishes for the grand success of the conference.

A handwritten signature in black ink, appearing to read 'P. L. Verma', with a horizontal line extending from the end of the signature.

P. L. Verma

Chief Patron & Chair of the Conference

5th Global Conference on Emerging Trends in Research & Development (ETRD-2026)

Patron, Scientific And Humanities Research Society (SAHRS)

Jaipur, Rajasthan, India

MESSAGE FROM THE WORLD TRADE CENTER (WTC)



*I*t indeed is a privilege and a matter of great pride for me that I am graced with the opportunity to write a congratulatory message on the 5th Global Conference on Emerging Trends in Research & Development (ETRD-26) from 17th to 18th of July 2026 at Pradhan Mantri Colleges of Excellence, Government Vivekanand PG College, Maihar, Madhya Pradesh.

It is noteworthy here to understand that the **Pradhan Mantri Colleges of Excellence (PM Colleges of Excellence)** are a network of state-run higher education institutions across Madhya Pradesh, India. Launched by the state government, this initiative upgrades existing government colleges in all 55 districts of the state to align with the holistic, employment-oriented framework of the National Education Policy (NEP) 2020. These colleges focus on multidisciplinary research, life skills, and "out-of-the-box" thinking rather than traditional rote learning; they provide modern subjects like Biotechnology, Computer Science, and vocational trades, alongside traditional arts, commerce, and science programs, focus on skill development and Employs the "Bhartiya Gyan Prampara" (Indian Knowledge Traditions) and offers instruction in the local language, including pioneering efforts to teach engineering and medical curriculums in Hindi.

Today, research trends are rapidly shifting toward digital integration, methodological inclusivity, and interdisciplinary collaboration. The biggest catalysts include artificial intelligence, big data analytics, and a strong push for open science. Generative AI is streamlining the research process, from hypothesis generation and literature reviews to automated data transcription and analysis. In the field of technology, researchers widely agree that blending neural networks with symbolic AI is a promising approach to achieving higher levels of machine intelligence. The proliferation of wearable devices, IoT, and real-time sensor data is enabling deep, continuous, and highly accurate longitudinal studies across healthcare and consumer behavior. Researchers are increasingly combining qualitative (narrative, experiential) insights with quantitative data for more multidimensional and robust conclusions. Additionally, there is a strong push to diversify perspectives and challenge traditional dominant paradigms by actively involving marginalized communities and shifting toward participant-led models such as online diaries and mobile ethnography.

Having said this, I extend my heartfelt congratulations to the Organizing Committee for organizing the 5th Global Conference on Emerging Trends in Research & Development (ETRD-26). I believe the organizers' vision, dedication, meticulous planning, and unwavering commitment have brought together eminent academicians, researchers, industry experts, policymakers, and students on a common platform to exchange ideas, foster innovation, and strengthen academic collaboration. By facilitating the exchange of knowledge across disciplines and national boundaries, this conference promotes international academic cooperation, encourages global research partnerships, and provides opportunities for collaborative projects, joint publications, and cross-cultural learning. Such interactions play a vital role in addressing global challenges through collective research and innovation.

I understand that the conference also serves as an inspiring forum for promoting research excellence, encouraging interdisciplinary dialogue, and nurturing the next generation of scholars and innovators. It equips students and young researchers with valuable insights into emerging trends, enhances their academic and professional outlook, and connects them with experts from around the world.

We at World Trade Center Jaipur, as collaborators to the 5th Global Conference on Emerging Trends in Research & Development (ETRD-26), congratulate and sincerely appreciate the organizing committee's commitment to fostering a vibrant research ecosystem and creating a platform that bridges academia, industry, and the global research community. Your efforts will leave a lasting impact on the advancement of knowledge, innovation, and sustainable development.

My gratitude to our International and National Advisory Committee, Organizing Committee, and esteemed international speakers, delegates, and all student participants. A special thanks to Prof. Leopoldo Soto Norambuena, Head of the Nuclear Fusion and Dense Plasma Laboratory, Chilean Energy Commission, Santiago, Chile, and Dr. Hospodarsky, Research Scientist, NASA's TRACERS mission, for their kind consent to grace the occasion with their kind presence.

We wish to bring together with our esteemed organizers many more impactful academic initiatives that strengthen international collaboration and research excellence.

Once again wishing, 5th Global Conference on Emerging Trends in Research & Development (ETRD-26), from 17th to 18th of July 2026, a huge success and a learning curve for us all.

Best regards



Navneet Agarwal

Regional Director

World Trade Center Jaipur

MESSAGE FROM THE PRESIDENT OF SAHRS



It is my privilege to welcome you to the **5th Global Conference on Emerging Trends in Research & Development (ETRD-2026)**. Organized by the **Faculty of Science, PM College of Excellence, Government Vivekanand P.G. College, Maihar, M.P., India** this prestigious event, in collaboration with **World Trade Center, A Fourth Dimension Group**, and **Pioneer Techno**, provides a vibrant platform for researchers, academicians, industry experts, and students to share knowledge, exchange innovative ideas, and build global collaborations.

Research is the driving force behind scientific advancement and sustainable development. I am confident that the deliberations and interactions at ETRD-2026 will inspire new perspectives, foster interdisciplinary partnerships, and contribute to impactful research outcomes.

I congratulate the Organizing Committee for their dedicated efforts and extend my sincere appreciation to all keynote speakers, delegates, authors, collaborators, and participants for making this conference a grand success.

I wish ETRD-2026 every success and hope your participation is intellectually enriching, professionally rewarding, and truly memorable.

With Best Wishes,

Preetam Singh Gour

President - SAHRS

Organizing Secretary ETRD-26

Venue: PM College of Excellence

MESSAGE FROM THE ORGANIZING SECRETARY



It is with great pleasure and a deep sense of responsibility that I welcome you to the **5th International Conference on Emerging Trends in Research & Development (ETRD-2026)**. This conference is **organized by the Faculty of Science, PM College of Excellence, Government Vivekanand P.G. College, Maihar**, in collaboration with **World Trade Center Jaipur, Scientific And Humanities Research Society (SAHRS), Jaipur, A Fourth Dimension Group, and Pioneer Techno**.

ETRD-2026 has been envisioned as a dynamic platform that brings together eminent scientists, academicians, researchers, industry professionals, and young scholars from around the world to exchange ideas, present innovative research, and foster interdisciplinary collaborations. In an era where scientific advancement thrives on collective knowledge and innovation, this conference aims to promote meaningful discussions and inspire solutions to contemporary research challenges.

Organizing an international conference of this scale is the result of the collective efforts and unwavering dedication of many individuals and institutions. I express my heartfelt gratitude to our Chief Patron, Patrons, distinguished keynote and invited speakers, advisory committee members, collaborators, sponsors, reviewers, session chairs, volunteers, and every member of the organizing team whose commitment has made ETRD-2026 a reality.

I also extend a warm welcome to all delegates, authors, and participants. Your enthusiastic participation and valuable contributions are the true essence of this conference and will undoubtedly enrich its scientific and academic outcomes.

I sincerely hope that ETRD-2026 provides an inspiring environment for learning, collaboration, and networking, leaving every participant with new knowledge, meaningful connections, and memorable experiences.

I wish the conference every success and all participants a rewarding and enjoyable experience.

With warm regards,



Kapil Pal

Organizing Secretary, ETRD-2026

General Secretary, SAHRS

MESSAGE FROM THE ORGANIZING SECRETARY ETRD-2026



*I*t gives me immense pleasure to welcome all delegates, researchers, academicians, industry experts, and students to the **5th International Conference on Emerging Trends in Research and Development (ETRD-2026)**. This prestigious conference is **organized by the Faculty of Science, PM College of Excellence, Government Vivekanand P.G. College, Maihar**, in collaboration with the **World Trade Center, Jaipur, Scientific And Humanities Research Society (SAHRS)** and **A Fourth Dimension Group, Pioneer Techno** with our Industrial Partners.

ETRD-2026 is a unique platform dedicated to fostering innovation, interdisciplinary research, and global academic collaboration. The conference aims to bring together distinguished scientists and scholars from diverse fields to exchange ideas, present pioneering research, and discuss solutions to emerging scientific and technological challenges.

The successful organization of this international event reflects the collective dedication and hard work of our patrons, advisory committee, keynote speakers, collaborators, reviewers, volunteers, and the entire organizing team. I sincerely express my gratitude to every individual and organization whose support and commitment have made ETRD-2026 possible.

I extend my heartfelt welcome to all participants and hope that the technical sessions, keynote lectures, and interactions during the conference will inspire new ideas, strengthen research collaborations, and create lasting professional relationships.

I wish ETRD-2026 great success and every participant a fruitful, enriching, and memorable experience.

With Best Wishes

S. P. Tamrakar
Organizing Secretary, ETRD-2026
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SMALL DEVICES, BIG CHALLENGES: COMPACT PULSED PLASMAS FOR FUSION ENERGY, CANCER RESEARCH, AND FRONTIER SCIENCE FROM THE GLOBAL SOUTH

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ABSTRACT

Some of the greatest challenges of our time, such as clean energy and cancer treatment, are usually associated with large laboratories, expensive technologies, and highly specialized infrastructures. However, important scientific questions can also be explored through compact experimental devices, creative approaches, long-term research programs, and international collaboration.

This talk presents the experience of a research program developed at the Chilean Nuclear Energy Commission in plasma physics and nuclear fusion. The work is based on compact pulsed plasma devices, especially plasma focus devices, which can generate very intense and short bursts of radiation, particles, shock waves, and plasma jets. Although these devices are small compared with large fusion facilities, they allow us to study extreme physical conditions and explore applications in different fields.

The talk will focus on two major global challenges: energy and cancer. In the context of fusion energy, compact pulsed plasma devices make it possible to investigate, at a reduced scale, plasma dynamics, neutron production, instabilities, shock waves, and the behaviour of matter under extreme conditions. In the context of cancer research, recent experiments using pulsed X-rays generated by plasma focus devices have shown biological effects that differ from those produced by conventional radiation sources, opening new questions at the interface between plasma physics, radiation biology, and biomedical research.

Beyond the specific results, the talk will discuss how frontier science can emerge from the Global South. The Chilean experience shows that scientific excellence is not only a matter of budget or size, but also of vision, persistence, creativity, collaboration, and the capacity to build knowledge from local realities. In this sense, small devices can help us address big challenges, while also inviting us to imagine more collaborative, inclusive, and sovereign ways of doing science.

Keywords: *Pulsed Plasma Devices, Energy and Cancer, Global Challenges.*

THE TANDEM RECONNECTION AND CUSP ELECTRODYNAMICS RECONNAISSANCE SATELLITES (TRACERS) MISSION

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ABSTRACT

The two-spacecraft small-explorer (SMEX) mission “Tandem Reconnection and Cusp Electrodynamics Reconnaissance Satellites” (TRACERS) recently launched (July 23, 2025) into a ~590 km sun-sync orbit. The science goal of the TRACERS mission is to examine the temporal and spatial nature of global magnetic reconnection in the terrestrial magnetosphere by making repeated two spacecraft plasma and fields measurements in the cusp region of Earth. A summary of the mission, the instruments, and spacecraft will be presented, along with the current status and initial scientific results.

Keywords: *SMEX mission, TRACERS, Cusp.*

DEVELOPMENT AND OPTIMIZATION OF LOW-COST PLASMA SYSTEMS FOR AGRICULTURE

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ABSTRACT

Atmospheric pressure cold plasma technology is an eco-friendly and low-cost approach for improving agricultural productivity. Our work focuses on the development and optimization of affordable plasma systems (gliding arc discharge, plasma jet, and dielectric barrier discharge devices) using locally available materials. These systems are applied for seed treatment and for producing plasma-activated water for irrigation. Experiments on crops such as rice, potato, and leaf mustard showed improved seed germination, enhanced plant growth, maintained chlorophyll content, and increased crop yield. These benefits are associated with improved water absorption and stimulation of biological processes in seeds and plants. The results demonstrate that low-cost cold plasma technology can support sustainable agriculture by reducing dependence on chemical fertilizers and pesticides while improving crop productivity and environmental sustainability.

Keywords: *Low-Cost Plasma, Agricultural Productivity, Environmental Sustainability.*

JOSEPHSON JUNCTIONS: ULTIMATE DEVICES FOR AI ENHANCEMENT

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ABSTRACT

Artificial Intelligence (AI) is rapidly transforming science, technology, healthcare, and industry. However, the unprecedented growth of AI models has led to enormous computational and energy demands, exposing the limitations of conventional CMOS-based computing architectures. Future AI systems require hardware platforms capable of ultra-fast processing, massive parallelism, low latency, and ultra-low energy consumption. In this context, superconducting electronics based on Josephson junctions have emerged as promising candidates for next-generation AI hardware.

Josephson junctions exhibit unique quantum mechanical properties, including picosecond switching speeds, quantized magnetic flux dynamics, and near-zero power dissipation. These characteristics enable the realization of superconducting neural networks, spiking neural systems, neuromorphic processors, and energy-efficient AI accelerators operating far beyond the performance limits of conventional semiconductor technologies. Recent developments demonstrate that Josephson-junction-based neurons and synapses can emulate biological neural functions while achieving operation frequencies in the gigahertz regime with femtojoule-level energy consumption.

This talk presents the fundamental physics of Josephson junctions, recent advances in superconducting neuromorphic computing, and their potential role in future AI infrastructures. The discussion will include Josephson-based artificial neurons, superconducting spiking neural networks, quantum-inspired AI processors, and challenges associated with cryogenic operation and large-scale integration.

Keywords: *Josephson Junctions, Artificial Intelligence, Neuromorphic Computing, Superconducting Electronics, Spiking Neural Networks, Quantum Computing.*

RELATIVISTIC TIGHT-BINDING MODEL FOR HEXAGONAL LATTICE: APPLICATION TO GRAPHENE

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ABSTRACT

Graphene has attracted enormous research interest because of its remarkable electronic and magnetic properties, its potential for a wide range of technological applications and its role in establishing a new paradigm of relativistic condensed-matter physics. In 2015, a relativistic tight-binding (TB) method capable of describing crystalline materials in the presence of a magnetic field was developed and successfully applied to silicon. To use this method for any material, its electronic structure without a magnetic field must first be determined. In the present work, we apply the relativistic TB method to graphene in the absence of a magnetic field. The Hamiltonian and overlap matrices are constructed by considering interactions between the nearest neighbouring atoms and the valence s and p orbitals. The required hopping and overlap parameters are obtained using the relativistic Slater–Koster table. This paper describes the construction of these matrices and presents the resulting energy-band structure of graphene in the first Brillouin zone. The calculations also show that relativistic effects produce a small energy gap at the K-points, known as the spin–orbit gap, with a value of about $25 \mu\text{eV}$ at low temperatures.

Keywords: *The Hamiltonian, K-points, Hexagonal Lattice.*

NON-THERMAL ATMOSPHERIC DIELECTRIC BARRIER DISCHARGE PLASMA FOR SURFACE MODIFICATION OF NATURAL FABRICS

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ABSTRACT

Natural fabrics such as silk, linen and banana fabric are increasingly being explored for healthcare and functional textile applications because of their biodegradability, comfort, breathability, and environmental sustainability. However, their inherent surface characteristics often limit wettability, liquid absorption, and moisture transport. In this study, atmospheric-pressure non-thermal dielectric barrier discharge (DBD) plasma generated in air was employed to modify the surface properties of these natural fabrics without affecting their bulk structure.

The non-thermal atmospheric air DBD plasma was electrically and optically characterized, confirming stable non-thermal discharge conditions suitable for temperature-sensitive natural fibers. The air DBD plasma was electrically and optically characterized, confirming stable non-thermal discharge conditions suitable for temperature-sensitive natural fibers. The surface modifications induced by plasma treatment were evaluated through water contact angle measurements, surface free energy and work of adhesion analyses, attenuated total reflectance Fourier-transform infrared (ATR-FTIR) spectroscopy, scanning electron microscopy (SEM), and air permeability testing. Plasma treatment significantly enhanced the hydrophilicity of silk and linen fabrics and also improved the wicking performance of banana fabric. The water contact angle of silk and linen fabrics decreased with increasing treatment time, accompanied by corresponding increases in surface free energy and work of adhesion. ATR-FTIR analysis indicated the incorporation of oxygen-containing polar functional groups onto the fiber surfaces, while SEM observations revealed surface cleaning and mild etching effects. A slight reduction in air permeability was observed after treatment, indicating surface modification with minimal alteration of the fabric structure. The results demonstrate that atmospheric-pressure non-thermal DBD plasma is an effective and environmentally friendly technique for tailoring the surface properties of natural textiles without chemical reagents. The improved wettability and wicking performance achieved through plasma treatment highlight its potential for healthcare and other functional textile applications.

INDIAN KNOWLEDGE SYSTEMS: FROM ANCIENT WISDOM TO MODERN SCIENTIFIC THOUGHT

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ABSTRACT

India possesses one of the world's oldest and most sophisticated knowledge traditions, with a scientific heritage that has evolved continuously since the Vedic period. Ancient Indian scholars made remarkable contributions to astronomy, mathematics, physics, cosmology, medicine, and environmental sciences, establishing conceptual foundations that continue to resonate with modern scientific thought. The Vedic literature, particularly the *Nāsadīya Sūkta* of the *Rigveda*, presents profound philosophical reflections on the origin and evolution of the universe, illustrating the depth of ancient Indian cosmological inquiry.

This talk explores the rich legacy of the Indian Knowledge System (IKS) through the pioneering contributions of Maharishi Kanada, Aryabhata, Varahamihira, and Brahmagupta. Kanada's *Vaisheshika Sutras* introduced fundamental concepts of atomism, space, time, motion, and material properties centuries before similar ideas emerged elsewhere. Building upon this intellectual tradition, Aryabhata revolutionized astronomy and mathematics through his precise calculations of planetary motion, Earth's rotation, the value of π , trigonometric functions, and astronomical distances. Varahamihira enriched observational astronomy through the *Pañcasiddhāntikā* and *Brhat Samhitā*, while Brahmagupta laid the foundations of algebra, arithmetic, and mathematical astronomy through the *Brāhmasphuṭasiddhānta* and related treatises. I will be also talking about the importance of Ujjain as centre of time measurement during ancient era.

The lecture will critically examine the mathematical methods, observational techniques, and scientific reasoning employed by ancient Indian scholars. The historical transmission of Indian astronomical and mathematical knowledge to other civilizations and its influence on the evolution of global science will also be discussed. This talk highlights the enduring relevance of the IKS in modern education, interdisciplinary research, and the history of science. It aims to promote an evidence-based appreciation of India's scientific heritage and encourage renewed academic engagement with classical Indian scientific literature as a valuable source of knowledge and innovation for the twenty-first century.

Keywords: IKS, Kanada's *Vaisheshika Sutras*, *Brhat Samhitā*.

RECENT ADVANCES IN THE FIELD OF POLYMER/CERAMIC COMPOSITE

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ABSTRACT

Miniaturization of electronics devices creates a strong desire to place capacitors on the circuit board in the form of integrated passive components. To realize this, lot of research is being carried out by several researchers to develop polymer ceramic composites with high dielectric constant. Need for high dielectric constant materials have been driven by the continuous demand for miniaturization of electronic devices. To fulfil this material with high or giant dielectric constant is required. Recently, $\text{CaCu}_3\text{Ti}_4\text{O}_{12}$ (CCTO) has attracted lot of scientific and technological interest because of its giant dielectric constant ($\epsilon_r \sim 10^4$) with weak temperature/frequency dependence in a wide range of temperature (100–600 K) and frequency. High density, brittleness and challenging processing conditions are few drawbacks which impede its use as high-k materials. So polymer ceramic composites have become a promising material for these applications. As they possess hardness, stiffness and high dielectric constant of ceramics and the flexibility, elasticity and low density of polymers. In the present work, we investigated the structural and dielectric properties of Poly (vinylidene fluoride)/modified CCTO composites.

Extrusion process was used to prepare high dielectric constant ceramic reinforced PVDF composites. The structure and morphology of the composites were characterized using X-ray diffraction and scanning electron microscope. SEM micrographs show that homogeneous distribution of ceramics has taken place in PVDF matrix with small trails of agglomeration. Tensile tests were performed to measure Young's modulus which increases significantly in composites in presence of ceramic filler. Dielectric measurements were carried out between frequencies 10^{-2} to 10^6 Hz using four probe Novocontrol set up (ZG4) from room temp to 120°C . With addition of CCTO there is substantial increase in the dielectric constant of matrix PVDF. Dielectric loss in composite slightly increases in presence of CCTO.

Keywords: Polymer, Ceramics, XRD, SEM.

SILENT CARRIERS: UNDERSTANDING THE EPIDEMIOLOGY OF SEED-BORNE PLANT PATHOGENS

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ABSTRACT

Seed-borne plant pathogens act as “hidden invaders”, moving silently with planting material to initiate epidemics long before symptoms appear, with impacts ranging from reduced emergence to severe yield and quality losses across cereals, legumes and vegetables. These pathogens—fungi, bacteria, viruses and nematodes—contaminate seeds externally or internally during flowering and seed development, and their transmission efficiency, survival and subsequent disease expression are strongly modulated by environment, host genotype and seed storage conditions. Quantitative epidemiological studies demonstrate non-linear relationships between seed infection levels and epidemic intensity, enabling definition of risk thresholds, design of models that link initial inoculum (I_0) and infection rate (r) to disease progress, and prioritization of surveillance along national and international seed pathways. Advances in diagnostics—from conventional blotter and grow-out tests to ELISA, qPCR, isothermal amplification and high-throughput sequencing—have greatly improved detection sensitivity and specificity, supporting certification and phytosanitary decision-making. Management options integrate exclusion, seed treatments (physical, chemical and biological), host resistance and strict seed production hygiene, increasingly informed by insights into seed microbiomes, climate-change-driven shifts in epidemiology and digital surveillance tools. Framed from a human perspective, the chapter emphasizes how these epidemiological insights translate into everyday choices for farmers, seed producers and regulators, and argues that investing in seed health research, diagnostics and inclusive extension can convert seed-borne pathogens from invisible drivers of loss into manageable components of resilient, climate-smart cropping systems.

Keyword: *Plant Pathogens, Seed Treatments, Viruses and Nematodes.*

DBD BASED ATMOSPHERIC PRESSURE COLD PLASMA DEVICES AND THEIR PROSPECTIVE APPLICATIONS

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ABSTRACT

Plasma is considered as an ionized gas ‘the fourth state of matter’ where electrically charged and neutral particles co-exist and exhibit collective processes. Primarily, plasma came into the picture to sustain a nuclear fusion process for fulfilling the energy requirement of the society. On the other way, scientists had recognized that the non-thermal ‘cold’ plasma discharge can also be used for several industrial and societal applications.

Dielectric Barrier Discharge (DBD) plasmas are most popular cold plasmas that are produced at atmospheric pressure. DBD plasmas are highly scalable and can be produced using different electrodes designs. They are proposed for applications such as material processing, ozone synthesis, pollution control, plasma displays, UV lamps, plasma aerodynamics, air/water purification, sterilization, plasma medicine, agriculture, food etc. In DBD, electrodes are insulated by thin dielectric layers to limit the growth of discharge current to prevent glow-to-arc transition at atmospheric pressure.

Our experiments focus to develop and test the DBD plasma devices of suitable electrode configuration to realize some of the prominent societal applications. Discharge is ignited between insulated electrodes by applying sinusoidal voltage of 2-5 kV of frequency $\sim 1-40$ kHz. The estimated plasma density & temperature in DBD remain in the range of $\sim 10^{10}-10^{11}$ cm⁻³ and $\sim 1-10$ eV respectively, indicating it is a glow discharge. We have produced DBD plasma in electrode configurations like parallel-plate, planar, co-planar and coaxial and studied their properties for specific applications. Optimization of design and plasma control parameters was done to obtain an energy efficient & safe DBD device. Our current experiments focus on characterizing DBD based plasma jet produced in helium and argon gases for biomedical applications. Important results of our experiments are presented.

Keywords: Cold Plasma Devices, Dielectric Barrier Discharge, Pollution Control.

THE GMO DILEMMA IN GLOBAL TRADE: FOOD SECURITY, REGULATORY DIVERGENCE, AND THE DYNAMICS OF DDGS FLOWS

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ABSTRACT

Genetically modified organisms (GMOs) are becoming increasingly central to discussions surrounding food security, sustainability, and international trade. This paper assesses whether GMOs serve mainly as solutions by boosting yields, reducing reliance on pesticides, and supporting climate-resilient crops, or as problems that exacerbate socioeconomic disparities, ecological threats, and fragmented regulation. We integrate agronomic, socio-economic, and policy literature, focusing especially on the implications of distillers dried grains with solubles (DDGS) trade flows within recent United States trade agreements. DDGS, a key coproduct of U.S. bioethanol production typically sourced from genetically modified maize, exemplifies how GMO-related disputes travel through commodity supply chains: trade liberalisation boosts DDGS exports, triggers resistance in importing nations with strict GMO regulations, and fosters regulatory differences that hinder the implementation of sanitary and phytosanitary (SPS) measures. Through case studies and policy analysis, we demonstrate that GMOs can deliver higher productivity and lower chemical inputs, benefits achievable in contexts where strong regulatory systems, transparent risk evaluation, and access to seeds, along with proper stewardship, are in place. In contrast, poor governance, concentrated intellectual property rights, and cross-border trade in GMO-derived byproducts can worsen vulnerabilities in food systems and erode public trust.

We conclude that GMOs are neither inherently a solution nor a problem; outcomes depend on regulatory consistency, equitable access, and trade governance that reconcile divergent acceptance standards. Policy recommendations include harmonised risk-assessment protocols for GMO-derived commodities (including DDGS), capacity building in importing countries, and trade safeguards that balance innovation with precaution and socio-economic equity.

Keywords: *GMOs, DDGS, Trade Policy, Regulatory Divergence, Food Security, Biotech Governance.*

A REVIEW: GREEN TECHNOLOGY AND MANAGEMENT

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ABSTRACT

Green technology and management have emerged as essential approaches to address growing environmental challenges and promote sustainable development. Green technology refers to the development and application of products, processes, and systems that conserve natural resources, reduce environmental pollution, and minimize ecological footprints. It encompasses renewable energy technologies, waste management practices, energy-efficient systems, and eco-friendly materials. Green management, on the other hand, involves the integration of environmental considerations into organizational policies, decision-making, and operational strategies.

This review highlights the significance of green technology in mitigating climate change, reducing greenhouse gas emissions, and promoting resource efficiency. It also examines the role of green management in fostering sustainable business practices through tools such as Environmental Management Systems (EMS), corporate social responsibility (CSR), and sustainable supply chain management. The study emphasizes the need for policy support, technological innovation, and stakeholder participation to effectively implement green initiatives. Despite challenges such as high initial costs, lack of awareness, and technological barriers, green technology and management offer long-term economic, environmental, and social benefits.

In conclusion, the integration of green technology with effective management practices is crucial for achieving sustainability goals and ensuring environmental protection for future generations.

Keywords: *Green Technology, Sustainable Development, Environmental Management, Renewable Energy.*

PYRIDINE-ENGINEERED SILVER NANOWIRE DUAL-FUNCTION TRANSPARENT ELECTRODES FOR ITO-FREE HIGH-PERFORMANCE THICK-FILM ORGANIC SOLAR CELLS

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ABSTRACT

Indium tin oxide (ITO)-free, solution-processed transparent electrodes are crucial for low-cost, scalable organic optoelectronic devices. Silver nanowire (AgNW) networks are promising ITO alternatives due to their high conductivity, transparency, flexibility, and roll-to-roll compatibility. Yet high-performance inverted organic photovoltaics (OPVs) with AgNW electrodes usually need complex electrode designs to ensure low roughness, proper energy-level alignment, and efficient charge extraction. Thus, creating fully solution-processed, carrier-selective contacts for large-area ITO-free OPVs remains a major challenge. Here, we report a simple and scalable strategy using a solution-processed pyridine interlayer as an electron-selective contact in ZnO/AgNW/ZnO (ZAZ) transparent electrodes. The pyridine interlayer, deposited on top of ZnO above the embedded AgNW network, enables precise tuning of interfacial electronic properties while preserving low-temperature, solution-based processing. Pyridine functionalization significantly improves both the optoelectronic performance and surface morphology of the ZAZ electrodes. The pyridine-modified ZAZ electrodes exhibit high optical transmittances of 88.27% and 88.50% at 550 nm, low sheet resistances of 13.24 and 17.30 Ω/sq , and high figures of merit of 21.69 and 17.00 $\times 10^{-3} \Omega^{-1}$, outperforming conventional ITO electrodes. Surface roughness is markedly reduced, facilitating uniform organic layer deposition. Importantly, this work provides the first detailed demonstration of surface potential evolution and work-function modulation in AgNW electrodes via pyridine functionalization, resulting in enhanced electron selectivity and extraction. Acting as dual-function transparent electrodes, they enable both efficient electron transport and collection. Fully solution-processed OPVs incorporating these electrodes achieve a power conversion efficiency of 10.93% and a fill factor of 65.22%, exceeding ITO-based reference devices. This work advances the development of high-performance, stable, and scalable ITO-free organic optoelectronic technologies.

Keywords: AgNW Transparent Electrode, Pyridine Coating, ITO-Free OSCs.

GREEN NANOMATERIAL CONCEPT, CLASSIFICATION, PROPERTIES AND APPLICATIONS

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ABSTRACT

Green nanomaterials have emerged as promising alternatives to conventional materials due to their unique physicochemical properties and reduced environmental impact. This chapter provides a comprehensive overview of green nanomaterials, exploring their fundamental concepts, classification systems, distinctive properties, and diverse applications in sustainable water treatment technologies. Green nanomaterials are classified based on their synthesis methods (biological, physical, and chemical), composition (metal/metal oxide, carbon-based, polymeric, and composite), morphology, and dimensionality (0D, 1D, 2D, and 3D structures). The chapter examines key properties including enhanced surface area-to-volume ratio, tunable surface chemistry, unique optical and electronic characteristics, and biodegradability that make these materials particularly valuable for environmental applications. Various applications are discussed with emphasis on water purification (adsorption, photocatalysis, antimicrobial action, and sensing), alongside emerging applications in renewable energy, agriculture, and biomedical fields. Current challenges, including scalability, standardization, and toxicity concerns, are addressed alongside future research directions. This comprehensive analysis establishes green nanomaterials as integral components in developing sustainable solutions for global environmental challenges, particularly in addressing water pollution and scarcity issues within the framework of the United Nations Sustainable Development Goals.

Keywords: *Green Nanomaterials, Sustainable Nanotechnology, Nanomaterial Classification, Eco-Friendly Synthesis, Water Treatment Applications, Nanomaterial Properties.*

HIGH IONIC AND ELECTRONIC CONDUCTING CeO₂ AS SOLID ELECTROLYTE FOR IT-SOFCs APPLICATION

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ABSTRACT

For green and clean energy, the first key challenge is finding the best candidate for electrolytes in Intermediate temperature solid oxide fuel cell (IT-SOFCs), that should cost-effective and exhibit high ionic conductivity. The CeO₂ is exist in fluorite type crystal structure and persist all possible properties similar to other conventional electrolyte of IT-SOFCs. The CeO₂ nanoparticle was synthesized using the sol-gel chemical route followed by heat treatment at 80 °C for 4 hours.

After the successful preparation of CeO₂ gel, it has been calcined at different temperature range 300-700 oC to obtain single phase and study reaction mechanism. The preliminary phase identification has been carried out by XRD followed by Rietveld refinement process suggest fluorite type crystal structure crystallized under Fd3m. The morphological studies indicate dense microstructure with cubical shape while their chemical homogeneity confirmed by Energy Dispersive X-ray spectroscopy.

The electrical properties of sample sintered at 1350 °C has been studied as a function of frequency and temperature (40-600 °C) to identify the contribution of grain and grain boundary contribution. The activation energy obtained from these methods suggests the migration of oxygen ion within the sample.

Keywords: Solid Electrolyte, Crystal Structure, CeO₂.

METRICS FOR CORPORATE SOCIAL RESPONSIBILITY (CSR) AND IMPACT ASSESSMENT: A STRUCTURE FOR EVALUATING SUSTAINABLE BUSINESSES

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ABSTRACT

Corporate Social Responsibility (CSR) has developed from a voluntary ethical practice to a strategic necessity for long-term organizational viability in the modern corporate environment. This study examines the developing frameworks for assessing the economic, social, and environmental effects of corporate social responsibility. The study looks at how companies might use structured CSR indicators to align their operations with global sustainability goals, such as the Sustainable Development Goals (SDGs) of the United Nations, using qualitative analysis and current literature. The article emphasizes the need for standardized, open, and accountable measuring systems by highlighting the discrepancy between CSR reporting procedures and actual stakeholder effect. The Global Reporting Initiative (GRI), Environmental, Social, and Governance (ESG) indicators, and the Triple Bottom Line (TBL) model are among the prominent CSR frameworks that are compared in order to provide firms with a thorough evaluative perspective. According to the data, companies that incorporate strong CSR indicators improve their long-term financial success and investor trust in addition to their social credibility. By providing useful advice for companies, legislators, and academic researchers, this work adds to the expanding corpus of interdisciplinary research linking ethics, commerce, and sustainable development.

Keywords: *CSR Metrics, Sustainable Development, ESG Triple Bottom Line ,Impact Measurement, GRI Framework.*

BUILDING A GREENER FUTURE THROUGH SUSTAINABLE PRACTICES

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ABSTRACT

Rapid acceleration of urbanization and climate change necessitates a fundamental shift toward sustainable practices in the built environment. This paper explores the transition from traditional construction to green building methodologies, highlighting the crucial role of ecological stewardship in shaping a resilient future. By analyzing current advancements, including energy-efficient design, renewable energy integration, and sustainable material selection, this work outlines how to minimize the construction industry's carbon footprint and resource depletion. Key focus areas include the implementation of passive energy designs and the integration of smart technologies to optimize resource usage. Furthermore, the adoption of circular economy principles—such as reducing, reusing, and recycling construction materials—is analyzed as a key driver for long-term sustainability.

Ultimately, this study emphasizes that fostering a greener future requires a holistic approach, integrating technological innovation with community engagement and informed decision-making. These practices not only mitigate environmental impact but also improve indoor environmental quality and occupant health, proving that sustainable construction is essential for safeguarding the welfare of future generations.

Keywords: *Energy Efficiency & Renewables, Sustainable Materials, Waste Reduction, Water Conservation, Green Infrastructure.*

DEPENDENCE OF GEOMAGNETIC STORMS ON CORONAL MASS EJECTIONS AND SOLAR WIND PARAMETERS DURING SOLAR CYCLE 23, 24 AND RISING PHASE OF SOLAR CYCLE 25

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ABSTRACT

Coronal mass ejections (CMEs) and solar flares are among the most energetic solar phenomena, in which large quantities of magnetized plasma are expelled from the solar corona into interplanetary space. These events are closely associated with variations in sunspot numbers and play a significant role in disturbing solar wind plasma conditions, which subsequently influence geomagnetic activity within the Earth's magnetosphere. The present study investigates the relationship between halo coronal mass ejections (HCMEs), annual variations in interplanetary magnetic field (IMF) strength, solar wind plasma pressure, and the occurrence of geomagnetic storms during Solar Cycles 23, 24, and the rising phase of Solar Cycle 25. The analysis reveals that the occurrence of geomagnetic storms generally follows the trend of halo coronal mass ejections throughout the investigated solar cycles, indicating a strong solar-terrestrial connection. However, certain anomalies are observed. In 2003, the frequency of halo CMEs does not correspond proportionally with the occurrence of geomagnetic storms, while in 2012 the number of halo CMEs is significantly higher compared to the number of geomagnetic storms recorded. These discrepancies suggest that not all halo CMEs are equally geoeffective and that additional interplanetary conditions influence storm generation. Further analysis demonstrates that the annual occurrence of geomagnetic storms is highly correlated with annual variations in halo CMEs, solar wind plasma pressure, and interplanetary magnetic fields. The study therefore concludes that geomagnetic storm activity is strongly controlled by the combined effects of coronal mass ejections, solar wind plasma dynamics, and the strength and orientation of interplanetary magnetic fields. These findings contribute to a better understanding of solar-terrestrial interactions and may help improve space weather forecasting during different phases of solar activity cycles.

Key words: - Coronal Mass Ejections, Solar Wind Plasma Pressure, Interplanetary Magnetic Fields, Geomagnetic Storms.

LONG TERM RELATIONS OF GEOMAGNETIC STORMS AND SOLAR WIND INDICES DURING SOLAR CYCLE 23 AND 24

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ABSTRACT

This investigation presents a comparative analysis of yearly average disturbances in solar wind plasma parameters and their relationship with the annual occurrence of geomagnetic storms during Solar Cycles 23 and 24. The study examines variations in solar wind plasma indices, including solar wind speed, plasma temperature, plasma pressure, and plasma density, and evaluates their influence on geomagnetic storm activity.

The analysis reveals that the annual occurrence of geomagnetic storms closely follows the yearly variations in solar wind plasma disturbances throughout both solar cycles. Statistical correlation analysis indicates a significant positive relationship between geomagnetic storm occurrences and solar wind plasma parameters. Positive correlations were obtained between annual geomagnetic storm occurrences and solar wind speed (correlation coefficient = 0.40), interplanetary magnetic fields (IMFB)(correlation coefficient = 0.82), solar wind temperature (correlation coefficient = 0.52), and solar wind pressure (correlation coefficient = 0.73). These results demonstrate that increases in solar wind plasma disturbances are associated with enhanced geomagnetic storm activity.

The findings suggest that disturbed solar wind conditions play a crucial role in the generation and intensification of geomagnetic storms. The study highlights the importance of solar wind plasma dynamics in space weather processes and contributes to a better understanding of Sun–Earth interactions during Solar Cycles 23 and 24.

Key words: - Solar Wind Plasma Speed, Solar Wind Plasma Density, Solar Wind Plasma Pressure, Solar Wind Plasma Temperature, Geomagnetic Storms.

ROLE OF SOIL THERMO-PHYSICAL AND BIOCHEMICAL PROPERTIES IN THE DEVELOPMENT OF CORROSION MORPHOLOGY

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ABSTRACT

Soil corrosion is a major challenge affecting buried metallic structures such as pipelines, storage tanks, grounding systems, and underground utilities. The present study investigates the role of soil thermo-physical and biochemical properties in the development of corrosion morphology on mild steel specimens buried in different soil environments. The study focuses on the influence of moisture content, temperature, pH, chloride concentration, organic matter, microbial activity, and soil resistivity on corrosion rate and surface morphology. Experimental analysis was conducted using soil samples with varying physicochemical characteristics under controlled laboratory conditions for 90 days. Weight loss measurements, pH analysis, moisture determination, and microscopic surface observations were employed to evaluate corrosion behaviour. The results indicate that higher moisture content, chloride concentration, acidic pH, and microbial presence significantly accelerate localized corrosion and pitting morphology. Statistical analysis confirms a strong relationship between soil biochemical activity and corrosion severity. The study concludes that thermo-physical and biochemical properties collectively control corrosion mechanisms and morphology development in buried metals.

Keywords: *Soil Corrosion, Surface Morphology, Soil Resistivity.*

INVESTIGATION OF GEOMAGNETIC STORMS RELATED TO X- AND M-CLASS ASSOCIATED PH-CMEs WITH SOLAR WIND CONDITIONS DURING THE ASCENDING PHASE OF SOLAR CYCLE 25

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ABSTRACT

This study presents a high-level analysis of geomagnetic storms (GMs) associated with X- and M-class partial halo coronal mass ejections (PH-CMEs) and corresponding solar wind turbulences during the ascending phase of Solar Cycle 25. The investigation reveals that all observed geomagnetic storms are strongly associated with significant disturbances in solar wind plasma parameters and interplanetary magnetic field (IMF) conditions. Statistical analysis indicates a positive correlation between the magnitude of geomagnetic storms and disturbances in IMF-B, with a correlation coefficient of 0.64, while an even stronger correlation of 0.86 is observed with IMF-Bz disturbances. Additionally, positive correlations are identified between geomagnetic storm intensity and solar wind plasma temperature (SWPT) disturbances (0.73), as well as solar wind plasma velocity (SWPV) disturbances (0.63). These results demonstrate that variations in interplanetary magnetic field components and solar wind plasma characteristics play a critical role in the development and intensity of geomagnetic storms. The study concludes that geomagnetic storms associated with X- and M-class PH-CMEs are closely linked to solar wind plasma disturbances, emphasizing the importance of solar wind dynamics in space weather processes during Solar Cycle 25.

Keywords: *Geomagnetic Storms (GMs), Partial Halo Coronal Mass Ejections, Disturbances in Solar Wind Plasma Parameters.*

A REVIEW ON INDIGENOUS PLANTS USED IN THERAPY OF ADHESIVE CAPSULITIS

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ABSTRACT

Adhesive capsulitis, also known as “frozen shoulder,” is a common shoulder condition characterized by pain and decreased range of motion, especially in external rotation. The most effective treatment for adhesive capsulitis is still unknown but mostly it includes nonsteroidal anti-inflammatory drugs, short-term oral corticosteroids, intra-articular corticosteroid injections, physiotherapy, acupuncture, and hydrodilatation. Studies have revealed that combination of Physiotherapy and corticosteroid injections provide greater improvement than physiotherapy alone. The review highlights the pathoanatomy of adhesive capsulitis and also provides an update on the usage of natural occurring medicines like arnica, vinca, ginger along with some enzymes like bromelain and Serratiopeptidase in the treatment of adhesive capsulitis and this new understanding can help facilitate development of novel pharmacological therapies.

Keywords: *Frozen Shoulder, Nonsteroidal Anti-Inflammatory, Physiotherapy, Corticosteroids.*

ARTIFICIAL INTELLIGENCE IN GST ADMINISTRATION: TRANSFORMING TAX COMPLIANCE AND DIGITAL GOVERNANCE IN THE SMART ECONOMY

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ABSTRACT

The emergence of Artificial Intelligence has significantly transformed public administration, financial management, and taxation systems across the globe. Among the major areas influenced by AI, the Goods and Services Tax (GST) framework has experienced remarkable technological advancement through the integration of intelligent digital solutions. This research examines the evolving role of Artificial Intelligence in enhancing GST administration, improving tax compliance, strengthening fraud detection mechanisms, and supporting transparent governance within the digital economy. The study explores how AI-driven technologies such as machine learning, predictive analytics, natural language processing, robotic process automation, and intelligent data processing are reshaping traditional taxation systems into more efficient and automated models.

The implementation of AI in GST systems enables tax authorities to process large volumes of transactional data in real time, thereby improving the accuracy and efficiency of tax collection and compliance monitoring. AI-powered algorithms assist in detecting irregularities, fake invoicing practices, tax evasion patterns, and fraudulent input tax credit claims through advanced risk assessment and behavioral analysis. Furthermore, automated invoice matching, return verification, and digital auditing reduce manual intervention, administrative burden, and operational costs for both governments and taxpayers. The study particularly highlights the Indian GST ecosystem, where digital initiatives such as e-invoicing, e-way bills, and integrated online tax portals have created a strong foundation for AI-enabled tax governance.

In addition to administrative efficiency, the research investigates the strategic importance of AI in policy formulation and revenue forecasting. AI systems can generate predictive insights from historical tax data, helping policymakers identify economic trends, optimize tax structures, and improve fiscal planning. The adoption of intelligent chatbots and virtual assistance systems also enhances taxpayer services by providing instant guidance, automated query resolution, and personalized compliance support.

However, the integration of AI within GST administration also presents significant legal, ethical, and technological challenges. Issues related to data privacy, cybersecurity threats, algorithmic bias, digital literacy, and transparency in automated decision-making require careful regulatory oversight and institutional preparedness. The study emphasizes the need for a robust legal framework, secure digital infrastructure, and continuous capacity-building programs to ensure ethical and accountable use of AI technologies in taxation systems.

The research concludes that Artificial Intelligence has the potential to revolutionize GST administration by promoting transparency, efficiency, accountability, and data-driven governance. AI-driven taxation systems not only strengthen revenue collection and compliance management but also contribute to the broader objectives of digital transformation and smart governance in the era of Industry 4.0. Therefore, governments and tax authorities must adopt balanced strategies that encourage technological innovation while safeguarding legal rights, data security, and public trust in digital tax ecosystems.

Keywords: *Artificial Intelligence, Goods and Services Tax (GST), Machine Learning, Tax Compliance, Digital Governance, Predictive Analytics.*

DESIGN, SYNTHESIS, AND BIOLOGICAL EVALUATION OF BENZOTHIAZOLE DERIVATIVES AS POTENT ANTIMICROBIAL AND ANTI-INFLAMMATORY AGENTS

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ABSTRACT

Heterocyclic compounds containing sulfur and nitrogen play a significant role in medicinal and pharmaceutical chemistry due to their diverse biological activities. Among these compounds, benzothiazole and its derivatives have attracted considerable attention because of their broad spectrum of pharmacological properties. Several clinically important drugs, including pramipexole, lubeluzole, probenazole, ethoxzolamide, zopolrestat, and bentazon, are based on the benzothiazole scaffold. Benzothiazole derivatives have demonstrated promising therapeutic potential against cancer, tuberculosis, HIV, microbial infections, cardiovascular disorders, seizures, inflammation, and diabetes.

Despite these advancements, the emergence of drug-resistant pathogens and the need for safer therapeutic agents necessitate the development of novel benzothiazole-based molecules with enhanced efficacy and reduced side effects. The present study focuses on the design and synthesis of new benzothiazole derivatives through innovative synthetic approaches and structural modifications. Furthermore, the synthesized compounds are evaluated for their antimicrobial and anti-inflammatory activities to explore their potential as effective therapeutic candidates. This work aims to contribute to the development of novel benzothiazole-based agents for combating microbial infections and inflammatory disorders.

Keywords: *Benzothiazole Derivatives, Antimicrobial Activity, Anti-Inflammatory Activity, Heterocyclic Compounds, Drug Discovery.*

ASSESSMENT OF IONOSPHERIC TEC VARIABILITY OVER JAIPUR UNDER SOLAR FLARE CONDITIONS DURING SOLAR MAXIMUM

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ABSTRACT

A solar flare is a sudden release of energy usually near a complex group of sunspots. The interaction of solar flare radiations with constituents of ionosphere produces immediate increase in the electron density in the ionosphere. The present paper describes the effect of solar flare on ionospheric total electron contents (TEC) using International Reference Ionosphere (IRI) data recorded at Jaipur, during solar maximum period. In this study, total two solar flares have been selected to study the effect of solar flares on ionosphere during the year 2012 on solar cycle 24, which is a solar maximum period. The enhancements on ionospheric TEC have been observed during the period of solar flares. The maximum enhancement of TEC during solar flare compared to quiet mean TEC up to 12-16 TEC units have been observed. A significant enhancement in TEC is observed at regions around the EIA crest region during the flare in association with: (a) the flare related EUV flux enhancement and consequent increased production of ionization, and (b) changes in the equatorial electrodynamics. The magnitude of enhancement in ionospheric TEC appears to be dependent on the class of the solar flare.

Keywords: Ionospheric Total Electron Content (TEC), Solar Flare, EUV Flux, Solar Flares, Solar Cycle.

ANALYSIS OF CORONAL MASS EJECTION–DRIVEN FORBUSH DECREASES AND ASSOCIATED SOLAR WIND VARIATIONS DURING SOLAR CYCLE 24

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ABSTRACT

This study presents an advanced investigation of Coronal Mass Ejection (CME)-driven Forbush Decreases (Fds) observed during Solar Cycle 24 and examines their relationship with interplanetary solar wind disturbances and heliospheric plasma conditions. Forbush decreases, characterized by sudden reductions in galactic cosmic ray intensity near Earth, are analyzed in connection with variations in key solar wind parameters, including interplanetary magnetic field (IMF) strength, solar wind velocity (SWV), solar wind temperature (SWT), and solar wind pressure (SWP). The analysis demonstrates that all selected Fd events are strongly associated with significant disturbances in these interplanetary parameters, confirming the dominant influence of CME-driven shocks and magnetic structures on cosmic ray modulation within the heliosphere. A detailed statistical correlation analysis has been performed to quantify the relationship between Fd magnitude and the magnitude of associated solar wind disturbances. The results reveal a positive correlation coefficient of 0.37 between Fd magnitude and IMF enhancement, indicating that intensified magnetic field conditions effectively suppress galactic cosmic ray flux through enhanced diffusion barriers and magnetic turbulence. A positive correlation coefficient of 0.26 is obtained between Fd magnitude and SWV disturbances, suggesting that elevated solar wind speeds and CME-driven plasma flows contribute to the modulation process. In addition, all investigated Fds exhibit pronounced enhancements in solar wind pressure and plasma temperature. The correlation coefficient between Fd magnitude and SWP disturbances is found to be 0.28, while the strongest positive correlation coefficient of 0.35 is observed between Fd magnitude and SWT disturbances, highlighting the significant role of thermal plasma dynamics in the evolution of cosmic ray intensity depressions. The findings suggest that the combined effects of enhanced magnetic turbulence, compressed plasma regions, and disturbed solar wind environments generated by CME propagation are critical factors governing the intensity and recovery characteristics of Forbush decreases during Solar Cycle 24. The comparatively stronger correlations with IMF strength and solar wind temperature imply that magnetic and thermal properties of interplanetary disturbances exert greater control over cosmic ray transport processes than solar wind speed alone. These results provide important insight into the coupling between solar transients and galactic cosmic ray variability and contribute to a deeper understanding of heliospheric modulation mechanisms in near-Earth space. The study further emphasizes the significance of CME-induced interplanetary disturbances in space weather dynamics and cosmic ray propagation throughout the inner heliosphere.

Keywords: Coronal Mass Ejections (CMEs), Forbush Decreases (Fds), Interplanetary Magnetic Field (IMF), Solar Wind Velocity (SWV), Solar Wind Temperature (SWT), Solar Wind Pressure (SWP).

CME-DRIVEN FORBUSH DECREASES AND THEIR ASSOCIATION WITH SOLAR WIND DISTURBANCES DURING SOLAR CYCLE 24

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ABSTRACT

This study presents a comprehensive investigation of Coronal Mass Ejection (CME)-related Forbush Decreases (Fds) in galactic cosmic ray intensity during Solar Cycle 24 and their association with interplanetary solar wind disturbances. The analysis reveals that all observed Fds are closely linked with significant variations in interplanetary magnetic field (IMF) strength, solar wind velocity (SWV), solar wind plasma temperature (SWT), and solar wind pressure (SWP), indicating the dominant role of CME-driven interplanetary disturbances in modulating cosmic ray intensity near Earth. Statistical correlation analysis has been carried out to examine the relationship between the magnitude of Fds and the peak amplitudes of associated solar wind parameters. The results show a positive correlation coefficient of 0.36 between Fd magnitude and IMF disturbances, suggesting that enhanced magnetic field strength contributes significantly to the suppression of cosmic ray flux. A positive correlation coefficient of 0.27 is obtained between Fd magnitude and SWV disturbances, indicating the influence of high-speed solar wind streams on cosmic ray modulation. Furthermore, all Fds are found to be associated with pronounced disturbances in SWP and SWT. The correlation coefficient between Fd magnitude and SWP disturbances is found to be 0.27, while the highest positive correlation coefficient of 0.37 is observed between Fd magnitude and SWT disturbances. The results suggest that enhanced interplanetary magnetic turbulence and disturbed solar wind plasma conditions generated by CME propagation play a crucial role in the development and intensity variation of Forbush decreases. The comparatively stronger correlation with solar wind plasma temperature and IMF indicates that thermal and magnetic properties of CME-driven disturbances are more effective in controlling cosmic ray modulation during Solar Cycle 24. This study contributes to a better understanding of heliospheric disturbances and their impact on cosmic ray transport processes in near-Earth space.

Keywords: *Coronal Mass Ejections (CMEs), Forbush Decreases (Fds), Interplanetary Magnetic Field (IMF), Solar Wind Velocity (SWV), Solar Wind Pressure (SWP), Solar Cycle 24.*

INVESTIGATION OF GEOMAGNETIC STORMS ASSOCIATED WITH HIGH-SPEED CORONAL MASS EJECTIONS AND SOLAR WIND PLASMA DISTURBANCES DURING THE MAXIMUM AND DECLINING PHASES OF SOLAR CYCLE 24

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ABSTRACT

The present investigation focuses on the association between geomagnetic storms (GMs) triggered by high-speed coronal mass ejections (CMEs) and the corresponding disturbances observed in interplanetary magnetic field (IMF) and solar wind plasma parameters during the maximum and declining phases of Solar Cycle 24. Geomagnetic storms represent one of the most significant manifestations of solar–terrestrial interactions, originating primarily from CME-driven disturbances propagating through the heliosphere and interacting with Earth’s magnetosphere. In this study, a comprehensive statistical analysis was performed to examine the extent to which variations in solar wind plasma and IMF parameters contribute to the intensity of geomagnetic activity. The analysis demonstrates that all investigated geomagnetic storms were consistently associated with significant disturbances in solar wind plasma conditions and interplanetary magnetic field components. The results reveal a strong positive correlation ($r = 0.72$) between the magnitude of geomagnetic storms and variations in the total interplanetary magnetic field strength (IMF-B), indicating the important role of enhanced magnetic field intensity in geomagnetic storm generation. An even stronger positive correlation ($r = 0.76$) was obtained between geomagnetic storm magnitude and disturbances in the southward component of the IMF (B_z), confirming that prolonged southward IMF orientations facilitate efficient magnetic reconnection between the solar wind and Earth’s magnetosphere, thereby intensifying geomagnetic activity. In addition, the study identifies significant relationships between geomagnetic storm intensity and key solar wind plasma parameters. A moderate positive correlation ($r = 0.47$) was found between geomagnetic storms and solar wind plasma temperature (SWPT), suggesting that thermal enhancements in the solar wind contribute to storm development but with comparatively lower influence. Strong positive correlations were also observed between geomagnetic storm magnitude and solar wind plasma velocity (SWPV) ($r = 0.73$), as well as solar wind plasma pressure (SWPP) ($r = 0.79$). These results indicate that fast and compressed solar wind streams associated with high-speed CMEs play a dominant role in transferring energy and momentum into Earth’s magnetosphere. The overall findings clearly demonstrate that geomagnetic storms associated with higher-speed CMEs are closely linked with substantial disturbances in both interplanetary magnetic field and solar wind plasma parameters. The enhanced plasma velocity, magnetic field strength, and dynamic pressure associated with CME-driven solar wind disturbances significantly contribute to the development and intensification of geomagnetic storms. This study provides important insights into the physical mechanisms governing solar–terrestrial coupling and highlights the critical role of CME-induced solar wind disturbances in space weather variability during Solar Cycle 24. The results may further contribute to improved forecasting and prediction models for severe geomagnetic storms and their potential impacts on satellite operations, communication systems, navigation technologies, and ground-based power infrastructure.

Keywords: Geomagnetic Storms (GMs), Coronal Mass Ejections (CMEs), Solar Wind Plasma Parameters, Interplanetary Magnetic Field (IMF), IMF- B_z , Solar Wind Velocity.

ANALYSIS OF COSMIC RAY VARIATIONS WITH SOLAR ACTIVITY AND GEOMAGNETIC PARAMETERS DURING SOLAR CYCLES (2009–2025)

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ABSTRACT

The present study investigates the long-term variation of Cosmic Ray Intensity (CRI) in relation to Sunspot Number (SSN), Interplanetary Magnetic Field (IMF) and Kp Index during the period 2009–2025, covering Solar Cycles 24 and the beginning of Solar Cycle 25. Cosmic rays are energetic charged particles originating from outer space and their intensity near Earth is significantly influenced by solar activity and heliospheric magnetic conditions. The analysis of annual average values of CRI, SSN, IMF and Kp Index was carried out to examine their correlation and mutual dependence.

The results reveal a strong inverse correlation between CRI and SSN ($r = -0.90$), indicating that cosmic ray intensity decreases with increasing solar activity. Similarly, CRI shows a significant negative correlation with IMF ($r = -0.77$) and Kp Index ($r = -0.61$), suggesting that stronger interplanetary magnetic fields and geomagnetic disturbances act as barriers to the penetration of galactic cosmic rays into Earth's atmosphere.

The study confirms that solar and geomagnetic parameters play an important role in the modulation of cosmic rays. These findings contribute to a better understanding of solar-terrestrial interactions, space weather processes, and the behavior of cosmic ray intensity during different phases of solar cycles.

Keywords: *Cosmic Ray Intensity (CRI), Sunspot Number (SSN), Interplanetary Magnetic Field (IMF), Kp Index, Solar Activity, Space Weather.*

ECOTOXICOLOGICAL EFFECTS OF HEAVY METALS ON EARTHWORMS

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ABSTRACT

Earthworms are important soil organisms that play a significant role in maintaining soil fertility, nutrient cycling, organic matter decomposition, and soil aeration. However, increasing industrialization, urbanization, mining activities, agricultural practices, and improper waste disposal have led to the accumulation of heavy metals such as lead (Pb), cadmium (Cd), mercury (Hg), chromium (Cr), copper (Cu), zinc (Zn), and arsenic (As) in the soil environment. These toxic metals adversely affect the physiology, growth, reproduction, and survival of earthworms. Earthworms absorb heavy metals through direct contact with contaminated soil and ingestion of organic matter, resulting in bioaccumulation within their tissues. Exposure to heavy metals can reduce body weight, inhibit cocoon production, decrease hatchability, alter enzymatic activities, and damage cellular structures. Prolonged exposure may also lead to oxidative stress, behavioral changes, and mortality in sensitive earthworm species. Since earthworms are highly responsive to soil contamination, they are widely used as bioindicators for assessing soil pollution and ecological health.

Toxic metal accumulation in earthworm tissues may lead to reduced growth, impaired reproduction, enzymatic alterations, oxidative stress, tissue damage, and increased mortality. Long-term exposure can disturb soil biodiversity and negatively influence ecosystem productivity and sustainability. Earthworms absorb contaminants directly through their skin and by ingesting contaminated soil particles, making them highly sensitive indicators of environmental toxicity. The impact of heavy metals on earthworms not only threatens soil biodiversity but also affects overall ecosystem functioning and agricultural productivity. The study highlights the importance of monitoring heavy metal contamination and emphasizes the need for effective soil management and pollution control strategies to protect soil biodiversity and ecological balance.

Keywords: *Heavy Metals, Earthworms, Ecotoxicology, Soil Pollution, Bioaccumulation, Soil Ecosystem.*

BIOPOLYMER-BASED SUSTAINABLE PACKAGING AND ITS CONTROLLED BIODEGRADATION FOR A CIRCULAR BIOECONOMY

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ABSTRACT

The rapid growth in plastic consumption has created significant environmental issue due to the accumulation of non-biodegradable waste. Biopolymers have emerged as promising materials for eco-friendly packaging due to their renewable origin, biodegradability, and reduced carbon footprint. Unlike conventional plastics, biopolymer-based packaging materials can be designed to degrade within predetermined time frames under specific environmental conditions, thereby minimizing long-term environmental pollution. The biopolymer based sustainable packaging and its controlled biodegradation have emerged as an important solution to reduce environmental pollution and support global economy. The objective of this study is to examine the role of natural and synthetic biopolymers in sustainable packaging applications, their physicochemical properties, degradation mechanisms, and factors influencing biodegradation rates. Particular emphasis is placed on controlled biodegradation within stipulated time frames to meet the environmental conservation. The study highlights recent advancements in biodegradable packaging technologies and discusses future challenges and opportunities in developing next-generation sustainable packaging systems.

Keywords: *Biopolymer, Sustainable Packaging, Biodegradation.*

EMERGING TRENDS IN RESEARCH AND DEVELOPMENT: DRIVING INNOVATION FOR A SUSTAINABLE FUTURE

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ABSTRACT

Through creative ideas, research and development (R&D) is essential in tackling global issues and promoting sustainable development. Scientific research and industrial innovation have changed dramatically as a result of the quick development of technologies like artificial intelligence (AI), the Internet of Things (IoT), big data analytics, biotechnology, nanotechnology, renewable energy systems, and green technologies. Interdisciplinary cooperation, digital transformation, climatic resilience, sustainable resource management, and environmentally conscious innovation are among the new trends in research and development. These advancements greatly aid in the accomplishment of the Sustainable Development Goals (SDGs) by fostering social well-being, environmental preservation, and economic progress. The concepts of the circular economy, smart agriculture, renewable energy, biodiversity preservation, and sustainable urban development are becoming more and more important in today's research methodologies. Additionally, scientific discoveries have been hastened and research procedures have become more efficient due to the integration of sophisticated computer tools and data-driven decision-making. This essay examines current research and development trends and emphasizes how they are fostering innovation for a sustainable future. It also looks at the potential, difficulties, and hopes for sustainable R&D methods in building long-term environmental sustainability and resilient communities.

Keywords: *Research Development, Sustainable Development, Innovation, Artificial Intelligence, Biotechnology and Green Technology.*

CME-DRIVEN FORBUSH DECREASES AND THEIR ASSOCIATION WITH SOLAR WIND DISTURBANCES DURING SOLAR CYCLE 24

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ABSTRACT

This study presents a comprehensive investigation of Coronal Mass Ejection (CME)-related Forbush Decreases (Fds) in galactic cosmic ray intensity during Solar Cycle 24 and their association with interplanetary solar wind disturbances. The analysis reveals that all observed Fds are closely linked with significant variations in interplanetary magnetic field (IMF) strength, solar wind velocity (SWV), solar wind plasma temperature (SWT), and solar wind pressure (SWP), indicating the dominant role of CME-driven interplanetary disturbances in modulating cosmic ray intensity near Earth. Statistical correlation analysis has been carried out to examine the relationship between the magnitude of Fds and the peak amplitudes of associated solar wind parameters. The results show a positive correlation coefficient of 0.36 between Fd magnitude and IMF disturbances, suggesting that enhanced magnetic field strength contributes significantly to the suppression of cosmic ray flux. A positive correlation coefficient of 0.27 is obtained between Fd magnitude and SWV disturbances, indicating the influence of high-speed solar wind streams on cosmic ray modulation. Furthermore, all Fds are found to be associated with pronounced disturbances in SWP and SWT. The correlation coefficient between Fd magnitude and SWP disturbances is found to be 0.27, while the highest positive correlation coefficient of 0.37 is observed between Fd magnitude and SWT disturbances. The results suggest that enhanced interplanetary magnetic turbulence and disturbed solar wind plasma conditions generated by CME propagation play a crucial role in the development and intensity variation of Forbush decreases. The comparatively stronger correlation with solar wind plasma temperature and IMF indicates that thermal and magnetic properties of CME-driven disturbances are more effective in controlling cosmic ray modulation during Solar Cycle 24. This study contributes to a better understanding of heliospheric disturbances and their impact on cosmic ray transport processes in near-Earth space.

Keywords: *Coronal Mass Ejections (CMEs), Forbush Decreases (Fds), Interplanetary Magnetic Field (IMF), Solar Wind Parameters.*

CONSTRUCTING EFFECTIVE COMMUNITY PLACES WITH SUSTAINABLE GREEN TECHNOLOGIES

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ABSTRACT

With the effective use of green growth ideas and techniques, communities can improve their health and economy while minimising the environmental effects of new construction and expansion. Smart growth practices like developing compactly and putting a variety of uses close together help to safeguard the environment by using resources more effectively and making it easy for individuals to drive less if they wish. Communities need to use sustainable technologies to build towns and cities that can function without producing a lot of waste. They also make it simpler for community members to lead more environmentally friendly lives and in this way, they can both enjoy the benefits of the community and maintain ecological balance. Therefore, communities must ensure to adopt green technologies and reach wide exposure of people.

Keywords: *Green Growth, Community Development, Environmental Protection, Sustainability, Technologies for Green Construction.*

TRANSFORMATIONAL LEADERSHIP FOR CROSS-CULTURAL, HYBRID, AND REMOTE TEAMS

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ABSTRACT

Covid-19 pandemic has brought a transformational outlook among the organizations across the world, accelerating changes which were once unimaginable, especially in the management of remote and hybrid workforce. Technological advances and shifts in workplace practices have also brought a paradigm shift in organizations that traditionally depended on the physical office spaces who were forced to move digitally and adopt virtual collaboration methods.

They were led to revamp their leadership approach, such as transformational approach that was able to adapt to dynamic and uncertain environments. The dispersal of teams geographically and with cultural diversity leadership became a challenging role. This transformation though has offered opportunities for flexibility and innovation but simultaneously has led to new leadership challenges like communication barriers, cultural differences and reduced face to face interactions. A global study found that 45% of remote workers experience feelings of isolation, which negatively impacts their productivity, and overall morale again calls for a challenge for the leadership team. This is where the transformational leadership has caught its attention as an effective tool to address these challenges and has emerged as powerful tool to address these challenges. This style focusses on inspiring, motivating and developing team members in achieving higher productivity and performance. My research explores how transformational leadership can be effectively applied across the cross-cultural, hybrid and team environments.

The study highlights the importance of designing and implementation of leadership developmental programme that emphasizes adaptive leadership styles, emotional intelligence and use of most emerging technologies like AI. These programs equip leadership with the skills needed to navigate the complexities arising with managing remote and hybrid teams, including communication barriers, cultural diversity and employee engagement. The study recommends the development and implementation of leadership training programs focusing on adaptive leadership styles, emotional intelligence, and the integration of AI technologies to address the unique challenges of managing remote and hybrid teams. These findings offer a practical roadmap for organizations to remain resilient, adaptable, and competitive in an evolving digital landscape, ensuring long-term success.

Keywords: *Cross Cultural, Remote Teams, Transformational Leadership.*

ANALYSIS OF GEOMAGNETIC STORMS DRIVEN BY X- AND M-CLASS ASSOCIATED PARTIAL HALO CMES UNDER SOLAR WIND CONDITIONS DURING THE RISING PHASE OF SOLAR CYCLE 25

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ABSTRACT

The present study examines the relationship between geomagnetic storms (GMs), X- and M-class partial halo coronal mass ejections (PH-CMEs), and associated disturbances in solar wind plasma parameters during the ascending phase of Solar Cycle 25. A comprehensive analysis of interplanetary conditions demonstrates that all investigated geomagnetic storms are accompanied by significant perturbations in solar wind and interplanetary magnetic field (IMF) parameters. Statistical investigations reveal a strong positive correlation ($r = 0.71$) between geomagnetic storm magnitude and peak disturbances in the total interplanetary magnetic field strength (IMF-B), while an exceptionally high correlation ($r = 0.89$) is observed with the southward IMF component (IMF-B_z), highlighting the dominant role of magnetic reconnection processes in storm intensification. In addition, geomagnetic storm intensity exhibits substantial positive correlations with solar wind plasma temperature disturbances (SWPT; $r = 0.73$) and solar wind plasma velocity disturbances (SWPV; $r = 0.67$), indicating the significant contribution of enhanced solar wind dynamics and plasma heating in magnetospheric coupling processes.

The results provide compelling evidence that geoeffective X- and M-class PH-CMEs generate pronounced interplanetary disturbances capable of efficiently transferring energy into the terrestrial magnetosphere, thereby triggering intense geomagnetic activity. The strong dependence of storm magnitude on IMF-B_z variations further confirms the critical importance of southward-directed magnetic fields in controlling geomagnetic storm severity during Solar Cycle 25. This study advances the understanding of Sun–Earth coupling mechanisms and emphasizes the predictive significance of solar wind plasma disturbances for space weather forecasting and geomagnetic storm modeling.

Keywords: *Geomagnetic Storms (GMs), Partial Halo Coronal Mass Ejections (PH-CMEs), Solar Wind Plasma, Interplanetary Magnetic Field (IMF-B, IMF-B_z), Space Weather, Solar Cycle 25.*

ANALYSIS OF SOLAR-TERRESTRIAL COUPLING: QUANTIFYING THE GEOMAGNETIC RESPONSE TO ERUPTIVE ACTIVITY FROM ACTIVE REGION AR 4366 IN FEBRUARY 2026

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ABSTRACT

This study investigates the relationship between solar flare intensity and subsequent planet-wide geomagnetic disturbances during a period of heightened solar activity from 1st February to 6th February 2026. Utilizing multi-observatory data primarily originating from the highly complex active region AR 4366, the research tracks a sequence of eruptive events across C, M, and X flare classes. The methodology integrates descriptive statistics, Pearson correlation analysis, and Superposed Epoch Analysis (SEA) to model the temporal lag and magnitude of global magnetic variations via the Disturbance Storm Time (Dst) index. The observation period recorded exceptionally high activity, including over 45 M-class events and 6 major X-class flares, peaking with an X8.11 eruption. Statistical and time-series analyses revealed a moderate positive correlation (approx 0.55 - 0.68) between log-transformed peak X-ray flux and absolute Dst minimums. Major X-class flares systematically triggered moderate geomagnetic storms ($Dst < -50\text{nT}$), driving the ring current depression to a minimum of -62nT on 5th February after an observational lag of 12 to 48 hours. While these findings validate the direct solar-terrestrial coupling mechanism via inferred coronal mass ejections (CMEs), the study acknowledges limitations regarding the absence of in-situ solar wind data and its short temporal window. Ultimately, this work reinforces the utility of real-time Dst monitoring and highlights the vital role of tracking active region morphologies for space weather forecasting and infrastructure mitigation.

Keywords: Space Weather, Solar Flares, Geomagnetic Storms, Dst Index, Active Region 4366, Solar-Terrestrial Coupling.

AN ANALYSIS OF SOLAR AND INTERPLANETARY DRIVERS OF EXTENSIVE GEOMAGNETIC STORMS (CYCLES 23–24)

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ABSTRACT

Geomagnetic storms are large-scale disturbances of Earth's magnetosphere resulting from the efficient transfer of energy from the solar wind into the near-Earth space environment. This study presents a comprehensive analysis of extensive geomagnetic storms ($Dst \leq -150$ nT) that occurred during Solar Cycles 23 and 24, with the objective of identifying the key interplanetary conditions responsible for their development. The relationships between storm intensity and several solar wind parameters, including the southward interplanetary magnetic field component (IMF- B_z), total interplanetary magnetic field strength (IMF-B), solar wind plasma velocity (V_{sw}), solar wind plasma temperature (T_{sw}), and solar wind proton density (D_{sw}), are systematically investigated. The results indicate that extensive geomagnetic storms are strongly controlled by variations in the interplanetary magnetic field. IMF-B exhibits the strongest correlation with the magnitude of storm intensity ($r = 0.67$ for peak values and 0.56 for disturbance magnitude), followed by IMF- B_z ($r = 0.49$ for peak values and 0.48 for disturbance magnitude). Solar wind velocity shows a moderate influence ($r = 0.48$ for peak values, and 0.18 for disturbance magnitude), whereas T_{sw} ($r = 0.31$ for peak values, and 0.32 for disturbance magnitude) and D_{sw} ($r = 0.20$ for peak values, and 0.13 for disturbance magnitude) display comparatively weak correlations. Furthermore, 94% of the analyzed storms were associated with coronal mass ejections (CMEs), with halo CMEs accounting for 78.57% of these events and 21.43% as partial halo CMEs. These findings confirm the dominant role of enhanced interplanetary magnetic field conditions and CME-driven solar activity in producing extensive geomagnetic storms and provide valuable insights for improving space weather forecasting and mitigating risks to space- and ground-based technological systems.

Keywords: *Geomagnetic Storm, Earth's Magnetosphere, Solar Wind, Space Weather, Technological Systems.*

SMART HEALTHCARE WORKFLOW OPTIMIZATION SYSTEM USING SALESFORCE CRM

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ABSTRACT

The rapid growth of digital healthcare technologies has increased the demand for intelligent systems capable of automating hospital workflows and optimizing healthcare resource management. Traditional healthcare management systems often rely on fragmented operational modules for patient records, appointment scheduling, inventory management, billing, and admission workflows, leading to inefficiencies and increased administrative overhead. This research presents a Smart Healthcare Workflow Optimization System using Salesforce CRM designed to integrate healthcare operations into a centralized cloud-based environment. The proposed system incorporates intelligent workflow automation for appointment scheduling, emergency admission prioritization, doctor recommendation, automated bed allocation, inventory monitoring, billing management, and healthcare analytics. Salesforce technologies including Apex Triggers, Flows, Validation Rules, and custom objects are utilized to automate healthcare workflows and improve operational coordination. The system demonstrates enhanced workflow efficiency, real time resource visibility, reduced manual intervention, and improved healthcare process management. The proposed framework provides a scalable and structured healthcare automation solution suitable for modern hospital environments.

Keywords: *Healthcare Workflow Automation, Salesforce CRM, Hospital Resource Optimization, Intelligent Healthcare Systems, Workflow Management, Inventory Monitoring.*

LONG-TERM RELATIONS OF COSMIC RAY INTENSITY WITH SOLAR AND GEOMAGNETIC ACTIVITY PARAMETERS DURING MAXIMUM AND DECLINE PHASE OF SOLAR CYCLE 24

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ABSTRACT

This study presents a comprehensive investigation of the modulation of galactic cosmic ray intensity (CRI) during the maximum and declining phases of Solar Cycle 24 using long-term observational datasets from the Oulu Neutron Monitor. Yearly averaged cosmic ray intensity measurements recorded by the Oulu Super Neutron Monitor were analyzed in conjunction with key indicators of solar and geomagnetic activity, including yearly averaged sunspot number (SSN), Solar Flare Index (SFI), geomagnetic activity parameters (Ap, Kp, and AE indices), and interplanetary magnetic field (IMF) strength.

The analysis reveals a pronounced inverse relationship between CRI and all selected solar–terrestrial activity parameters, confirming the significant role of heliospheric and geomagnetic conditions in cosmic ray modulation. A strong negative correlation coefficient of $r = -0.80$ was observed between CRI and SSN, indicating enhanced suppression of galactic cosmic rays during periods of elevated solar activity. Similarly, CRI exhibited a substantial anti-correlation with the Solar Flare Index ($r = -0.76$), suggesting that intensified flare activity contributes effectively to heliospheric disturbances and particle diffusion barriers.

Geomagnetic activity indices also demonstrated significant inverse associations with CRI. The correlation coefficients were found to be $r = -0.68$ for the Ap index, $r = -0.58$ for the Kp index, and $r = -0.69$ for the AE index, implying that enhanced geomagnetic disturbances correspond to reduced cosmic ray penetration into the near-Earth environment. Furthermore, the interplanetary magnetic field showed a strong negative correlation with CRI ($r = -0.75$), emphasizing the dominant influence of heliospheric magnetic turbulence and magnetic shielding on cosmic ray transport processes.

The results support the classical theory of solar modulation of galactic cosmic rays and demonstrate that variations in solar magnetic activity, geomagnetic disturbances, and interplanetary magnetic conditions collectively govern the temporal behavior of cosmic ray intensity during Solar Cycle 24. This work contributes to a deeper understanding of Sun–Earth coupling processes, heliospheric dynamics, and space weather variability, with potential applications in cosmic ray forecasting and space climate studies.

Keywords: Cosmic Ray Intensity (CRI), Sunspot Number (SSN), Solar Flare Index (SFI), Geomagnetic Activity, Ap Index, Kp Index.

CYTOTOXIC EFFECTS AND ANTICANCER EFFICACY OF BIOFABRICATED GRAPHENE OXIDE–ZNO/CUO NANOHYBRIDS AGAINST MCF-BREAST CANCER CELLS

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ABSTRACT

The development of multifunctional nanomaterials with enhanced therapeutic efficiency and biocompatibility has emerged as a promising strategy in modern cancer nanomedicine. In the present study, graphene oxide (GO)-based hybrid nanocomposites incorporating copper oxide (CuO) and zinc oxide (ZnO) nanoparticles were successfully biofabricated through an environmentally friendly green synthesis approach. The integration of GO with metal oxide nanoparticles was intended to improve the physicochemical stability, surface reactivity, and biomedical performance of the resulting nanocomposites, particularly for anticancer applications. The synthesized GO–ZnO/CuO hybrid nanocomposites were comprehensively characterized using various analytical and spectroscopic techniques, including X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), and transmission electron microscopy (TEM). The characterization studies confirmed the successful formation of well-dispersed hybrid nanostructures with desirable morphological and structural properties suitable for biomedical applications. The biological performance of the synthesized nanocomposites was evaluated through in vitro cytotoxicity and anticancer studies. Cytotoxicity analysis on normal fibroblast cells demonstrated good biocompatibility and minimal toxicity at lower concentrations, indicating the relative safety of the prepared materials for biological systems. However, a slight reduction in cell viability was observed at higher concentrations (100 µg/mL), suggesting dose-dependent toxicity. Anticancer activity studies against human breast cancer cell lines revealed significant inhibition of cancer cell proliferation by the GO–ZnO/CuO nanocomposites. Comparative investigations with the individual components, including pristine GO and metal oxides, demonstrated that the hybrid nanocomposites exhibited superior activity, which may be attributed to the synergistic interactions between GO, ZnO, and CuO nanoparticles.

Keywords: Graphene Oxide, Zinc Oxide, Copper Oxide, Nanocomposite, Anticancer Activity, Cytotoxicity.

INVESTIGATING THE SOLAR AND INTERPLANETARY ORIGINS OF SEVERE GEOMAGNETIC STORMS DURING SOLAR CYCLE 25

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ABSTRACT

Severe geomagnetic storms are among the most significant space weather events affecting Earth's technological systems. This study presents an event-based analysis of seven severe geomagnetic storms ($Dst \leq -150$ nT) that occurred during Solar Cycle 25 between December 2019 and January 2025. Relationships between storm intensity and key solar and interplanetary parameters, including sunspot number (SSN), F10.7 solar radio flux, CME linear velocity, and CME acceleration, were examined. The results show that F10.7 ($r = 0.76$) exhibited a stronger association with storm intensity than SSN ($r = 0.41$), while CME linear velocity ($r = 0.85$) and acceleration ($r = 0.79$) displayed substantial correlations with peak Dst, highlighting the importance of CME dynamics in driving severe geomagnetic activity. Most storm-associated eruptions originated from major M- and X-class flares, with fast Earth-directed CMEs producing geoeffective interplanetary structures, particularly shock sheaths and sheath-magnetic cloud combinations. These findings demonstrate that CME evolution and interplanetary magnetic field conditions are the primary factors controlling severe geomagnetic storms during Solar Cycle 25 and remain essential for improving space weather forecasting.

Keywords: *Geomagnetic Storms, Disturbance Storm Time (Dst) index, Coronal Mass Ejections (CMEs), Sunspot number (SSN), Solar radio flux (F10.7).*

CHARGE TRANSPORT AND AC RESPONSE MECHANISM OF $\text{PVA}_{(1-x)}\text{:NH}_4\text{I}_{(x)}$ BASED GEL POLYMER ELECTROLYTES SYSTEM

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ABSTRACT

For the past several decades, gel polymer electrolytes have received a lot of interest because of their exceptional ease of processing, safety, and flexibility. This research work focuses on the improvement of ionic conductivity and charge transport properties in Gel Polymer Electrolytes (GPEs). Using a solution casting method, gel films are developed using a host polymer PVA and ammonium iodide (NH_4I) salt based $\text{PVA}_{(1-x)}\text{:NH}_4\text{I}_{(x)}$ system for different salt concentrations. DMSO is used as a solvent because of its enhanced dielectric constant and plasticizing qualities. This work uses FTIR and EIS to investigate further into ion transport parameters. FTIR is used to characterize the GPEs system, and impedance spectroscopy (EIS) is used to evaluate the GPEs ionic conductivity at room temperature. Optimum ionic conductivity, is determined $8.52 \times 10^{-3} \text{ S/cm}$ at 30 wt% of NH_4I concentration at ambient temperature. Cyclic voltammetry results confirm the operational stability and recyclability of the GPEs. LSV results is indicated the broad electrochemical stability window (-1.49 to $+1.27$ V). The system shows a proclivity for ion-dominated electrochemical applications, which is further confirmed by the ionic transference number ($t_{\text{ion}} \approx 0.99$), indicating charge transport is nearly entirely ionic. The material demonstrates excellent electrochemical reversibility, showing minimum degradation across multiple cycles. Consequently, these findings highlight its viability for practical electrochemical device applications.

Keywords: Gel Polymer Electrolytes, EIS, FTIR, Dielectric Constant.

ION TRANSPORT STUDIES OF PVA: STARCH BLEND BASED GEL POLYMER ELECTROLYTE FOR ELECTROCHEMICAL DEVICE

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ABSTRACT

The growing demand for safe, flexible, and high-performance energy storage devices has accelerated research on gel polymer electrolytes (GPEs) as promising alternatives to conventional liquid electrolytes. Poly (vinyl alcohol) (PVA) and starch-based blend polymer electrolytes have attracted significant attention due to their biodegradability, low cost, film-forming ability, and excellent compatibility with ionic salts. This study focuses on the transport properties of PVA–starch blend-based gel polymer electrolytes and their potential application in electrochemical energy storage systems. The incorporation of suitable salts and plasticizers within the polymer matrix enhances ionic mobility by increasing the amorphous phase and segmental motion of polymer chains. In this present research work, we report on the synthesis of PVA: Starch: $\text{NH}_4\text{CH}_3\text{COO}$ based blend Gel polymer Electrolyte. Significant improvement of electrical conductivity in GPEs through the variation of starch concentration. The blend gel polymer electrolyte was prepared by solution casting technique. Fourier Transform Infrared Spectroscopy (FTIR) confirmed the strong interactions and complexation among the polymer matrix, salt. Electrochemical Impedance Spectroscopy (EIS) also showed a big rise in ionic conductivity, reaching an astonishing $4.67 \times 10^{-4} \text{ S/cm}$ with only 50 wt% of starch concentration at ambient temperature. The GPEs also works well, with a wide electrochemical stability window from -2.27 to +1.51 V and a high ionic transference number of about 0.99, which shows that ion-dominated conduction is happening. Finally, cyclic voltammetry studies indicated that these materials are not only stable but also recyclable. Owing to their improved electrochemical stability, mechanical flexibility, and environmentally friendly nature, PVA–starch blend gel polymer electrolytes represent a promising class of materials for next-generation batteries, supercapacitors, and other electrochemical devices

Keywords: Polymer, Electrolyte, Ion Transport.

ELECTRICAL AND ELECTROCHEMICAL PROPERTIES OF [PVA: CMC] BASED PROTON-CONDUCTING GEL POLYMER ELECTROLYTES

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ABSTRACT

Developing environmentally friendly gel polymer electrolytes with high ionic conductivity is critical for advancing solid-state electrochemical energy storage devices. In this study, gel polymer electrolytes based on polyvinyl alcohol/carboxymethyl cellulose (PVA/CMC) blends, doped with 0.5 wt% ammonium acetate and were synthesized via solution casting. We investigated various PVA/CMC blend ratios to determine their influence on the structural, dielectric, and electrical properties of the electrolyte system. The resulting films were characterized using electrochemical impedance spectroscopy. Impedance analysis revealed that ionic conductivity is highly dependent on blend composition, peaking at 2.08×10^{-3} for the 35wt% CMC. This enhancement is attributed to increased amorphous content, improved segmental mobility of the polymer chains, and effective dissociation of ammonium acetate within the matrix. FTIR studies confirmed the formation of polymer-salt complexes arising from interactions between ammonium ions and the hydroxyl and carboxyl functional groups of the host polymers. These results demonstrate that optimizing the PVA/CMC blend ratio significantly improves the electrochemical performance of ammonium acetate-doped gel polymer electrolytes. Owing to their high ionic conductivity, mechanical stability, and eco-friendly nature, these materials show considerable promise for solid-state batteries, supercapacitors, and other energy storage applications.

Keywords: PVA, CMC, ammonium acetate, Biopolymer Electrolyte, Ionic Conductivity, Dielectric Properties, Proton Conduction.

STRUCTURAL AND ELECTRICAL ANALYSES OF CARBOXYMETHYL CELLULOSE -BASED BIOPOLYMER POLYMER GEL ELECTROLYTES

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ABSTRACT

Gel polymer electrolytes have significant promise for application in electrochemical devices. This study effectively develops free-standing Solid Polymer Electrolytes (SPEs) with the non-toxic and environmentally acceptable polymer carboxymethyl cellulose (CMC). The impact of incorporating ammonium iodide (NH₄I) into a carboxymethyl cellulose-based polymer matrix has been analysed concerning its structural, electrical, and electrochemical stability properties, with the objective of potential applications in electrochemical devices. The SPE films have been produced via the well-established solution casting technique. The characterization of these SPEs was conducted using X-ray diffraction (XRD), electrochemical impedance spectroscopy (EIS), cyclic voltammetry (CV), and linear sweep voltammetry (LSV). An enhancement in the amorphous characteristics of the gel electrolyte films has been noted in the X-ray diffraction when the NH₄I salt concentration rises. The Wegner polarization tests indicate that the electrolyte system is ionic. The conductivity at room temperature attains a maximum of 4.4×10^{-3} S/cm at a salt content of 25 wt%. All of these discoveries have been well elucidated.

Keyword: *Polymer Electrolytes, X-ray diffraction, Solid Polymer.*

SYNTHESIS OF SUGAR BAGASSE BASED NATURAL NANOFIBER USING GREEN SYNTHESIS METHOD

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ABSTRACT

Originating from the Greek word nanos, which means dwarf, the term "nano" is a unit prefix that denotes a factor of 10⁻⁹, or "one billionth". The term "nanotechnology" is frequently used to refer to a variety of approaches and strategies for producing a wide range of nanoscale structures, or structures at the level of individual particles. Recent technology makes it feasible to create ultra-thin fibres, or nanofibers. The primary structural component of many different living things, including plants, animals, and certain microorganisms, is cellulose, the most abundant natural, renewable, and biodegradable polymer in the world. It is also becoming more significant as a renewable chemical resource to replace petroleum-based chemicals. One of the key areas of nanotechnology study is nanofibers, which are extensively used in many scientific fields. Depending on the substance, nanofibers can be categorised as composite, polymeric, or ceramic. Because of its huge surface area per unit mass, narrow pore size, high porosity, and low density, nanofibers are widely used. This work used an alkaline-mechanical technique to develop cellulose nanofiber (SB-CNF) from sugarcane bagasse. A thorough description of Fourier transform infrared spectroscopy (FT-IR). The FT-IR analysis verified the alkaline-mechanical treatment. All of these findings demonstrated its appropriateness for a wide range of potential uses.

Keywords: *Nanofibers, Mechanical Treatment, Sugarcane Bagasse.*

NEW ANALYSIS ON ITERATION FOR COMMON FIXED POINT TO A PAIR OF RELATIVELY NON-EXPANSIVE MAPPING

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ABSTRACT

In this work we generate new iterative technique in Banach as well as Hilbert space using new technique, we approximate a common fixed point for a pair of non-expansive mapping. For the support of four new result, we also provide some numerical result.

Keywords: *Iteration, Hilbert Space, Non-Expansive Mapping.*

MECHANICAL ANALYSIS OF NATURAL FIBER REINFORCED POLYMER COMPOSITE (NFRPC)

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ABSTRACT

Natural fibre reinforced polymer composites (NFRPCs) have gained significant attention due to their sustainability, low cost, biodegradability, lightweight materials combining renewable fibres (jute, flax, hemp) with polymer matrices and high specific strength, making them excellent alternatives to synthetic fibres like glass. This study focuses on enhancing the mechanical properties of NFRPCs, addressing the challenge of hydrophilic fibre incompatibility with hydrophobic matrices through various surface modifications and treatment techniques. Through experimental fabrication, such as resin transfer molding, optimal fibre loadings are analysed to improve tensile, flexural, and impact performance for industrial applications in automotive and construction sectors.

Keyword: *Stiffness, Tensile, Flexural, Impact.*

COMPARATIVE ANALYSIS OF SOLAR FLARE ACTIVITY IN SOLAR CYCLE 24 AND 25

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ABSTRACT

The research paper is about to study Solar flare activity in previous and present solar cycle (2008-2019 and 2019-2025). As we know that, Solar cycle is an approx. 11-year cycle moving from solar minimum to maximum and back to minimum. Solar flare is a sudden and intense electromagnetic radiation from Sun's atmosphere. The flares vary with 11-year solar cycle. In this paper we study a comparative analysis of Solar flare activity using some parameters.

Keywords: *Solar flare, CME, Geomagnetic Activity.*

GST AND E-COMMERCE IN INDIA: TRANSFORMING DIGITAL TRADE THROUGH TAXATION REFORM

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ABSTRACT

The rapid growth of Electronic Commerce has revolutionized commercial activities, consumer behaviour, and market accessibility across the globe. In India, the digital economy has expanded substantially due to increasing internet penetration, smartphone usage, digital payment systems, and government initiatives promoting digitalization. In this context, the implementation of the Goods and Services Tax (GST) on 1 July 2017 marked a historic fiscal reform aimed at simplifying the indirect taxation system and creating a unified national market. GST replaced multiple indirect taxes such as Value Added Tax (VAT), service tax, excise duty, and Central Sales Tax (CST), thereby introducing a comprehensive destination-based tax structure for goods and services, including online commercial transactions. This research abstract critically examines the transformative role of GST in regulating and strengthening the e-commerce ecosystem in India.

The study analyses how GST has significantly altered the operational, financial, and compliance framework of e-commerce businesses. Special emphasis is placed on statutory provisions applicable to e-commerce operators, including mandatory registration, Tax Collected at Source (TCS), electronic invoicing, return filing mechanisms, and Input Tax Credit (ITC). The research evaluates the manner in which GST has enhanced tax transparency, reduced cascading tax effects, improved interstate trade efficiency, and encouraged business formalization within digital marketplaces. Through technology-driven compliance systems, GST has streamlined tax administration and strengthened digital governance by integrating automated invoice matching, online return filing, and real-time monitoring systems.

The research further explores the impact of GST on major stakeholders within the e-commerce ecosystem, including online sellers, consumers, logistics providers, marketplace operators, and small and medium enterprises (SMEs). The implementation of GST has facilitated smoother movement of goods across states by eliminating complex entry taxes and multiple state-level tax barriers, thereby reducing logistics costs and improving supply-chain efficiency. Additionally, GST has contributed to increasing government revenue collection and expanding the taxpayer base by bringing numerous unorganized online businesses into the formal economy.

Despite these achievements, the study identifies several operational and regulatory challenges associated with GST implementation in the e-commerce sector. Frequent amendments in GST provisions, technical complexities in compliance procedures, classification disputes relating to digital products and services, and the compliance burden imposed on small online sellers continue to create difficulties for businesses operating through digital platforms. The requirement of compulsory GST registration for e-commerce sellers, irrespective of turnover thresholds, has particularly affected small entrepreneurs and startups. Furthermore, issues relating to data management, cybersecurity, and technological accessibility remain significant concerns in ensuring effective compliance and smooth digital tax administration.

Using analytical and doctrinal research methodologies, the study concludes that GST has emerged as a transformative fiscal instrument that has strengthened India's digital economy by promoting transparency, accountability, and economic integration within the e-commerce sector. The integration of technology with taxation has improved regulatory efficiency and facilitated the formalization of online trade. However, continuous policy reforms, simplification of compliance procedures, and enhanced digital infrastructure are essential to ensure sustainable growth, ease of doing business, and long-term competitiveness of India's expanding e-commerce industry in the global digital economy.

Keywords: *Electronic Commerce, Goods and Services Tax (GST), Digital Economy, Taxation Reform, Online Marketplaces, Input Tax Credit.*

EVALUATION OF PHYTOCHEMICAL ANALYSIS AND ANTIMICROBIAL ACTIVITY OF SANTALUM ALBUM L.

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ABSTRACT

Santalum album (Indian sandalwood) is an economically important aromatic and medicinal plant widely used in traditional systems of medicine for its therapeutic

properties. The present study evaluates the antimicrobial activity of heartwood extract and essential oil of *Santalum album* against selected pathogenic microorganisms.

Phytochemical screening revealed the presence of bioactive compounds such as

sesquiterpenoids (α -santalol and β -santalol), phenolics, and flavonoids that are known for their antimicrobial potential. The antimicrobial activity was assessed using agar well

diffusion and minimum inhibitory concentration (MIC) methods against Gram-positive bacteria (*Staphylococcus aureus* and *Bacillus subtilis*), Gram-negative bacteria

(*Escherichia coli* and *Pseudomonas aeruginosa*), and fungal strains (*Candida albicans* and *Aspergillus Niger*). Results showed significant inhibitory activity against Gram-positive bacteria and *Candida albicans*, while moderate inhibition was observed against Gram-negative bacteria. The essential oil demonstrated comparatively higher antimicrobial activity than the crude extract. The findings support the traditional medicinal use of *Santalum album* and highlight its potential as a natural antimicrobial agent for pharmaceutical and cosmetic applications.

Keywords: *Santalum Album, Antimicrobial Activity, Essential Oil, A-Santalol, Phytochemicals, Medicinal Plants.*

SEASONAL PHYSICOCHEMICAL EFFECTS ON THE MICROPHYTE COMMUNITY OF THE WESTERN PORTION OF GOVINDA POND, REWA DISTRICT, MADHYA PRADESH, INDIA

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ABSTRACT

Freshwater ecosystems are highly dynamic environments where seasonal fluctuations in physicochemical parameters significantly influence the structure, diversity, and productivity of microphyte communities. The present study investigates the seasonal variations in water quality and their effects on microphytes inhabiting the western portion of Govinda Pond, located in Rewa District, Madhya Pradesh, India. Water samples and microphyte populations were monitored across three major seasons—summer, monsoon, and winter—to evaluate the relationships between environmental variables and microphyte distribution.

Physicochemical parameters including water temperature, pH, dissolved oxygen (DO), biological oxygen demand (BOD), electrical conductivity, total dissolved solids (TDS), turbidity, alkalinity, hardness, nitrate, phosphate, and chloride concentrations were analyzed using standard limnological methods. Simultaneously, qualitative and quantitative assessments of microphytes, primarily represented by phytoplanktonic algae and cyanobacteria, were conducted. Results revealed significant seasonal variability in water quality characteristics. Summer months exhibited elevated temperature, conductivity, TDS, and nutrient concentrations, promoting higher abundance of pollution-tolerant microphytes. Monsoon conditions increased turbidity and nutrient influx through surface runoff, resulting in shifts in community composition and enhanced algal productivity. Winter season showed improved dissolved oxygen levels and moderate nutrient availability, supporting greater species diversity and ecological stability.

Correlation and multivariate analyses demonstrated that temperature, nutrient availability (nitrate and phosphate), dissolved oxygen, and pH were the principal factors regulating microphyte dynamics. Dominance patterns indicated seasonal succession among chlorophytes, diatoms, and cyanophytes, reflecting adaptive responses to changing environmental conditions. The study highlights the ecological significance of seasonal physicochemical fluctuations in shaping microphyte assemblages and provides valuable baseline information for freshwater biodiversity conservation, ecological monitoring, and sustainable management of pond ecosystems in central India.

The findings suggest that continued monitoring of limnological parameters and microphyte communities can serve as an effective tool for assessing aquatic ecosystem health and predicting the impacts of environmental change on freshwater resources.

Keywords: *Microphytes, Physicochemical Parameters, Seasonal Variation, Freshwater Ecology, Phytoplankton, Cyanobacteria, Water Quality.*

DACTYLORHIZA HATAGIREA (SALAM PANJA): MEDICINAL IMPORTANCE, PHARMACOLOGICAL POTENTIAL, AND CONSERVATION OF AN ENDANGERED HIMALAYAN ORCHID

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ABSTRACT

Dactylorhiza hatagirea (D. Don) Soó, commonly known as Salam Panja, is a rare and valuable medicinal orchid belonging to the family Orchidaceae. It is naturally distributed in the alpine and subalpine regions of the Himalayas, including India, Nepal, Bhutan, Pakistan, and Tibet. The species has been widely used in traditional systems of medicine such as Ayurveda, Unani, and Tibetan medicine for the treatment of digestive disorders, respiratory ailments, wounds, fractures, and reproductive health problems. The medicinal importance of *D. hatagirea* is attributed to the presence of bioactive compounds such as alkaloids, flavonoids, phenolics, glycosides, terpenoids, and saponins, which exhibit antioxidants, anti-inflammatory, antimicrobial, antidiabetic, wound-healing, and neuroprotective properties. Despite its therapeutic significance, the species faces severe threats due to overharvesting, habitat destruction, illegal trade, livestock grazing, and climate change, resulting in a rapid decline of natural populations. Consequently, *D. hatagirea* is considered an endangered medicinal plant and has become a priority for conservation efforts. This seminar paper reviews taxonomy, distribution, morphology, phytochemistry, medicinal applications, pharmacological activities, economic importance, threats, and conservation strategies related to the species. Furthermore, it highlights the role of biotechnology, including tissue culture and micropropagation, in supporting its sustainable utilization and conservation. The study emphasizes the urgent need for integrated conservation measures, scientific research, and community participation to ensure the long-term survival of this valuable Himalayan medicinal orchid.

Keywords: *Dactylorhiza Hatagirea*, *Salam Panja*, *Medicinal Orchid*, *Himalayas*, *Phytochemistry*, *Pharmacology*.

CHARACTERIZATIONS AND COMPUTATIONAL APPROACH TO STUDY COPPER (II) COMPLEXES FOR EFFICIENT NLO APPLICATIONS

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ABSTRACT

The development of advanced nonlinear optical (NLO) materials has attracted significant attention due to their potential applications in optical communication, photonic devices, data storage, laser technology, and signal processing. In the present study, a series of Copper (II) complexes were synthesized and comprehensively characterized to evaluate their structural, electronic, and nonlinear optical properties. The synthesized complexes were obtained through the coordination of Copper (II) ions with suitably designed organic ligands containing electron-donating and electron-accepting functional groups, facilitating effective intramolecular charge transfer and enhanced optical response.

The structural and physicochemical properties of the complexes were investigated using various spectroscopic and analytical techniques, including Fourier Transform Infrared Spectroscopy (FTIR), Ultraviolet–Visible (UV–Vis) spectroscopy, Nuclear Magnetic Resonance (NMR) spectroscopy (where applicable), Electron Paramagnetic Resonance (EPR), Mass Spectrometry, Thermogravimetric Analysis (TGA), and single-crystal or powder X-ray diffraction studies. These techniques confirmed the successful formation of the Copper (II) coordination framework and provided insights into the geometry, bonding interactions, and thermal stability of the complexes.

To gain a deeper understanding of their electronic structure and NLO behaviour, computational investigations were performed using Density Functional Theory (DFT) and Time-Dependent DFT (TD-DFT) methods. Frontier Molecular Orbital (FMO) analysis, molecular electrostatic potential mapping, global reactivity descriptors, and natural bond orbital (NBO) calculations were employed to elucidate charge-transfer mechanisms and electronic transitions. The calculated dipole moments, polarizability, and first hyperpolarizability values revealed significant NLO activity, indicating the suitability of the synthesized Copper (II) complexes for photonic and optoelectronic applications. Furthermore, a strong correlation between experimental observations and theoretical predictions validated the computational approach for designing high-performance NLO materials.

The combined experimental and theoretical findings demonstrate that Copper (II)-based coordination compounds possess enhanced electronic delocalization, excellent thermal stability, and promising nonlinear optical responses. These results provide valuable guidelines for the rational design and optimization of next-generation metal-complex-based NLO materials for advanced optical technologies.

Keywords: Copper (II) Complexes, Nonlinear Optical Materials (NLO), Density Functional Theory (DFT), TD-DFT, Hyperpolarizability, Charge Transfer, Coordination Compounds.

ELECTRIFICATION OF MADHYA PRADESH AND ITS CONTRIBUTION TOWARDS INDIA'S VISION 2047

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ABSTRACT

Electricity is a fundamental driver of economic development, industrialization, agricultural modernization and social transformation. The state of Madhya Pradesh has witnessed substantial progress in electrification over the last two decades through rural electrification programs, transmission network expansion, renewable energy Investments and improvements in power generation capacity. . This transformation in Madhya Pradesh is characterized by a dramatic shift from historic power deficit to surplus, heavy investment in renewable energy and aggressive efforts to fuel both agricultural productivity and industrial manufacturing. Madhya Pradesh is significantly reducing National carbon emissions while powering the domestic manufacturing boom by integrating mass scale renewable and achieving 100% railway electrification. Electrification of Madhya Pradesh and green energy transition serve as a core anchor for India vision 2047 This study examines the contribution of electrification in Madhya Pradesh to the growth of the Indian economy using an econometric framework. It further evaluates the implications of electrification for achieving the objectives of India vision 2047. The empirical results from 2005- 2025 prove that Madhya Pradesh energy strategy is shifting from standard access provision to productive utilization. The regression analysis demonstrates a strong positive relationship between electrification and economic development in Madhya Pradesh. Industrial electricity consumption emerges as the most significant determinant of per capita GSDP growth. While household electrification, agriculture electricity consumption, and renewable energy capacity exhibit weaker individual statistical effects due to multicollinearity and time lagged impacts, their combined contribution has been instrumental in improving productivity, living standards, energy access and sustainable development. $R^2 = 0.995$ which means approximately 99.5 % of the variation in Madhya Pradesh GSDP per capita over the last 20 years is explained by the progress in these four electrification vectors-Household Electricity, Industrial Electricity, Agricultural Electricity and Renewable Energy Capacity. Consequently, continued investment in electricity infrastructure, Universal access, industrial power supply and renewable energy expansion is likely to strengthen Madhya Pradesh contribution to the realization of India's vision 2047. To hit the benchmark set by Niti Aayog viksit Bharat @ 2047 scenarios, policy focus over the next two decades must target industrial electrification and green grid expansion to maximize economic returns.

Keywords: Viksit Bharat @ 2047, GSDP Growth, Industrial Electrification.

SOLAR AND INTERPLANETARY CAUSES OF GEOMAGNETIC STORMS DURING SOLAR CYCLE 24

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ABSTRACT

Solar Cycle 24 (SC24; 2008–2019) was the weakest solar cycle observed in the space-age era, exhibiting significantly reduced sunspot activity, lower coronal mass ejection (CME) productivity, and diminished heliospheric magnetic field strength compared with previous cycles. Despite its low overall activity, SC24 produced several moderate and intense geomagnetic storms, providing an important opportunity to investigate the solar and interplanetary conditions governing storm generation. This study presents a comprehensive analysis of the solar sources and interplanetary drivers associated with geomagnetic storms during SC24 using solar observations, CME catalogs, in situ solar wind measurements, and geomagnetic indices (Dst, Kp, and AE).

The analysis demonstrates that intense geomagnetic storms were predominantly driven by Earth-directed CMEs and their interplanetary manifestations (ICMEs), particularly magnetic clouds characterized by enhanced magnetic field strength and prolonged southward interplanetary magnetic field (IMF Bz). The geoeffectiveness of these events was found to depend strongly on CME speed, magnetic flux-rope orientation, shock strength, and the duration of southward IMF intervals. Statistical correlations reveal that storm intensity increases with increasing solar wind velocity, total magnetic field magnitude, and negative Bz excursions, confirming the critical role of solar wind–magnetosphere coupling in energy transfer processes. In contrast, recurrent moderate storms were mainly associated with high-speed solar wind streams (HSSs) emanating from long-lived coronal holes during the declining phase of the cycle.

Furthermore, several of the most severe storms were linked to CME–CME interaction events, which produced complex ejecta with amplified magnetic fields and extended periods of southward IMF, thereby enhancing geomagnetic activity. The results indicate that although SC24 exhibited reduced solar activity, favorable interplanetary conditions compensated for the weaker solar output and enabled the occurrence of significant geomagnetic disturbances. This study highlights the combined influence of solar eruptive phenomena and heliospheric propagation effects in determining storm geoeffectiveness and emphasizes the importance of integrated Sun–Earth system analyses for improving space-weather prediction capabilities and understanding solar-terrestrial coupling processes.

Keywords: Solar Cycle 24, Geomagnetic Storms, Coronal Mass Ejections, Interplanetary CMEs, Magnetic Clouds, Solar Wind.

STUDY OF ARTIFICIAL INTELLIGENCE AND 6G NETWORKS: FUTURE CHALLENGES AND OPPORTUNITIES WITH SPECIAL REFERENCE TO REWA DISTRICT, MADHYA PRADESH

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ABSTRACT

Artificial Intelligence (AI) and Sixth Generation (6G) wireless communication technologies are expected to revolutionize future digital ecosystems. Unlike previous generations of mobile communication, 6G is envisioned as an AI-native network in which Artificial Intelligence is embedded throughout the communication architecture. AI-enabled 6G networks are expected to provide ultra-high data rates, intelligent resource management, ultra-low latency, enhanced security, and autonomous decision-making capabilities. This paper examines the opportunities and challenges associated with AI-driven 6G networks, with special reference to Rewa District of Madhya Pradesh. The study highlights potential applications in smart education, agriculture, healthcare, governance, and rural development. It also discusses technical, economic, security, and policy-related challenges that may affect the implementation of 6G technologies in developing regions. The findings suggest that AI-enabled 6G networks can significantly contribute to digital transformation and sustainable development in Rewa district if supported by appropriate infrastructure, policy frameworks, and digital literacy initiatives.

The evolution of wireless communication technologies from 1G to 5G has transformed modern society. The upcoming sixth-generation (6G) network is expected to provide data rates up to terabits per second, ultra-low latency, intelligent connectivity, and AI-driven network management. Researchers increasingly view 6G as an "AI-native" communication platform where machine learning and intelligent automation are embedded throughout the network architecture. AI is expected to assist in network planning, spectrum management, energy optimization, cyber security, and autonomous decision-making.

Keywords: Artificial Intelligence, 6G Networks, Smart Communication, Rewa District, Digital Transformation, Wireless Technology.

MEASUREMENT OF INDOOR/OUTDOOR RADON CONCENTRATION IN BHADOHI DISTRICT OF EASTERN UTTAR PRADESH USING LR-115 TYPE II PLASTIC TRACK DETECTOR (SSNTD's)

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ABSTRACT

A study of indoor radon dwelling of Bhadohi Uttar Pradesh, India. Radon is a colourless and odourless radioactive gas. Radon has been a natural component of the air we breathe. Radon is an invisible radioactive gas that occurs naturally in the indoor atmosphere. It comes from the naturally breakdown of uranium in soils and rocks. Lung cancer risk depends upon the concentration of radon, thoron and their decay product in air. Measurement of indoor radon concentration was carried out in the residential houses, indoor and outdoor environment of district Bhadohi, Uttar Pradesh using solid state nuclear track detector (SSNTDs). Radon exists in soil gas, building materials, Indoor atmosphere etc. Solid state nuclear track detector using 25 dosimeters in indoor and 25 dosimeters in outdoor, the radon concentration was measured in total 50 dwellings of Bhadohi district in the eastern U.P. in the winter season and inhalation dose in (mSv/y). Significant variation of radon concentration was found in the different type of houses. A study of indoor/ outdoor radon dwelling of Bhadohi Uttar Pradesh, India. This paper presents the experimental calibration of LR-115 type II plastic track detectors for monitoring environmental radon. The indoor/ outdoor concentration however depends on various factors viz. ventilation condition, type of construction seasonal variation and geology of the area. Radon in dwellings originates from walls, floors and ceilings and also depends on the construction material. The conditions prevailing in India eastern region in the Uttar Pradesh with respect to people's life-styles, building construction type, topography and meteorological parameters are greatly different. Concentration of Radon measured in different houses, SSNTDs technique is used for present work in selected indoor/outdoor environments. Detector mounting for three months. Detector used in Bare on card mode and Dosimeter. Most of the houses in Bhadohi district are houses with typical construction their dense population, different geological and environment conditions which provide a wide scope of radon studies in this area. A result of measurements of radon concentration in Bhadohi (India) are presented.

Keywords: SSNTDS, Dosimeter, Indoor /Outdoor Environment, Residential building.

DEVELOPMENT AND VALIDATION OF AN INTEGRATED PRODUCTIVITY OPTIMIZATION FRAMEWORK FOR SUSTAINABLE MANUFACTURING PERFORMANCE USING LEAN SIX SIGMA, SUPPLY CHAIN MANAGEMENT, RELIABILITY ENGINEERING AND INDUSTRY 5.0

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ABSTRACT

Manufacturing industries are under increasing pressure to improve productivity, quality, reliability and supply chain responsiveness while adapting to the evolving requirements of Industry 5.0. Although improvement methodologies such as Lean Six Sigma (LSS), Supply Chain Management (SCM), Reliability Engineering, and Quality Management Systems (QMS) have been widely implemented. These approaches are often applied independently, resulting in fragmented performance improvements. The absence of an integrated framework that combines these disciplines represents a significant research and industrial gap.

This study proposes an Integrated Productivity Optimization Framework (IPOF) that integrates Lean Six Sigma, Supply Chain Management, Reliability Engineering, Quality Management Systems and Industry 5.0 practices to enhance sustainable manufacturing performance. Critical Success Factors (CSFs) including supplier reliability, digital transformation, employee competency, leadership effectiveness, equipment reliability, quality system maturity, safety performance, process capability and supply chain integration are identified through an extensive literature review and expert consultation.

A structured questionnaire survey is conducted among manufacturing professionals to collect empirical data. Statistical techniques including Cronbach's Alpha, Correlation Analysis and Multiple Regression Analysis are employed to evaluate the relationships between critical success factors and manufacturing productivity. Furthermore, the Analytic Hierarchy Process (AHP) is utilized to prioritize and rank the identified factors according to their relative importance. Lean Six Sigma tools such as DMAIC, Failure Mode and Effects Analysis (FMEA), Statistical Process Control (SPC) and Value Stream Mapping (VSM) are integrated with reliability metrics including Mean Time Between Failures (MTBF) and Mean Time To Repair (MTTR) to support continuous improvement and operational excellence.

The proposed framework establishes a quantitative relationship between operational, quality, reliability and supply chain variables and their impact on manufacturing productivity. The findings provide a practical roadmap for reducing defects, improving equipment reliability, strengthening supply chain resilience, optimizing resource utilization and achieving sustainable manufacturing performance in the industry 5.0 environment. The study contributes both to academic research and industrial practice by offering a comprehensive framework for productivity optimization in modern manufacturing industries.

Keywords: *Industry 5.0, Lean Six Sigma, Supply Chain Management, Reliability Engineering, Manufacturing Productivity, Operational Excellence.*

LONG-TERM COSMIC RAY MODULATION IN RELATION TO SOLAR ACTIVITY PARAMETERS DURING THE RISING PHASE OF SOLAR CYCLE 25

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ABSTRACT

The modulation of galactic cosmic rays (GCRs) within the heliosphere is fundamentally governed by variations in solar and interplanetary conditions associated with the solar activity cycle. The rising phase of Solar Cycle 25 presents a unique opportunity to investigate the evolving relationship between cosmic ray intensity (CRI) and key solar activity parameters under contemporary heliospheric conditions. This study examines the long-term modulation of cosmic rays during the period spanning the onset of Solar Cycle 25 through its ascending phase (2019–2025), utilizing high-resolution neutron monitor observations in conjunction with multiple solar and heliospheric indices, including sunspot number (SSN), solar radio flux at 10.7 cm (F10.7), coronal mass ejection (CME) occurrence rate, solar wind speed (Vsw), interplanetary magnetic field (IMF) strength (B), and heliospheric current sheet (HCS) tilt angle.

Statistical analyses employing cross-correlation, spectral decomposition, wavelet coherence, and multivariate regression techniques were performed to quantify temporal relationships and identify dominant modulation mechanisms. The results reveal a pronounced anti-correlation between CRI and solar activity indicators, with correlation coefficients exceeding -0.85 for SSN and F10.7 during periods of enhanced solar activity. Time-lag analyses indicate that cosmic ray intensity responds to changes in solar activity with delays ranging from several solar rotations to a few months, reflecting the cumulative influence of heliospheric transport processes. Enhanced IMF strength and increased solar wind turbulence during the ascending phase significantly contributed to the suppression of GCR flux through diffusion barriers and particle scattering mechanisms. Wavelet analysis further identifies persistent periodicities near the solar rotation period (~ 27 days) and intermediate-term quasi-periodic oscillations associated with evolving solar magnetic structures.

The study also highlights the growing influence of transient solar disturbances, particularly CME-driven interplanetary shocks and recurrent high-speed solar wind streams, on cosmic ray variability as Solar Cycle 25 approaches its maximum phase. Multivariate modeling demonstrates that combined solar and interplanetary parameters explain a substantial fraction of the observed cosmic ray modulation, emphasizing the interconnected role of large-scale heliospheric dynamics and solar magnetic activity. These findings provide new insights into the modulation characteristics of GCRs during Solar Cycle 25 and contribute to improving predictive models of space weather, radiation exposure risk assessment, and heliospheric particle transport processes. The results further suggest that the modulation patterns observed during the rising phase of Solar Cycle 25 exhibit both similarities to and notable departures from previous solar cycles, reflecting the evolving nature of solar magnetic field dynamics in the current era of solar activity.

Keywords: *Galactic Cosmic Rays, Solar Cycle 25, Cosmic Ray Modulation, Solar Activity Parameters, Sunspot Number, F10.7 Solar Flux.*

INVESTIGATING FORBUSH DECREASES DURING SOLAR CYCLE 25: FROM SOLAR ERUPTIONS TO COSMIC RAY SUPPRESSION

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ABSTRACT

Short-term reductions in the Galactic cosmic ray flow caused by solar and interplanetary disturbances like Coronal Mass Ejections and Interplanetary Coronal Mass Ejections, together with accompanying shocks, are known as Forbush Decreases. Given the high activity in Solar Cycle 25, there is an opportunity to examine solar transient's effect on the modulation of GCR using Forbush Decreases that occur in Solar Cycle 25. In this paper, we examine the features of the Forbush Decreases occurring in Solar Cycle 25 and follow the chain of events starting from the eruption on the Sun through its impact on cosmic rays. We study the parameters of solar flares, CME, solar wind, and IMF and correlate them with neutron monitor observations to determine the parameters causing Forbush Decreases. Our results show that fast Earthward CMEs, strong interplanetary shocks, strong magnetic field and fast solar wind are the main factors leading to the strong suppression of GCR fluxes. There was a clear link found between FD amplitudes and geomagnetic disturbances showing the role of magnetic structures in the heliosphere in the modulation of Galactic Cosmic Rays. The recent occurrence of extreme events within Solar Cycle 25, such as the significant Forbush Decreases that occurred in both 2025 and 2026, highlight the relevance of cosmic ray measurements to space weather phenomena. This research enhances our understanding of the complex Sun–Earth relationship by exploring how cosmic rays is influenced by solar activity. The findings provide valuable insights into cosmic ray modulation, heliospheric processes, and space weather phenomena.

Keywords: *Forbush Decreases, Solar Cycle 25, Coronal Mass Ejections (CMEs), Cosmic Ray Modulation, Interplanetary Shocks, Neutron Monitors.*

SOLAR SOURCE ASSOCIATION WITH INTERPLANETARY DISTURBANCES

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ABSTRACT

The Sun and Earth are intimately related. The Sun sustains life on Earth, drives our weather, and regulates our climate. Powerful solar radiation strikes the top of the terrestrial atmosphere and produce changes in terrestrial atmosphere. The geomagnetic disturbances in the Earth's environment originate in active regions of the sun. Solar outputs in different form such as solar flares, disruptive filaments, Coronal Mass Ejections, solar wind etc and their changes produce variations in the various geomagnetic field compounds. We have studied the various forms of geomagnetic field variations in association with various solar and interplanetary disturbances for the solar cycle 23, &24.

A number of solar parameters such as sunspot numbers, Hasolar flares, solar radio flux, solar irradiance, coronal green lines, Tilt angle, coronal index (CI) of solar activity show eleven-year periodicity. Out of these solar parameters, generally it is sunspot number (Rz) is a most suitable and easily available parameter of solar activity. A large number of physical phenomena occurring in the heliosphere follow the change associated with various solar indices over period of 11/22 years. Sun spot numbers, grouped solar flares and solar flux are examined as a reliable solar parameter. All these solar parameters show 11-year variational trend. High speed solar wind stream produce enhancement in geomagnetic field variation However increasing geomagnetic activity is more prominent during high solar activity periods. We have several most all the solar indices have shown positive & good correlation with each other. We derived the relationship of various solar indices. Geomagnetic indices are also correlated with solar activity. Halo CMEs are also found to be more effective in geomagnetic activity during rising phases of solar cycles. It is also found that the overall values of all solar index is higher during the ascending phase of solar cycles 24 in comparison to ascending phase of solar cycles 23.

Keywords: Radiations, Terrestrial atmosphere, Geomagnetic disturbances, Solar flares, Disruptive filaments, Coronal index (CI).

COMPUTING EXCHANGE ECONOMIC PROBLEMS USING SUITABLE TRIANGULATION: A COMPUTATIONAL AND MATHEMATICAL FRAMEWORK

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ABSTRACT

Exchange economic problems involve the allocation and redistribution of goods, resources, and commodities among agents to achieve market equilibrium, efficiency, and optimal welfare. Traditional computational approaches often face challenges related to high-dimensional preference spaces, nonlinear utility functions, and equilibrium convergence. This study proposes an advanced triangulation-based computational framework for solving exchange economic problems by partitioning the feasible allocation domain into a finite set of simplices and applying suitable triangulation techniques for equilibrium computation. The methodology integrates concepts from computational economics, numerical optimization, fixed-point theory, and geometric modeling to improve the accuracy and stability of exchange equilibrium analysis.

The proposed framework employs adaptive simplicial decomposition to discretize the exchange economy space, enabling efficient approximation of equilibrium points through piecewise-linear representations of excess demand functions. By utilizing triangulation algorithms, the model systematically explores the feasible region and identifies candidate equilibrium solutions while reducing computational complexity associated with large-scale economic systems. The approach further incorporates iterative refinement procedures to enhance convergence toward Pareto-optimal allocations and competitive market equilibria.

Experimental simulations demonstrate that suitable triangulation significantly improves computational efficiency compared with conventional grid-based and gradient-search methods. The framework effectively handles heterogeneous agents, multiple commodities, and dynamic market conditions while maintaining numerical robustness. Results indicate enhanced equilibrium detection accuracy, reduced processing time, and improved scalability for high-dimensional exchange economies. Furthermore, the triangulation strategy facilitates visualization of economic interactions and supports sensitivity analysis under varying market parameters.

The research contributes to the growing intersection of computational geometry and economic modelling by providing a mathematically rigorous and computationally efficient tool for analysing complex exchange systems. The proposed methodology has potential applications in market design, resource allocation, financial exchange networks, decentralized economic platforms, and policy evaluation. Future work will focus on integrating machine learning techniques with adaptive triangulation to further enhance predictive capability and real-time equilibrium computation in evolving economic environments.

Keywords: *Exchange Economy, Triangulation Methods, Computational Economics, Market Equilibrium, Simplicial Decomposition, Fixed-Point Algorithms.*

REGIOSELECTIVE SYNTHESIS OF NOVEL PYRAZOLE DERIVATIVE AND SPECTRAL CHARACTERIZATION WITH POTENTIAL MEDICINAL APPLICATIONS

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ABSTRACT

Pyrazole derivatives are recognized for their diverse pharmacological properties, including antimicrobial, anti-inflammatory, and anticancer activities. This study details the efficient synthesis of 4-methyl-1,5-diphenyl-1H-pyrazole-3-carboxylic acid, a scaffold designed to explore the impact of specific substitution patterns on biological potency.

The target compound was synthesized through a regioselective cyclocondensation approach, typically involving the reaction of appropriate 1,3-diketone or α , β -unsaturated carbonyl precursors with phenyl hydrazine. The 4-methyl substitution was strategically introduced to modify the electronic environment of the pyrazole core, while the 1,5-diphenyl arrangement serves as a bulky hydrophobic moiety often associated with increased cellular permeability and target affinity.

Structural confirmation was achieved using comprehensive spectroscopic techniques, including ¹H NMR, ¹³C NMR, FT-IR, and mass spectrometry. Preliminary *in vitro* screening suggests that this derivative may hold promise as a lead candidate for further development in medicinal chemistry, particularly in areas targeting inflammatory pathways or microbial growth.

Keywords: Pyrazole Derivatives, Cyclocondensation Approach, FT-IR.

TRENDS IN RESEARCH AND DEVELOPMENT: CURRENT SCENARIO AND EMERGING DIRECTIONS

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ABSTRACT

Research and Development (R&D) has become a critical driver of innovation, economic growth, and sustainable development in the twenty-first century. The current R&D landscape is characterized by rapid technological advancements, increasing digitalization, and growing investments in emerging technologies such as Artificial Intelligence (AI), Machine Learning (ML), Big Data Analytics, Internet of Things (IoT), Biotechnology, and Quantum Computing. Organizations across industries are transforming traditional research methodologies through data-driven approaches, automation, and interdisciplinary collaboration. Recent trends indicate a strong emphasis on sustainable innovation, green technologies, renewable energy solutions, and environmentally responsible product development to address global challenges such as climate change and resource scarcity. Furthermore, open innovation ecosystems, industry-academia partnerships, and global research networks are accelerating knowledge exchange and technological breakthroughs. AI-enabled research platforms are significantly enhancing productivity, reducing development cycles, and improving decision-making processes across healthcare, manufacturing, agriculture, and information technology sectors. Simultaneously, increasing governmental and private-sector investments in R&D are fostering competitiveness and supporting national innovation agendas. However, challenges related to research ethics, cybersecurity, data privacy, funding disparities, and talent shortages continue to influence the effectiveness of R&D initiatives. The present study examines the evolving trends, opportunities, and challenges shaping the contemporary R&D environment and highlights the strategic importance of innovation-driven research for sustainable economic and societal development. The findings suggest that future R&D success will depend on the integration of advanced technologies, collaborative innovation frameworks, and sustainability-oriented research strategies. Recent evidence shows that AI-driven innovation, digital transformation, sustainability-focused research, and increased investment in scientific infrastructure are among the dominant forces shaping global R&D activities.

Keywords: Research and Development (R&D), Innovation Management, Artificial Intelligence, Digital Transformation, Sustainable Development, Green Innovation.

ENVIRONMENTAL ENDOCRINE DISRUPTOR DIETHYL PHTHALATE CHALLENGES MALE MURINE FERTILITY

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ABSTRACT

Phthalates are common environmental endocrine disruptors (EEDs). Nowadays these are widely used as plasticizers, solvents and additives in cosmetics, daily care products, wall coverings, food containers, plastic bags and covers, vinyl flooring etc. Studies are there focusing on the deleterious effects of various phthalates on male reproduction; but the mechanisms are not clear. The present study was planned to evaluate the effect of chronic dietary administration of di-ethyl phthalate (DEP), a low molecular weight phthalate ester, at low doses (1 and 10 mg/kg bw/day) to adult male Swiss albino mice. We observed the induction of oxidative stress in testicular germ cells and epididymal spermatozoa upon DEP exposure. Cellular ROS generator NADPH oxidase proteins caused the overburden of reactive oxygen species and thus induced an imbalance between the pro-oxidants and the anti-oxidant defence capacity of germ cells. In this regard, the activation of Nrf2-Keap1-HO-1 axis inside the testicular germ cells was also prominent. Parallely, the increase in the concentration of cellular pro-inflammatory molecules established a systemic inflammatory response after DEP exposure. World Health Organization recommended standard sperm parameters were also observed to be significantly altered due to the disturbed pro-oxidant: anti-oxidant balance. DEP lowered sperm count, motility and viability as well as induced abundant anomalies in sperm head and tail. Elevated levels of ROS and overactivation of PARP1 in spermatozoa readily led to a decrease in sperm count. Overall, the data revealed that impeded reproductive parameters inflicted by a common EED like DEP could be a potential contributor to the rising incidence of male infertility and subfertility-related issues.

Keywords: *Phthalates, Endocrine Disruptors, PARP1.*

CLIMATE CHANGE AND RENEWABLE ENERGY: INSIGHTS FROM COSMIC RAY INTENSITY VARIATIONS AND SOLAR-TERRESTRIAL INTERACTIONS

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ABSTRACT

This study investigates the correlation between climate change, renewable energy stability, and solar-terrestrial interactions, focusing on cosmic ray intensity variations. Analysing data from neutron monitors and global temperature anomalies reveals that cosmic ray fluxes modulate atmospheric ionization, subtly influencing cloud cover and solar grid predictability.

The intersection of solar-terrestrial physics and meteorology is critical for the green transition. As global energy grids increasingly rely on solar and wind power, understanding cosmic ray intensity variations—which alter cloud condensation nuclei (CCN)—becomes essential for long-term climate modelling and infrastructure resilience.

Using a quantitative, cross-correlative approach, we analysed a 30-year dataset of GCR intensities from the Moscow Neutron Monitor alongside global satellite cloud cover data (ISCCP) and renewable energy metrics across solar cycles 23 and 24.

Statistical analysis reveals a minor correlation between peak GCR fluxes and increased low-altitude cloud cover, which temporarily dips solar photovoltaic generation efficiency by up to 4.5% during solar minima. Cosmic ray variations subtly influence climate baselines. Integrating solar-terrestrial data into predictive models is essential for stabilizing next-generation renewable energy grids.

Keywords: *Cosmic Rays, Solar-Terrestrial Interactions, Renewable Energy Grid, Atmospheric Ionization, Climate Dynamics.*

SURFACTANT-ASSISTED OXIDATION OF CLOTRIMAZOLE BY VANADIUM(V): A SPECTROPHOTOMETRIC KINETIC STUDY

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ABSTRACT

The present investigation explores the kinetics and micellar effects on the oxidation of clotrimazole (Cltz), an important anti-fungal drug, by vanadium (V) in acidic medium. The reaction was studied spectrophotometrically under pseudo- first order conditions in both aqueous and sodium lauryl sulphate (SLS) micellar media at 30 degree centigrade. The influence of substrate concentration, oxidant concentration, sulfuric acid concentration and surfactant concentration on reaction rate was systematically examined. Kinetic measurements revealed that the oxidation rate exhibit a positive dependence on clotrimazole and vanadium (V) concentrations, confirming the participations of both species in a rate-determining step. Comparative studies demonstrated that the presence of SLS micelles significantly enhanced the reaction rate relative to the aqueous medium, indicating effective micellar catalysis. The enhancement is attributed to the incorporation of reactant molecules into the micellar pseudo phase, resulting in increased local reactant concentration and favourable orientation for electron transfer processes. The reaction followed pseudo-first order kinetics with respect to vanadium (V), and the calculated rate constants supported the catalytic role of the surfactant. The findings provide the valuable insights into the oxidation behaviour of clotrimazole in organized media and highlight the potential application of micellar systems in enhancing the efficiency of pharmaceutical oxidation processes.

Keywords: Clotrimazole, Vanadium (V), Oxidation of Clotrimazole by Vanadium (V).

ELUCIDATION OF RESISTANCE INDUCTION THROUGH OXIDATIVE BURST AND HYPERSENSITIVE REACTION AGAINST *P. INFESTANS* IN 'TRIPLE COMBINATION OF CU-CHI-TRI TREATED PLANTS

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ABSTRACT

A detached leaf assay has been developed to determine the resistance induction against *Phytophthora infestans* through Oxidative burst and Hypersensitive reaction. Chain of events was analysed in the form of quantitative and qualitative estimation of ROS (H₂O₂) production, synthesis and accumulation of Phytoalexins and by lesion/blight severity. This experiment was conducted in Triple combination [A novel consortium of Cu (OH)₂500ppm-Chitosan500ppm-Trichoderma asperellum (MH593785)] and BABA (β amino butyric acid) treated plants and in Control. In 'Triple combination' and BABA treated plants both qualitatively as well as quantitatively sufficient amount of H₂O₂ (421.44μmol/g fwt and 394.42 μmol/g fwt respectively) were recorded at 24 h post inoculation which is needed for cell signalling and hypersensitive reaction for defence induction and pathogen containment. Whereas Maximum ROS production (H₂O₂) qualitatively as well as quantitatively (551.73μmol/g fwt.) was observed in control which causes oxidative stress in the form of damage in plant membrane. In post inoculated Triple combination treated plants peak area % of antimicrobial compound γ-Sitosterol (5.21%), Isosolanidane-3-one (4.32) and Phytoalexins Rishitin (2.01) and Tuberin (1.16) followed by in BABA treated plants γ-Sitosterol (4.30), Isosolanidane-3-one (3.65) and Rishitin (2.25) peak area were observed while in Control Isosolanidane-3-one (1.55), γ-Sitosterol (0.70) and Rishitin (0.25) were found. Maximum disease severity was observed in control (91.66%) at 72 h post inoculation followed by in BABA (15.33%) and Minimum disease severity 4.53% was observed in the 'Triple combination'.

Keywords: *P. Infestans*, Triple Combination, ROS Production, Hypersensitive Reaction, Phytoalexins, *Trichoderma Asperellum*.

INTEGRATING SUSTAINABLE DEVELOPMENT, SMART CITIES, AND ADAPTIVE URBAN PLANNING: A SYSTEMS-BASED FRAMEWORK FOR RESILIENT URBAN FUTURES

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ABSTRACT

Rapid urbanization, climate change, resource scarcity, and increasing socio-economic inequalities have intensified the need for transformative urban development models. Sustainable development, smart city technologies, and innovative urban planning have emerged as interconnected approaches for addressing contemporary urban challenges while ensuring long-term environmental, economic, and social well-being. This study proposes an integrated systems-based framework that examines the synergistic relationship between sustainable development principles, smart city infrastructures, and adaptive urban planning strategies in creating resilient and inclusive urban environments.

The research synthesizes contemporary advancements in digital technologies, including the Internet of Things (IoT), artificial intelligence (AI), big data analytics, geographic information systems (GIS), and digital twins, to evaluate their role in enhancing urban governance, resource efficiency, mobility management, energy optimization, and public service delivery. The framework emphasizes the transition from technology-centric smart cities toward human-centered, sustainability-driven urban ecosystems that prioritize environmental stewardship, social equity, and economic resilience. Particular attention is given to the integration of renewable energy systems, green infrastructure, circular economy practices, climate-responsive urban design, and participatory governance mechanisms.

Furthermore, the study explores how adaptive urban planning can facilitate data-informed decision-making, disaster risk reduction, and climate adaptation while promoting citizen engagement and transparency. By examining emerging global case studies, the research identifies critical success factors, including institutional collaboration, digital inclusivity, policy coherence, and sustainable financing mechanisms. The findings indicate that cities adopting integrated smart-sustainable planning approaches demonstrate improved environmental performance, enhanced quality of life, reduced carbon emissions, and greater resilience to climate-related disruptions.

The proposed framework contributes to the growing discourse on sustainable urban transformation by bridging the gap between technological innovation and sustainability objectives. It highlights the necessity of interdisciplinary planning methodologies that align smart city initiatives with the United Nations Sustainable Development Goals (SDGs), particularly SDG 11 (Sustainable Cities and Communities). The study concludes that future urban development requires a holistic paradigm that combines advanced technological capabilities with inclusive governance and ecological sustainability. Such an approach can support the development of adaptive, resilient, and liveable cities capable of meeting the complex challenges of the twenty-first century while fostering equitable and sustainable growth.

Keywords: Sustainable Development, Smart Cities, Urban Planning, Urban Sustainability, Resilient Cities, Sustainable Development Goals (SDGs).

CLIMATE CHANGE, ENVIRONMENTAL SUSTAINABILITY, AND RENEWABLE ENERGY: AN INTEGRATED PATHWAY FOR A RESILIENT FUTURE

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ABSTRACT

Climate change represents one of the most critical global challenges of the twenty-first century, posing significant threats to ecosystems, economic stability, human health, and sustainable development. Rising greenhouse gas emissions from fossil fuel consumption, industrialization, deforestation, and unsustainable resource utilization have accelerated global warming, leading to extreme weather events, biodiversity loss, sea-level rise, and environmental degradation. Addressing these interconnected challenges requires a comprehensive framework that integrates climate mitigation, environmental sustainability, and renewable energy transition.

This study explores the synergistic relationship between climate change adaptation and mitigation strategies, environmental sustainability principles, and the deployment of renewable energy technologies. The research examines how renewable energy sources, including solar, wind, hydropower, geothermal, and biomass energy, contribute to reducing carbon emissions while promoting sustainable economic growth and energy security. Furthermore, it evaluates the role of green technologies, circular economy practices, sustainable resource management, and climate-resilient policies in fostering long-term environmental sustainability.

The analysis highlights recent advancements in renewable energy systems, energy storage technologies, smart grids, and digital innovations that enhance efficiency and facilitate the transition toward low-carbon economies. Emphasis is placed on the importance of policy interventions, international cooperation, public-private partnerships, and community participation in achieving global climate goals, particularly those outlined in the United Nations Sustainable Development Goals and the Paris Agreement. The study also investigates barriers to renewable energy adoption, including financial constraints, technological limitations, regulatory challenges, and social acceptance issues.

The findings suggest that integrating renewable energy deployment with sustainable environmental management can significantly reduce greenhouse gas emissions, enhance ecosystem resilience, and support inclusive socioeconomic development. A holistic and multidisciplinary approach is essential to balancing environmental protection, energy demand, and economic progress. The transition to renewable energy not only serves as a climate mitigation strategy but also acts as a catalyst for sustainable development and environmental stewardship. The study concludes that accelerating investments in renewable energy infrastructure, innovation, and governance mechanisms is imperative for achieving climate resilience and ensuring a sustainable future for present and future generations.

Keywords: *Climate Change, Environmental Sustainability, Renewable Energy, Green Energy Transition, Sustainable Development, Carbon Emissions.*

INCORPORATING AI ASSISTED TOOLS FOR VISUALLY INCAPACITATED PEOPLE- STUDY BASED ON BELAGAVI DISTRICT, KARNATAKA

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ABSTRACT

Visual impairment is a significant disability that affects the quality of life of millions of people worldwide. In Karnataka, particularly in Belagavi district, visually impaired individuals face numerous challenges related to mobility, education, employment, social interaction, and access to information. These challenges often restrict their independence and active participation in society.

Recent advancements in Artificial Intelligence (AI) have led to the development of various assistive technologies, including smartphone applications, smart glasses, object recognition systems, text-to-speech converters, voice assistants, and AI-powered navigation tools. These technologies can enhance accessibility, improve independence, and support visually impaired individuals in performing daily activities more effectively. However, the adoption and utilization of such technologies remain limited in many regions.

This study examines the awareness, accessibility, adoption, and usefulness of AI-assisted tools among visually impaired individuals in Belagavi district. Data were collected through surveys and interactions with participants to understand their experiences and challenges in using assistive technologies. The findings reveal that AI-based tools have considerable potential to improve the quality of life and self-reliance of visually impaired individuals. However, their adoption is hindered by factors such as limited awareness, high costs, inadequate infrastructure, lack of training, and insufficient technical support. The study highlights the need for awareness programs, affordable technological solutions, policy support, and improved accessibility initiatives to promote the effective use of AI-assisted tools among visually impaired individuals and enable their greater inclusion in society.

Keywords: *Visually Impaired People, AI Assisted Technology, Belagavi, Voice Assistants, Smartphones.*

FAST RADIO BURSTS AS COSMOLOGICAL PROBES: FROM THE MACQUART RELATION TO THE PRECISION IGM ERA

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ABSTRACT

Out near the edge of the visible universe, something flickers: brief bursts of radio energy lasting barely a moment. These signals, spotted only by chance at first, now arrive in steady streams thanks to instruments like ASKAP, CHIME, FAST, and MeerKAT. Instead of puzzling endlessly over their origin, scientists shift focus toward whether they can serve another purpose entirely. One pattern stands out, specifically the link between how much the signal spreads out in frequency and how far it has travelled, a connection once doubted but now taken seriously as a cosmological diagnostic. It turns out such bursts carry clues about invisible matter strewn between galaxies. Their paths reveal where ordinary baryonic matter hides, even when telescopes cannot detect it directly. Recent years brought sharper localization, allowing teams to identify exact host galaxies almost as soon as flashes appear. What seemed like noise not long ago begins to look like a precision measuring tool, one tuned to the large-scale structure of space itself. The Galactic magnetar SGR 1935+2154 produced an FRB-like burst that anchored the progenitor discussion in a physically grounded framework, validating the emission mechanism and improving how the dispersion measure budget is modelled. Because these events tie directly into magnetar emission physics, they offer a calibration anchor for the distance measurement chain. Alongside that come outstanding questions, including whether current statistical frameworks capture enough detail or whether key systematic noise factors remain underestimated. As new tools like the Square Kilometre Array prepare to detect more events with sharper localization precision, gaps remain in interpretation. Among them sit poorly constrained contributions from host galaxy interstellar media, inhomogeneous intergalactic matter distributions, and unresolved patterns in repeating source demographics. Without overselling progress, the field moves forward by facing those specific hurdles directly. What lies ahead depends less on optimism than on resolving concrete, well-defined problems now.

Keywords: *Fast Radio Bursts, Intergalactic Medium, Dispersion Measure, Macquart Relation, Missing Baryons.*

GRAVITATIONAL WAVES AND THE RISE OF MULTI-MESSENGER ASTRONOMY: FROM GW150914 TO THE NEXT-GENERATION ERA

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ABSTRACT

Out in space, ripples in spacetime became something we can actually measure. Back when only equations described them, few imagined catching these waves would happen so fast. One moment they were math on paper, then suddenly detectors started humming with real data. From 2015 onward, each new signal piled up: first a handful, now close to four hundred confirmed events from distant cosmic collisions. Yet counting detections misses what truly shifted everything. A single event named GW170817 rewrote expectations: two dense stars spiralling into one another, observed simultaneously across the full electromagnetic spectrum.

Telescopes caught flashes at the exact instant, radio, X-ray, and visible light all lighting up in coordination. That coincidence pulled gravity and light together in ways never before witnessed. One moment changed everything, delivering an independent measurement of the Hubble constant, clues about the origins of short gamma-ray bursts, plus the first confirmed kilonova. Not simply a bonus for gravitational wave research, linking gravity signals with light and particles has become its core direction. This review traces the theoretical foundations of gravitational wave emission, the evolution of the LIGO-Virgo-KAGRA detector network, and the landmark science unlocked by key detections. Persistent open challenges facing researchers are examined alongside the transformative capabilities promised by next-generation observatories including LISA, the Einstein Telescope, Cosmic Explorer, and pulsar timing arrays. The aim is not to catalogue every detection made so far, but to present a clear and forward-looking account of where this field stands and where it is genuinely heading.

Keywords: *Gravitational Waves, Multi-Messenger Astronomy, GW170817, Hubble Constant, Next-Generation Detectors.*

MEASURES FOR POST-COVID ADAPTATION AT KERALA INTERNATIONAL AIRPORTS

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ABSTRACT

The four airports in Kerala (Cochin International Airport, Kannur International Airport, Thiruvananthapuram International Airport, and Calicut International Airport) introduced massive adaptations related to COVID-19, such as health screening, sanitation, ventilation upgrades, contactless systems, and how traffic flow is re-designed. Mitigation measures (since the beginning of 2020) were rigorous screening and isolation protocols at entry gates. These were gradually supplemented throughout 2020-2025 by increased cleaning measures, digital check-in/DigiYatra systems, and infrastructure enhancements, including UV baggage tunnels and HVAC upgrades. In 2020 passenger traffic decreased sharply, but by 2024-2025 the passenger traffic had almost returned to pre-pandemic levels. The analysis contrasts the chronology and efficiency of these measures at all four airports and demonstrates that standardized health measures, technological enhancements, and operational redesign allowed safe recovery and increased aviation resilience.

Keywords: *COVID-19 Airport Management, Health Screening Protocols, Contactless Technology, Passenger Traffic Recovery, Aviation Resilience.*

THERMAL POLLUTION AND THE CHANGING DYNAMICS OF WATER LIFE

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ABSTRACT

Thermal pollution is when the temperature of natural water bodies like rivers and lakes goes up a lot. This usually happens because thermal power plants, nuclear plants and industries release water into these water bodies. These industries use a lot of water to cool down then they put it back into the rivers and lakes. The water is really hot. This makes a change in the water. It affects the animals and plants that live in the water. One big problem is that the water has oxygen, which's really important for fish and other animals to survive. When the water gets hotter it cannot hold oxygen so the fish and other animals get stressed and can even die. Thermal pollution also affects how fish and other animals grow have babies and move around. If the temperature of the water changes really fast it can stop fish from spawning and their eggs from developing so they can have babies. Thermal pollution is a problem for fish and other animals that live in the water. Some animals are really sensitive to pollution. They might just disappear, which means there are types of animals and the whole ecosystem gets out of balance. When the water is hotter it helps things like algae and microorganisms grow which makes the water dirty and toxic. This is a problem because it makes the water more dangerous for animals that live in the water.

The problem of pollution gets worse because more and more industries are being built and people are using more energy. This means that more thermal power plants, nuclear plants and industries are releasing water into the rivers and lakes which makes the problem of thermal pollution worse. To stop pollution from happening we can use things like cooling towers and cooling ponds. We can reuse the water that industries use, which helps to reduce pollution. We also need to make sure that industries do not release water into the rivers and lakes which's a big part of stopping thermal pollution. In the end thermal pollution is a problem that threatens the animals that live in the water and the whole ecosystem. We need to make sure that industries are careful, with the water and that we do not waste it so we can protect the water for our children and grandchildren. Stop thermal pollution.

Keywords: *Thermal Pollution, oxygen, Water Life.*

SYNTHESIS AND COMPUTATIONAL ANALYSIS OF SCHIFF BASE MN (II) COMPLEXES WITH SALEN-TYPE LIGANDS FOR PHARMACEUTICAL APPLICATIONS

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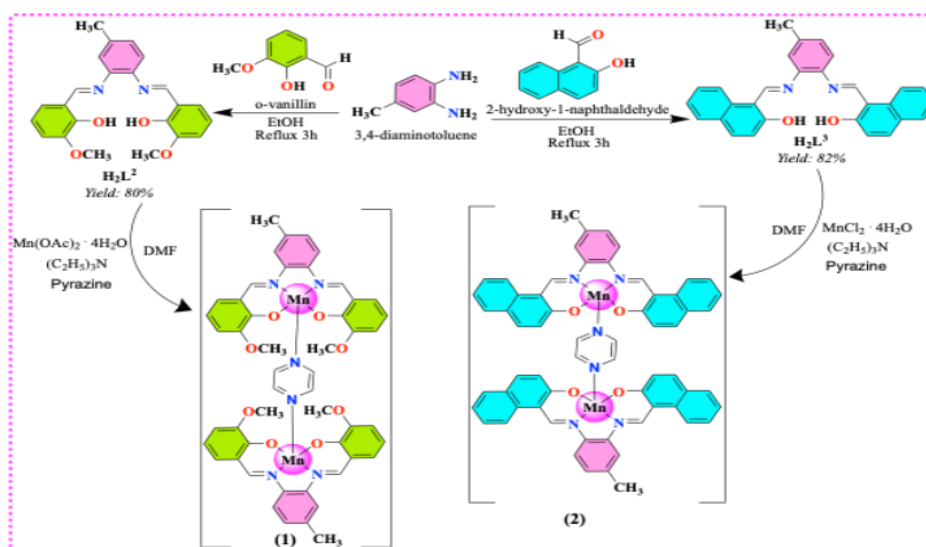
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ABSTRACT

Manganese is one of the biocompatible core elements of metal enzymes, found in all tissues and fluids, playing many physiological roles in living organisms. In this study, two new Mn (II) coordination complexes $[\text{Mn}_2(\text{L}^1)_2(\text{Pyrazine})]$ (**1**) and $[\text{Mn}_2(\text{L}^2)_2(\text{Pyrazine})]$ (**2**) constructed by cis- N_2O_2 donor Salen-type ligands have been synthesized and characterized by experimental tests and computational approaches. Both the Mn (III) coordination complexes (**1**) and (**2**) were extensively characterized using single-crystal X-ray diffraction, spectroscopic methods, electrochemical analysis, magnetic measurements, theoretical DFT calculations, Hirshfeld surface analysis, and a comprehensive in-silico evaluation of their potential biological activities. The solid-state structures of complexes (**1**) and (**2**) revealed pyrazine bridged square pyramidal geometry. Both the complexes were studied against three different cancer cell lines. A theoretical investigation using molecular docking approach of Mn (II) complexes (**1**) and (**2**) have been performed with viral proteins of the viruses.

Keywords: Mn (II) complexes, SARS-CoV-2, HIV-1 protease, Cytotoxicity.



ENHANCING ENVIRONMENTAL QUALITY THROUGH INTEGRATED MATHEMATICAL MODELLING APPROACHES FOR SUSTAINABLE SMART CITY SYSTEMS

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ABSTRACT

Environmental degradation is one of the most critical global challenges. It occurs due to human activities, industrialisation and natural processes negatively affect the environment. As a result, there is deterioration of the environment through the depletion of natural resources, destruction of ecosystems, loss of biodiversity, and various pollutions. The Sustainable development practices, environmental protection policies, and smart city initiatives can help reduce environmental degradation. Smart cities have emerged as a promising framework for achieving these goals. This paper explores the application of mathematical tools such as differential equations, optimization theory, probability models etc. analysing and improving the smart city systems. The study includes the use of smart technologies and sustainable development strategies as a powerful tool for enhancing the quality of environment.

Keywords: *Environment Degradation, Mathematical Approach, Smart Cities, Sustainable Development.*

WOMEN ENTREPRENEURSHIP IN THE DIGITAL ERA: CHALLENGES AND OPPORTUNITIES

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ABSTRACT

The digital revolution has created unprecedented opportunities for women entrepreneurs by reducing traditional barriers to business entry and expanding access to global markets, digital finance, and online networking platforms. Women-led enterprises are increasingly leveraging digital technologies, e-commerce, social media, and innovative business models to establish and grow their ventures. Despite these advancements, women entrepreneurs continue to face significant challenges, including limited access to funding, digital skill gaps, gender bias, work-life balance pressures, and inadequate institutional support. This paper examines the evolving landscape of women entrepreneurship in the digital era, focusing on both the opportunities presented by digital transformation and the barriers that hinder entrepreneurial success. The study highlights the importance of digital literacy, policy interventions, mentorship programs, and inclusive entrepreneurial ecosystems in empowering women entrepreneurs. By fostering an enabling environment that supports innovation and equal access to resources, women entrepreneurs can contribute significantly to economic growth, employment generation, and sustainable development. The paper concludes that strengthening digital inclusion and entrepreneurial support mechanisms is essential for unlocking the full potential of women entrepreneurship in the contemporary economy.

Keywords: *Women Entrepreneurship, Digital Transformation, Entrepreneurial Ecosystem.*

GEOLOGICAL INVESTIGATION OF GAS-BEARING ROCKS OF THE SANU FORMATION, JAISALMER BASIN, WESTERN RAJASTHAN, INDIA

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ABSTRACT

The Sanu Formation of the Jaisalmer Basin represents one of the important Paleocene hydrocarbon-bearing units of western Rajasthan. The formation consists predominantly of sandstone with subordinate shale and siltstone deposited in a shallow marine to marginal marine environment. Geological investigations indicate that the Sanu sandstones possess favourable reservoir characteristics including moderate to high porosity, good permeability, and extensive lateral continuity. Petrographic and geochemical studies reveal that the sandstones are mainly sub-arkosic and were derived from silicic source rocks of the Aravalli craton. Hydrocarbon accumulations within the basin are controlled by lithofacies distribution, diagenetic modifications, structural traps, and stratigraphic variations. This study reviews the lithology, stratigraphy, depositional environment, reservoir properties, provenance, and hydrocarbon potential of the Sanu Formation and highlights its significance in gas exploration within the Jaisalmer Basin.

Keywords: *Sanu Formation, Jaisalmer Basin, Natural Gas, Reservoir Sandstone, Western Rajasthan, Petroleum Geology.*

VIKSIT BHARAT AND INDUSTRY 4.0: BUILDING A DEVELOPED INDIA THROUGH THE FOURTH INDUSTRIAL REVOLUTION

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ABSTRACT

India's goal of becoming a developed country by 2047 necessitates radical structural changes driven by advancement in all fields. Viksit Bharat focuses on economic development, social harmony, technological advancement, environmental sustainability and global leadership. The government's goal of a \$30 trillion economy by 2047, the year of the country's centennial, is not possible without increasing country's capacity to leverage emerging technology making it integral in its growth strategy. Industry 4.0, integrates digital, physical and biological systems through technologies such as Artificial Intelligence, quantum computing, advance manufacturing and data-driven automation. Economic growth also helps in achieving Sustainable Development Goals (SDGs), out of which innovation, decent labour and sustainable industrialization, are such goals that are supported by Industry 4.0.

Through innovation, value addition and the rise of efficiency, Industry 4.0 has a great potential to boost GDP. Global competitiveness and product quality are improved when AI, IOT and blockchain are integrated into manufacturing process. Start Ups in vital industries like space technology, healthcare and education are being supported by policy, initiatives like 'Make in India' and 'Digital India'.

At the same time, it is important to address the challenges in the Path of Industry 4.0. Digital Divide in Manufacturing, Human Capital Crisis, Cybersecurity, Vulnerability of the Gig Economy requires to pay attention. Diffusion of technology by itself, however does not ensure inclusive growth. Making sure that increases in GDP and productivity result in fair growth and respectable jobs is the real challenge. It is essential to take a balanced strategy that incorporates innovation and policy formulation.

Keywords: Viksit Bharat, Industry 4.0, Innovation, Challenges.

THE IMPACT OF ARTIFICIAL INTELLIGENCE ON FINANCIAL ACCESSIBILITY AND EFFICIENCY IN INDIA

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ABSTRACT

The role of Artificial Intelligence (AI) is considered as a transformative technology in the financial sector. AI significantly improving financial accessibility and operational efficiency. This study investigates AI's impact in increasing financial Inclusion and strengthening government led initiatives. In India, where a large segment of the population had historically faced barriers to accessing formal financial and banking services, AI-driven innovations such as digital banking, automated customer support, credit scoring, fraud detection, and personalized financial services have played a crucial role in promoting financial inclusion. This study examines the impact of AI on enhancing financial accessibility and efficiency in India. It explores how AI technologies help financial institutions reduce operational costs, improve service delivery, and expand financial services to underserved and rural populations. AI is transforming how financial services are designed and delivered, increasing efficiency, expanding outcomes and enabling more personalized financial solutions. Using secondary data from research articles, government reports, and industry publications, the study finds that AI has significantly contributed to increasing financial inclusion and improving the efficiency of financial systems in India. The findings suggest that continued investment in AI infrastructure and digital literacy programs can further strengthen the country's financial ecosystem and support inclusive economic growth.

Keywords: *Artificial Intelligence, Financial Inclusion, Financial Accessibility, Financial Efficiency, Digital literacy, operational costs.*

INDIGENOUS KNOWLEDGE SYSTEMS AND SUSTAINABLE DEVELOPMENT: PRESERVING TRADITIONAL ECOLOGICAL WISDOM FOR A SUSTAINABLE FUTURE

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ABSTRACT

Indigenous Knowledge Systems (IKS) represent the cumulative body of knowledge, practices, beliefs, and cultural traditions developed by indigenous and tribal communities through long interaction with their natural environment. In the contemporary era of climate change, ecological degradation, and unsustainable development, indigenous wisdom offers valuable insights for achieving sustainable development goals. This paper examines the role of indigenous ecological practices in environmental conservation, biodiversity protection, water management, sustainable agriculture, and community-based resource utilization. Special emphasis is placed on tribal communities of India, particularly those of Rajasthan, whose traditional practices promote harmony between humans and nature. Indigenous communities have historically adopted sustainable lifestyles based on collective responsibility, conservation ethics, and intergenerational knowledge transmission. However, globalization, modernization, and rapid industrialization threaten the survival of these traditional systems. The study highlights the need to integrate indigenous knowledge with modern scientific approaches for inclusive and sustainable development. It argues that recognizing and preserving indigenous cultural heritage can contribute significantly to environmental sustainability, social justice, and resilient communities. The paper concludes that policy frameworks, educational institutions, and development agencies must actively incorporate indigenous perspectives to create sustainable and culturally sensitive development models for the future.

Keywords: *Indigenous Knowledge System, Sustainable Development, Tribal Communities, Ecological Conservation, Traditional Wisdom.*

हरित उत्पादों के प्रति उपभोक्ता जागरूकता: एक अध्ययन

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सारांश (Abstract)

वर्तमान समय में पर्यावरण संरक्षण विश्व की प्रमुख चिंताओं में से एक है। औद्योगीकरण, शहरीकरण तथा प्राकृतिक संसाधनों के अत्यधिक दोहन के कारण पर्यावरणीय समस्याएँ निरंतर बढ़ रही हैं। इन समस्याओं के समाधान के लिए हरित उत्पादों (Green Products) की अवधारणा महत्वपूर्ण बन गई है। हरित उत्पाद ऐसे उत्पाद हैं जिनका उत्पादन, उपयोग तथा निपटान पर्यावरण को न्यूनतम हानि पहुँचाता है। प्रस्तुत अध्ययन का उद्देश्य हरित उत्पादों के प्रति उपभोक्ता जागरूकता, उनके दृष्टिकोण तथा खरीद व्यवहार का विश्लेषण करना है। अध्ययन से ज्ञात होता है कि उपभोक्ताओं में पर्यावरणीय चेतना बढ़ रही है, किंतु उच्च मूल्य, सीमित उपलब्धता एवं जानकारी के अभाव के कारण हरित उत्पादों का उपयोग अपेक्षित स्तर तक नहीं पहुँच पाया है। अध्ययन यह निष्कर्ष प्रस्तुत करता है कि उचित जागरूकता, सरकारी सहयोग तथा प्रभावी हरित विपणन रणनीतियों के माध्यम से हरित उत्पादों की स्वीकार्यता बढ़ाई जा सकती है।

मुख्य शब्द: हरित उत्पाद, उपभोक्ता जागरूकता, हरित विपणन, पर्यावरण संरक्षण, उपभोक्ता व्यवहार।

THE SHORT-FORM VIDEO PLATFORMS AND THE PSYCHOLOGICAL DAMAGE AMONG ADOLESCENTS

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ABSTRACT

In the beginning of the internet era, the social media platforms were generally used for connecting to people all over the world and showing individual talent, but in the last decade of flood of short-term video platforms, the digital content has become so wide that it has brought about the over-consumption of content. This study examines the impact of short-form video consumption on users' psychological state, especially on attention span, self-esteem, anxiety, and overall mental health. Using the interview method, data were collected from 30 adolescents who are regularly consuming the short-term video content. The finding reveals that excessive use of these platforms is associated with decreased attention span, increased social comparison, and increased levels of anxiety and stress. Furthermore, participants reported lack of concentration on academic or work-related tasks after long-term exposure to short-videos. The findings contribute to the growing body of research on digital media and mental health and highlights the need for psychological intervention.

Keywords: *Short-Term Video Platforms, Psychological Damage, Social Media.*

ORGANIC–INORGANIC HYBRID CRYSTALS: SYNTHESIS, PROPERTIES, AND APPLICATIONS

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ABSTRACT

Organic–inorganic hybrid crystals have become a viable class of functional materials with great potential because they can possess the desirable characteristics of both organic and inorganic components in one crystal structure. The materials have structural flexibility, adjustable physicochemical characteristics, and high performance in various technological applications. The organic portion accounts for flexibility, processability, and molecular functionality, whereas the inorganic portion is responsible for thermal stability, mechanical strength, and excellent electronic properties. This review emphasizes the recent developments in the synthesis, structure, and applications of organic–inorganic hybrid crystals. The solution growth, hydrothermal, and solvothermal methods are discussed, and the effects of these methods on crystal quality and material properties are emphasized. Optical, electrical, and thermal properties are used to examine the functional behaviour of the crystal structure. In addition, the potential application of hybrid crystals in optoelectronic devices, photovoltaic devices, sensors, light emitters, and energy technologies is discussed. Their promise of greater efficiency, stability, and design flexibility has grown with interest in these materials. While many advances have been made, there are still some challenges that need to be addressed, such as the fabrication of larger-scale, long-term stability, and environmental sustainability. As materials design and synthesis progress, the range of hybrid crystal applications is being further broadened, and their incorporation into future technologies is expected to accelerate.

Keywords: *Crystal Growth, Functional Materials, Optoelectronics, Photovoltaics, Sensors, Material Synthesis.*

COMPARATIVE ANALYSIS OF DEEP LEARNING ARCHITECTURES FOR BREAST CANCER HISTOPATHOLOGICAL IMAGE CLASSIFICATION

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ABSTRACT

Breast cancer is a leading cause of cancer-related deaths within the female population, ensuring precise and timely diagnosis essential. Histopathological image analysis is considered the gold standard for diagnosis, yet is time consuming and relies on expert pathologists. This study presents a comparative evaluation of five deep learning architectures—ResNet50, DenseNet121, EfficientNetB0, InceptionV3, and Vision Transformer (ViT)—for breast cancer histopathological image classification using the BreakHis dataset. Transfer learning and fine-tuning were employed to adapt pre-trained models for binary classification of benign and malignant tissue samples. Experimental results showed that Vision Transformer achieved the best performance, attaining 95.24% accuracy and an AUC of 0.98. Among CNN-based models, EfficientNetB0 delivered the strongest results while maintaining computational efficiency. The findings demonstrate the effectiveness of transformer-based architectures for capturing complex histopathological patterns and provide a benchmark comparison of CNN and transformer models for intelligent breast cancer diagnosis.

Keywords: *Breast Cancer Classification, Histopathological Image Analysis, Break His Dataset, Transfer Learning, Vision Transformer.*

PREPARATION AND CHARACTERIZATION OF BIOPOLYMER–CLAY NANOCOMPOSITES AND STUDY OF THEIR PROPERTIES

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ABSTRACT

The growing demand for sustainable and environmentally friendly materials has accelerated research on biopolymer-based nanocomposites as potential alternatives to conventional petroleum-derived plastics. In this study, biopolymer–clay nanocomposites were prepared and systematically characterized to investigate the influence of nanoclay incorporation on their structural, thermal, mechanical, and barrier properties. Biopolymers such as starch, chitosan, cellulose derivatives, or polylactic acid (PLA) were selected as matrix materials due to their biodegradability, renewability, and biocompatibility. Layered silicate nano clays, particularly montmorillonite (MMT), were incorporated at varying concentrations using solution casting and melt intercalation techniques to achieve homogeneous dispersion within the polymer matrix.

The prepared nanocomposites were characterized using advanced analytical techniques. X-ray diffraction (XRD) was employed to evaluate the intercalation and exfoliation behaviour of clay layers, while Fourier Transform Infrared Spectroscopy (FTIR) was used to investigate molecular interactions between the biopolymer and nano clay. Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM) provided insights into the morphology and dispersion of clay nanoparticles within the matrix. Thermal stability and degradation behaviour were analysed through Thermogravimetric Analysis (TGA) and Differential Scanning Calorimetry (DSC). Mechanical properties, including tensile strength, Young's modulus, and elongation at break, were assessed to determine reinforcement effects imparted by the nano clay.

The results demonstrated that the incorporation of nanoclay significantly enhanced the performance of the biopolymer matrix. Improved tensile strength, modulus, thermal resistance, and reduced water vapor permeability were observed compared to pristine biopolymer films. The enhancement was attributed to strong interfacial interactions, increased crystallinity, and the formation of a tortuous path that restricted the diffusion of gases and moisture. Optimal nano clay loading resulted in uniform dispersion and superior property enhancement, whereas excessive clay content led to particle agglomeration and reduced effectiveness.

The findings highlight the potential of biopolymer–clay nanocomposites as advanced multifunctional materials for sustainable packaging, biomedical devices, agricultural applications, and environmentally responsible engineering products. This research contributes to the development of high-performance biodegradable nanocomposites and provides valuable insights into structure–property relationships essential for future material design and industrial implementation.

Keywords: *Biopolymer Nanocomposites, Nano clay, Montmorillonite (MMT), Biodegradable Materials, Polymer–Clay Interactions, XRD; FTIR.*

WASTE-TO-WEALTH APPROACH: HYDROTHERMAL SYNTHESIS OF FLY ASH-DERIVED ZEOLITE FOR ARSENIC (AS³⁺) REMOVAL

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ABSTRACT

Global climate change and sustainability necessitate novel strategies for waste recycling and water treatment processes. The increasing use of fly ash as a waste product from thermal power stations raises concerns about its proper disposal; however, owing to its abundance in aluminosilicate components, fly ash is considered as one of the potential precursors for zeolite preparation. In this study, a zeolite sample was prepared from fly ash by employing an alkaline hydrothermal approach. Its efficacy for the removal of As³⁺ ions from aqueous samples was evaluated in terms of its physical characteristics, such as higher porosity, larger surface area, and increased ability to perform ion exchange reactions. Results demonstrated that zeolite prepared from fly ash can be efficiently used to remove toxic arsenic ions from wastewaters, providing new opportunities for implementing environmentally friendly practices in water treatment processes.

Keywords: *Zeolite Synthesis from Fly Ash, Alkaline Hydrothermal Approach, Arsenic Ion Removal, Environmental Sustainability.*

A REVIEW OF AUTO-SCALING TECHNIQUES FOR WORKLOAD-AWARE RESOURCE ALLOCATION IN CLOUD COMPUTING

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ABSTRACT

A popular model for providing scalable, on-demand services via the Internet is cloud computing. Because cloud workloads are dynamic and unexpected, efficient resource allocation continues to be a major concern. When workload fluctuates, traditional static resource provisioning frequently leads to either resource underutilization or performance degradation. Auto-scaling mechanisms automatically modify computing resources in response to shifting demand in order to overcome these difficulties. By using workload analysis and prediction approaches to improve scaling decisions, workload-aware auto-scaling frameworks have drawn a lot of interest in recent years. The current auto-scaling methods, such as rule-based, predictive, machine learning-based, and reinforcement learning-based approaches, are thoroughly examined in this review study. Key performance measures like response time, resource usage, operational cost, scalability, and Service Level Agreement (SLA) compliance are used to assess and contrast these strategies. A conceptual architecture for intelligent workload-aware auto-scaling in cloud systems is also presented, along with an identification of current research gaps. In order to support the creation of more flexible, effective, and economical cloud systems, possible future research avenues in AI-driven cloud resource management are finally explored.

Keywords: *Cloud Computing, Auto-Scaling, Resource Allocation, Workload Prediction, Machine Learning, Reinforcement Learning.*

PSYCHOLOGICAL RESILIENCE AND ENTREPRENEURSHIP**Shailendra Pratap Lokhande**

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ABSTRACT

Entrepreneurship is a dynamic process that requires individuals to cope with uncertainty, risk, and frequent challenges. Psychological resilience, defined as the ability to adapt positively and recover from adversity, plays a crucial role in entrepreneurial success. The present study explores the relationship between psychological resilience and entrepreneurial behaviour among aspiring and established entrepreneurs. It examines how resilience contributes to opportunity recognition, decision-making, innovation, persistence, and business sustainability.

Using a quantitative research design, data were collected from entrepreneurs through standardized measures of psychological resilience and entrepreneurial orientation. The findings indicate a significant positive relationship between resilience and entrepreneurial performance. Entrepreneurs with higher resilience demonstrated greater adaptability, problem-solving abilities, and perseverance during periods of financial, operational, and market-related stress. Furthermore, resilience was found to mediate the impact of external challenges on entrepreneurial outcomes.

The study highlights the importance of developing resilience-building interventions and training programs to enhance entrepreneurial effectiveness. These findings contribute to the growing literature on entrepreneurial psychology and provide practical implications for educators, policymakers, and business development professionals seeking to foster successful entrepreneurship in a rapidly changing economic environment.

Keywords: *Psychological Resilience, Entrepreneurship, Entrepreneurial Behaviour, Adaptability, Innovation, Business Success.*

EFFECT OF CORONAL MASS EJECTION ON NEAR EARTH SPACE WEATHER

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ABSTRACT

Coronal Mass Ejections (CMEs) inject large amounts of magnetized plasma and magnetic fields into the heliosphere. CMEs play an important role in influencing space weather conditions and can affect various technological systems on Earth, including communication and navigation systems. In this paper, we analyse the impact of CMEs on space weather and investigate how they contribute to space weather disturbances. The effects of CMEs on the near-Earth space weather have been analysed and discussed.

Keywords: *Coronal Mass Ejection, Space Weather, Navigation System.*

अनुसंधान एवं विकास के क्षेत्र में नवाचार का प्रयोग

अनुराग श्रीवास्तव

सहायक प्राध्यापक, इतिहास, पी.एम.सी.ओ.ई, शासकीय विवेकानंद महाविद्यालय, मैहर-485771, म.प्र.

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शोध सार

वैश्विक दृष्टिकोण से अध्ययन किया जाय तो अनुसंधान और विकास, नवाचार एवं प्रगति के क्षेत्र में निरंतर प्रगति कर रहा है। 21वीं सदी तकनीकी और डिजिटल परिवर्तन का युग है। वर्तमान समय में शोध और विकास प्रयोगशालाओं तक सीमित नहीं है, बल्कि यह आर्टिफिशियल एंटलिजेस, क्वांटम कंप्यूटिंग, नैनो तकनीकी, जैव प्रौद्योगिकी आदि क्षेत्र में भी तीव्र गति से संचालित हो रहा है। 21 वीं सदी के चौथे दशक तक आते-आते औद्योगिक क्रांति ने शोध के पारंपरिक तौर-तरीकों को पूरी तरह से परिवर्तित कर दिया। इस परिवर्तन ने न केवल शोध की गतितीव्र हुई है बल्कि इसके परिणाम भी अधिक सटीकता, व्यावहारिकता पर केंद्रित हो गए हैं। इस शोध पत्र का मुख्य उद्देश्य वैश्विक और राष्ट्रीय स्तर पर शोध और विकास कार्य के क्षेत्र में निरंतर हो रहे परिवर्तनों, नई प्रवृत्तियों, प्रभावों और भविष्य की चुनौतियों का एकवृहद् विश्लेषणात्मक मूल्यांकन प्रस्तुत करना है जिससे शोध एवं विकास कार्यों के एक नवीन दिशा मिल सके। इस शोध के मुख्य उद्देश्य नवीन प्रवृत्तियों की पहचान करना, वैश्विक शोध और विकास के दृष्टिकोण में उभरती हुई प्रमुख तकनीकी और गैर-तकनीकी प्रवृत्तियों की पहचान करना, कृत्रिम बुद्धिमत्ता के प्रभाव का मूल्यांकन करना आदि को शामिल करना। इस शोध पत्र में वर्णनात्मक (Descriptive) और विश्लेषणात्मक अनुसंधान पद्धति पर आधारित है। इस शोध पत्र की प्रामाणिकता सुनिश्चित करने के लिए द्वितीयक आकड़े का वृहद् उपयोग किया गया है।

इस शोध पत्र के माध्यम से क्वांटम कंप्यूटिंग और उन्नत सामग्री, अंतर-विषयक और सहयोगात्मक अनुसंधान, जैव प्रौद्योगिकी और उन्नत स्वास्थ्य सेवा, हरित और संधारणीय प्रौद्योगिकी के विषय में जानकारी प्रस्तुत की जाएगी।

अनुसंधान और विकास के क्षेत्र में उभरती प्रवृत्तियाँ मानव सभ्यता और संस्कृति को एक मूल्यवान तकनीकी शिखर की ओर ले जाएगी। इस शोध पत्र में यह भी जानकारी दी जाएगी कि भविष्य का अनुसंधान पूरी तरह से स्वायत्त प्रयोगशालाओं, कृत्रिम बुद्धिमत्ता, पर्यावरण अनुकूल एवं नवाचारों पर आधारित रहेगा। यह मानवीय नैतिक मूल्यों को बनाए रखते हुए नवाचार तकनीकी को प्रोत्साहित करेगा। संयुक्त राष्ट्र के द्वारा जारी सतत विकास लक्ष्यों को उचित तरीके से प्राप्त करने में अधिक पारदर्शी, जन-केंद्रित एवं समावेशी होगा।

Keywords: अनुसंधान और विकास, कृत्रिम बुद्धिमत्ता, प्रौद्योगिकी, क्वांटम कंप्यूटिंग, जैव प्रौद्योगिकी, सतत एवं समावेशी विकास, अंतर-विषयक अनुसंधान।

PROMOTING DIGITAL CITIZENSHIP FOR HOLISTIC DEVELOPMENT AMONG SCHOOL STUDENTS IN THE 21ST CENTURY

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ABSTRACT

The twenty-first century is characterized by rapid technological advancement and increasing digital connectivity. Students today spend a significant amount of time in online environments for learning, communication, entertainment, and social interaction. In this context, the concept of digital citizenship has become an essential component of modern education. Digital citizenship refers to the responsible, safe, ethical, and effective use of digital technologies. It includes digital literacy, online safety, cyber ethics, responsible communication, and respect for the rights and privacy of others in the digital world.

This paper explores the role of digital citizenship in promoting the holistic development of school students. Holistic development focuses on the overall growth of learners, including their intellectual, emotional, social, moral, and personal development. By developing digital citizenship skills, students become more responsible, informed, and ethical users of technology. These skills help them develop critical thinking, decision-making, communication, collaboration, and problem-solving abilities, which are essential for success in the modern world.

The paper highlights the importance of integrating digital citizenship education into school curricula to prepare students for the opportunities and challenges of the digital age. It also emphasizes the role of teachers, parents, and educational institutions in guiding students toward responsible online behaviour. Furthermore, the study discusses how digital citizenship can contribute to the development of values such as respect, empathy, accountability, and social responsibility. The paper concludes that promoting digital citizenship is essential for nurturing well-rounded individuals who can participate responsibly and effectively in both digital and real-world communities.

Keywords: *Digital Citizenship, Holistic Development, School Students, Digital Literacy, 21st-Century Skills, Online Safety.*

COMPARATIVE GRAPH-THEORETIC STUDY OF STAR GRAPH AND HYPERCUBE INTERCONNECTION NETWORKS

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ABSTRACT

Interconnection networks play a critical role in parallel and distributed computing systems. Among the numerous network topologies proposed for multiprocessor architectures, the Star Graph and Hypercube have received considerable attention because of their symmetry, scalability, and communication efficiency. This study presents a comparative graph-theoretic analysis of these two interconnection networks. Key parameters including degree, diameter, connectivity, fault tolerance, routing complexity, scalability, and network cost are examined. The analysis demonstrates that while Hypercube networks provide shorter communication paths, Star Graphs offer lower node degree growth and improved scalability for large systems. The study concludes that Star Graphs constitute an effective alternative to Hypercube networks in large-scale parallel processing environments.

Keywords: *Star Graphs, Hypercube Networks, Interconnection Networks.*

A NOVEL GENERALIZED EXPONENTIAL ENTROPY OF ORDER α : THEORETICAL DEVELOPMENT, PROPERTIES, AND COMPARATIVE ASSESSMENT

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ABSTRACT

Entropy measures are fundamental tools for quantifying uncertainty and information in probability distributions. Since the pioneering work of Shannon, numerous generalized entropy measures have been developed to address the limitations of classical entropy in modelling complex and nonlinear systems. Existing measures such as Rényi, Tsallis, Arimoto, Havrda–Charvát, and Sharma–Mittal entropies provide enhanced flexibility through parametric generalizations; however, they often rely on logarithmic or power-law structures and may not adequately capture exponential sensitivity in uncertainty representation. To address this limitation, the present study proposes a novel generalized exponential entropy of order α that combines the logarithmic foundation of Shannon entropy with an exponential transformation mechanism. The proposed entropy serves as a smooth one-parameter extension of Shannon entropy and preserves important theoretical properties including non-negativity, continuity, symmetry, maximality, minimality, concavity, and limiting behaviour. Furthermore, a detailed comparative analysis with existing entropy measures is presented to demonstrate its advantages in uncertainty quantification. Numerical examples and sensitivity analysis reveal that the proposed entropy exhibits adaptive uncertainty representation and enhanced nonlinear discrimination capability. The developed measure offers a promising framework for applications in information theory, statistical physics, machine learning, pattern recognition, fuzzy decision-making, and intelligent systems.

Keywords: Entropy, Shannon Entropy, Exponential Entropy, Information Theory, Uncertainty Quantification, Generalized Entropy.

GLEs AND SPACE WEATHER EXTREMES IN THE CURRENT SOLAR CYCLE

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ABSTRACT

Solar Cycle 25's rapid development has far exceeded early predictions, resulting in a valuable dataset of extreme space weather phenomena. The complicated sequence of Ground Level Enhancements (GLE73–GLE77) observed during the present maximum, primarily driven by intense solar flares and fast Coronal Mass Ejections (CMEs), is examined in this paper along with their coincidence with strong terrestrial geomagnetic responses. The primary interplanetary mechanisms causing these high-hazard events are assessed by evaluating the influence of flare-accelerated particles and CME-driven shocks on the interaction between cosmic ray modulation and transient solar wind structures. Particular attention is drawn to the exceptional occurrence of GLE74, which occurred during the trough of a profound Forbush Decrease in conjunction with a major G5 geomagnetic storm a complex event fuelled by interacting CMEs that defies standard forecasting models. High-resolution interplanetary plasma parameters from the OMNI database, solar proton fluxes from GOES satellites, and multi-instrument data from the global Neutron Monitor Database (NMDb) are utilized to resolve the underlying physical mechanisms. Spectral asymmetries between the prompt injection of solar energetic particles and the suppression of galactic cosmic rays are systematically characterized using sophisticated analytical methods, namely differential rigidity spectrum reconstruction, asymptotic direction modelling, pitch-angle distribution mapping, and time-shift particle tracing. These findings provide important new limits on particle acceleration and diffusion-barrier mechanisms, supplying crucial information for reducing the effects of extreme space weather in the inner heliosphere.

Keywords: Solar Cycle 25, Ground Level Enhancements (GLE), Space Weather, Forbush Decrease, Solar Energetic Particles, Cosmic Ray Modulation.

CLOSING THE LOOP: A SMART AGRICULTURE APPROACH TO NUTRIENT-FILM TECHNIQUE (NFT) AQUAPONICS POWERED BY COLORED ORGANIC PHOTOVOLTAICS

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ABSTRACT

Aquaponics offers a sustainable approach of food production, but energy consumption and nutrient management remain significant challenges. This study proposes an innovative, integrated systems combining Nutrient-Film Technique (NFT) hydroponics with Colored Organic Photovoltaics (OPVs) to enhance sustainability in Aquaponics waste water treatment, plant production and renewable energy generation. The NFT system provided efficiency. Aquaponics waste water contains high concentrations of nitrogen and phosphorus requiring efficient, sustainable treatment methods that align with circular economy principles. The NFT system provides high oxygenation for roots, optimizing the uptake of nutrients from aquaculture wastewater. Concurrently semi-transparent colored OPVs are used as an adaptable light weight shading mechanism, replacing conventional shading to stabilize green house canopy temperature during high-intensity sunlight. The coloured OPV module allow selective light transmission for photosynthesis while harvesting energy for the water pumps and aeration, achieving high-light utilization efficiency. The integrated approach showed promising in reducing nitrate-nitrogen by over 68% in leafy greens used herbs, offering a sustainable energy-positive and space efficient solution for closed loop food production. This combination minimize dependency on external energy, improving water use efficiency and provide a robust treatment frameworks suitable for Urban agriculture.

Keywords: *Nutrient-Film Technique (NFT), Aquaponics, Waste water management, Organic Photovoltaics (OPVs), Sustainability, Nutrient removal.*

ON A CLASS OF FRACTIONAL DIFFERENTIAL OPERATORS ASSOCIATED WITH ANALYTIC FUNCTIONS AND THEIR GEOMETRIC PROPERTIES

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ABSTRACT

In this paper, we introduce and investigate a new fractional differential operator defined by

$\mathcal{L}_\lambda^\alpha f(z) = (1 - \lambda)D^\alpha f(z) + \lambda z(D^\alpha f(z))'$, where (D^α) denotes the fractional derivative of order $(\alpha > 0)$ and $(0 \leq \lambda \leq 1)$. By means of this operator, we define a subclass of analytic functions in the unit open disk through a Carathéodory-type condition. Coefficient estimates and a Fekete–Szegő inequality are established for functions belonging to the newly introduced class. Also a subordination characterization is obtained, giving additional geometric information about the operator-generated family of functions. Several special cases are discussed, showing that the proposed operator unifies and extends a number of known operators from fractional calculus and geometric function theory. We also investigate structural properties of the operator and show that it does not preserve homogeneity. To overcome this difficulty, a weighted modification is introduced and its eigenvalue problem is analyzed explicitly on the polynomial subspace. In addition, asymptotic estimates for the associated eigenvalues are derived. The results presented here contribute to the theory of fractional differential operators and provide a framework for further investigations involving scaling effects and geometric properties of analytic functions.

Keywords: Fractional Differential Operator, Fractional Calculus, Analytic Functions, Geometric Function Theory, Carathéodory Functions, Subordination.

STUDY OF CORROSION INHIBITION EFFICIENCY OF GRAVIA-TENAX EXTRACT FOR COPPER AND ITS ALLOYS IN ACIDIC MEDIUM

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ABSTRACT

This study investigates the corrosion inhibition performance of *Grewia tenax* (Gravia-Tenax) plant extract as an eco-friendly, "green" corrosion inhibitor for copper and its alloys in an aggressive acidic medium. The evaluation was carried out using standard gravimetric (weight loss) techniques alongside advanced electrochemical analyses, including potentiodynamic polarization (PDP) and electrochemical impedance spectroscopy (EIS). Experimental data demonstrates that the plant extract acts as a highly capable inhibitor, with its inhibition efficiency ($\eta\%$) scaling directly with increased extract dosage. Conversely, the protective capacity displays a downward trend when subjected to elevated temperatures, indicating a dominant physical adsorption pathway on the metallic surface.

Keywords: *Corrosion Inhibition, Grewia Tenax, Physical Adsorption.*

IMPACT OF INTERPLANETARY MAGNETIC FIELD (IMF Bz) SOUTHWARD TURNING ON GEOMAGNETIC ACTIVITY

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ABSTRACT

Variations in the southward component of the Interplanetary Magnetic Field (IMF Bz) are widely regarded as a key factor controlling geomagnetic disturbances in the near-Earth environment. A sustained southward orientation of IMF Bz promotes efficient magnetic reconnection at the dayside magnetopause, enabling the transfer of energy, momentum, and plasma from the solar wind into Earth's magnetosphere. As a result, enhanced geomagnetic activity may develop in the form of magnetic storms, substorms, and auroral intensifications, which can adversely affect space-borne and ground-based technological systems. The present study investigates the influence of southward IMF Bz turning on geomagnetic activity through an analysis of solar wind conditions and geomagnetic response parameters. Measurements of IMF Bz, solar wind velocity, proton density, and commonly used geomagnetic indices such as Dst, Kp, and AE are examined to assess the magnetospheric reaction to different magnitudes and durations of southward IMF conditions. Statistical techniques are employed to evaluate the relationship between changes in IMF Bz and subsequent geomagnetic disturbances. The analysis indicates that prolonged and intense southward IMF Bz intervals are generally associated with stronger geomagnetic activity and deeper storm development. The results highlight the importance of IMF Bz as a controlling parameter in solar wind–magnetosphere coupling and emphasize its role in determining the severity of geomagnetic events. A better understanding of these interactions can contribute to improved space weather prediction and mitigation strategies, thereby reducing potential impacts on communication systems, navigation technologies, satellites, and power infrastructure. This study provides further insight into the physical processes linking interplanetary conditions with geomagnetic variability and supports ongoing efforts to enhance space weather monitoring capabilities.

Keywords: *Interplanetary Magnetic Field (IMF Bz), Southward Turning, Geomagnetic Activity, Magnetic Reconnection, Geomagnetic Storms, Solar Wind.*

ELECTROCHEMICAL CHARACTERIZATION AND ANTIBACTERIAL STUDIES OF Zn- DOPED g-C₃N₄ NANOCOMPOSITES

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ABSTRACT

Graphitic carbon nitride (g-C₃N₄) has emerged as a highly promising material for next-generation multifunctional applications due to its tuneable electronic structure and chemical stability. In this study, pristine g-C₃N₄ was synthesized via. thermal condensation of melamine, followed by zinc (Zn) doping through a green Synthesis to enhance its structural, electronic, and functional properties. X-ray diffraction confirmed the successful incorporation of Zn into the g-C₃N₄ frame-work, while HRTEM analyses revealed a porous nanostructure. UV–visible spectroscopy indicated intensified absorption peaks with increasing Zn content. Electrochemical investigations demonstrated a wide potential window and significantly enhanced capacitance, validating the suitability of Zn-doped g-C₃N₄ as a high- performance electrode material. Furthermore, biological activity in process. The dual functionality—energy storage capability and antibacterial activity—positions Zn-doped g-C₃N₄ as a versatile candidate for advanced multifunctional devices and local material.

Keywords: Graphitic Carbon Nitride (g-C₃N₄), Sustainable Waste Antibacterial Nanocomposites. Clean, Electrochemical Characterization.

SOUL CONSCIOUSNESS AS A PSYCHOLOGICAL RESOURCE: UNDERSTANDING THE ROLE OF BRAHMA KUMARIS RAJYOGA MEDITATION IN ENHANCING EMOTIONAL REGULATION AND PSYCHOLOGICAL WELL-BEING AMONG ADOLESCENTS

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ABSTRACT

Adolescence is a very crucial and decisive phase of development in human life cycle. Important stages of development like physical, cognitive, emotional, and social are determined in this stage. Peer pressure, easy access to online information, academic pressure, thoughts regarding career etc have become sources of fear, depression, anxiety and stress for young people. Researchers and educators are seeking various ways to strengthen inner power, confidence and self-efficacy. Rajyoga meditation taught by Brahmakumaris have stress-reducing, relaxing, and psychologically strengthening effects. This research article views "spiritual awareness" as a mindset that links the practice of Raja Yoga with mental health and well-being. This research article examines how the mind contributes to the well-being and psychological development of adolescents through an in-depth analysis of the mind and mental processes. Finally, the implications of these findings for future scientific development, psychology, and management are discussed.

Keywords: *Rajyoga Meditation, Soul Consciousness, Psychological Well-Being, Emotional Regulation, Adolescents, Spirituality.*

HYBRID AI FRAMEWORKS FOR PRIVACY-PRESERVING DATA MINING IN CLOUD ENVIRONMENTS: A SYSTEMATIC REVIEW

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ABSTRACT

Cloud computing has transformed modern data analytics by enabling scalable processing of massive distributed datasets. However, the centralized storage and analysis of sensitive information introduce significant privacy, security, and regulatory challenges. Privacy-Preserving Data Mining (PPDM) has emerged as a critical research area focused on extracting actionable knowledge while maintaining data confidentiality. Traditional PPDM techniques such as perturbation, anonymization, and cryptographic methods often suffer from limitations in scalability, utility preservation, and computational efficiency. Recent advances in Artificial Intelligence have facilitated the development of hybrid frameworks integrating Federated Learning (FL), Differential Privacy (DP), Homomorphic Encryption (HE), Secure Multi-Party Computation (SMPC), Reinforcement Learning (RL), blockchain auditing, and anomaly detection mechanisms. This systematic review follows the PRISMA 2020 methodology and analyses 78 peer-reviewed studies published between 2015 and 2026. The study presents a unified taxonomy of hybrid AI-driven PPDM systems, evaluates leading architectures through comparative benchmarking, identifies critical research gaps, and proposes a future research roadmap. Comparative analysis indicates that hybrid frameworks consistently outperform traditional privacy-preserving approaches, achieving F1-scores exceeding 0.89 while maintaining strong privacy guarantees and cloud-scale operational capability.

Keywords: *Privacy-Preserving Data Mining, Federated Learning, Differential Privacy, Homomorphic Encryption, Cloud Computing, Hybrid Artificial Intelligence.*

EFFICACY OF BRAHMA KUMARIS RAJYOGA MEDITATION IN ENHANCING ACADEMIC ACHIEVEMENT AMONG ADOLESCENT STUDENTS OF UDAYNARAYANPUR

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ABSTRACT

Puberty is an important stage of physical, mental, social, and cognitive development in a student's life. It is one of the most crucial stages of human development. Academic achievement is a significant indicator of students' educational accomplishment. However, adolescent students face numerous challenges in achieving academic success. In this digital era, they are often affected by excessive use of social media, lack of concentration, distractions, addictive behaviours, stress, and examination anxiety. These factors adversely affect their academic performance. Brahma Kumaris Rajyoga Meditation is a simple and effective spiritual meditation technique that promotes self-awareness, positive thinking, inner peace, emotional stability, and self-discipline. This study aimed to examine the efficacy of Brahma Kumaris Rajyoga Meditation in enhancing the academic achievement of adolescent students in Udaynarayanpur Block, Howrah District, West Bengal.

An experimental study was conducted with 100 secondary school students from Udaynarayanpur Block selected through purposive sampling. Participants were divided into an experimental group, which received a structured daily Rajyoga Meditation intervention for three months, and a control group, which continued with their regular routines. Academic achievement was assessed using First Summative Evaluation scores under the West Bengal Board of Secondary Education. Pre- and post-intervention performances were compared.

The students demonstrated substantial improvement in academic achievement following the Rajyoga Meditation intervention. Post-test mean scores were higher than pre-test scores, indicating improved concentration, learning efficiency, memory retention, emotional stability, and examination performance among the participants. The findings of the study suggest that regular practice of Rajyoga Meditation is an effective intervention for enhancing academic achievement among adolescent students. The practice may be integrated into school educational programmes to support students' academic growth and overall well-being.

Keywords: *Rajyoga Meditation, Brahma Kumaris, Meditation.*

A DIVERGENCE MEASURE FOR PICTURE FUZZY SETS FOR SOLVING MULTI-CRITERIA GROUP DECISION MAKING PROBLEMS

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ABSTRACT

Picture Fuzzy Sets (PFSs) have emerged as an effective mathematical way for dealing uncertain, imprecise, and inconsistent data in decision-making problems. Divergence measures play a vital part in quantifying the discrimination between PFSs. In this paper, a novel divergence measure for PFSs is proposed based on the divergence measure. The validity of the proposed measure is established by proving the fundamental axioms of divergence measures. Furthermore, a generalized parametric picture fuzzy divergence measure is developed and its mathematical properties are investigated. To demonstrate the practical applicability of the proposed measure, a decision-making framework is developed for solving multi-criteria group decision-making (MCGDM) problems. The effectiveness and reliability of the proposed approach are illustrated through a numerical example and comparative analysis.

Keywords: *Picture Fuzzy Sets, Divergence Measure, Distance Measure, Multi-Criteria Group Decision Making, Uncertainty Modelling.*

AN ANALYTICAL AND PERFORMANCE EVALUATION OF FIXED-POINT METHODS IN TRANSPORTATION PROBLEMS

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ABSTRACT

This study presents an analytical and performance-based evaluation of fixed-point techniques applied to solve transportation problems, which are a fundamental class of optimization problems in operations research. Traditionally, transportation problems are solved using methods such as the North-West Corner Rule, Least Cost Method, and Vogel's Approximation Method, followed by optimality tests like MODI or stepping stone methods. However, these classical approaches often involve iterative procedures with computational complexity and sensitivity to degeneracy.

In this research, fixed point theory is explored as an alternative mathematical framework for modelling and solving transportation problems. By transforming the transportation model into an equivalent fixed-point formulation, the existence and uniqueness of solutions are investigated using appropriate contraction mappings and fixed-point theorems. The study applies various fixed point iterative schemes to obtain optimal transportation plans and compares their convergence behaviour with conventional methods.

Keywords: *Fixed Point Theory, Transportation Problem, Contraction Mapping, Optimization, Iterative Methods, Operations Research.*

A MULTIPLE ATTRIBUTE GROUP DECISION-MAKING MODEL BASED ON NEW PYTHAGOREAN FUZZY DISTANCE MEASURE

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ABSTRACT

During the commencement of Pythagorean Fuzzy Sets (PFSs), it has been considered as an operative way for treating uncertain and imprecise information in complex decision-making situations. Distance measures show an important character in enumerating the degree of dissimilarity on PFSs and are extensively employed pattern recognition, clustering, medical diagnosis, and multi-criteria decision-making problems. In this paper, a novel Pythagorean fuzzy distance measure is proposed. The mathematical axioms of the proposed distance measure are investigated and proved thoroughly. Moreover, a decision-making methodology is developed by integrating the proposed distance measure with a weighting mechanism for decision experts and an aggregation framework. The effectiveness of the proposed approach is demonstrated through its applicability in decision analysis problems under PFSs settings.

Keywords: *Pythagorean Fuzzy Sets, Distance Measure, Decision-Making, Fuzzy Aggregation Operators, Multi-Attribute Decision-Making.*

CAREER WEAVE: AI-DRIVEN MILESTONE ORCHESTRATION FOR PROFESSIONAL SKILL

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ABSTRACT

In modern digital learning the unstructured use of tutorials often leads to incoherent knowledge without an application strategy and without a clear path of professional development. To overcome this challenge, this paper introduces Career Weave, an AI-powered career architect that generates personalised, project-based learning roadmaps.

Career Weave is an innovative Two-Pass LLM Orchestration with the Gemini 3 Flash engine. The Recruiter Pass converts unstructured user input into a standardised technical profile using a context parser. The Architect Pass performs qualitative Delta Analysis of the desired job requirements against the user competencies. This pass has a Feasibility Gate, a logic filter that avoids the generation of unrealistic career paths by evaluating transition realism.

The system is developed using Fast API, MySQL and React Flow, utilizing the principle of Sequential Milestone Unlocking to ensure learners remain focused on achievable goals within a standardized 24-week framework. Experimental results demonstrate the effectiveness of the framework to scale time to learn and recognise career jumps.

Keywords: *Artificial Intelligence, Personalised Learning, LLM, Skill Gap Analysis, Career Path Optimisation, Educational Technology.*

RAKSHA: RAPID AID AND KNOWLEDGE-BASED SYSTEM FOR HEALTH ASSISTANCE

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ABSTRACT

Medical emergencies in India are frequently lost to delay rather than lack of treatment. Road accidents alone caused over 1.73 lakh deaths in the most recent official NCRB data, yet only about one-fifth of victims used the government's 108 ambulance service. Existing systems remain fragmented: victims struggle to locate capable hospitals, ambulance routing is manual and disconnected from live traffic, and hospitals receive no advance notice of incoming patients' condition or history, forcing cold triage on arrival. RAKSHA (Rapid Aid and Knowledge-based System for Health Assistance) addresses this gap through an integrated, real-time platform connecting patients, ambulances, hospitals, and caregivers. Core features include one-tap SOS alerts with live location sharing, AI-assisted capacity-aware hospital matching, shortest-route ambulance navigation, and pre-arrival transmission of patient vitals and history, allowing hospitals to prepare staff and resources before arrival. A hospital dashboard tracks incoming cases and bed availability, while caregivers stay continuously updated. By unifying these previously disconnected actors into one intelligent system, RAKSHA aims to compress response time within the golden hour, improve resource allocation, and reduce preventable deaths in urban and infrastructure-limited regions.

Keywords: *Emergency Response, Ambulance Routing, Hospital Coordination, Real-Time Location Tracking, Golden Hour, AI-based Matching.*

HORMONES AS DIAGNOSTIC MARKERS IN FEMALE HEALTH

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ABSTRACT

Hormonal biomarkers play a critical role in maintaining female health and serve as essential diagnostic tools for evaluating reproductive, endocrine, and systemic disorders. Variations in hormone levels across different physiological stages, including puberty, menstrual cycle, reproductive age, pregnancy, and menopause, significantly influence women's health and disease susceptibility. Biomarkers such as oestradiol, progesterone, luteinizing hormone (LH), follicle-stimulating hormone (FSH), prolactin, testosterone, and anti-Müllerian hormone (AMH) have demonstrated considerable clinical utility in diagnosing gynaecological and reproductive disorders. This review highlights the diagnostic significance of hormonal biomarkers in female health, emphasizing their applications in conditions such as polycystic ovary syndrome (PCOS), infertility, menstrual irregularities, premature ovarian insufficiency (POI), and menopausal transition. Recent studies indicate that AMH is an effective marker for ovarian reserve assessment, whereas altered LH/FSH ratios and prolactin levels contribute to improved diagnosis of endocrine dysfunctions, particularly in PCOS. Furthermore, hormonal biomarkers are increasingly associated with broader aspects of women's health, including cardiovascular risk, metabolic imbalance, and mental wellbeing.

Advancements in precision medicine and emerging diagnostic technologies have enhanced the understanding of hormone-based clinical testing, enabling more accurate and individualized healthcare strategies for women. This review underscores the importance of hormonal profiling for early disease detection, effective diagnosis, and optimized therapeutic interventions. Future research integrating biomarker-based diagnostics may substantially improve women's healthcare outcomes and personalized treatment approaches.

Keywords: *Female Health, Hormonal Biomarkers, Diagnostic Markers, AMH, PCOS, Reproductive Health.*

COVID-19 TRANSMISSION DYNAMICS WITH SINGLE-DOSE VACCINATION: A DELAY DIFFERENTIAL EQUATION APPROACH

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ABSTRACT

The COVID-19 pandemic has prompted the swift development and deployment of vaccination programs aimed at reducing viral transmission. A Delay Differential Equation (DDE) model is proposed to examine the spread of COVID-19 under a single-dose vaccination framework. The model incorporates a time-delay factor to capture the realistic progression of infection among individuals. The results demonstrate that a single-dose vaccination strategy significantly reduces the infection rate and influences the overall dynamics of disease transmission within the population. The findings offer valuable insights for optimizing vaccination strategies and informing public health policies aimed at improving the effectiveness of COVID-19 vaccination programs.

Keywords: *Delay Differential Equations, COVID-19, Mathematical Modelling, Basic Reproduction Number, Stability, Vaccination.*

SOLAR FLARES AND GEOMAGNETIC STORMS DURING SOLAR CYCLE 24: CHARACTERISTICS AND SPACE WEATHER IMPLICATIONS

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ABSTRACT

Solar Cycle 24 (2008–2019) was characterized by relatively low solar activity compared with previous solar cycles, making it an important period for investigating the relationship between solar eruptions and geomagnetic disturbances under weak solar conditions. This study examines the occurrence and characteristics of solar flares and their associated geomagnetic storms during Solar Cycle 24 using solar, interplanetary, and geomagnetic observations. Particular attention is given to the role of coronal mass ejections (CMEs), solar wind parameters, and interplanetary magnetic field (IMF) conditions in determining storm intensity.

The analysis indicates that although Solar Cycle 24 produced fewer intense eruptive events, several major geomagnetic storms occurred due to fast Earth-directed CMEs and favourable interplanetary conditions. The geoeffectiveness of these events was strongly controlled by CME speed, magnetic structure, and the duration of southward IMF-Bz, which enhanced magnetic reconnection at the dayside magnetopause. Results show that flare magnitude alone is not a reliable predictor of geomagnetic storm severity. Instead, CME characteristics and solar wind–magnetosphere coupling processes play a dominant role in generating intense geomagnetic activity. In addition, recurrent moderate storms were frequently associated with high-speed solar wind streams originating from coronal holes during the declining phase of the cycle. The findings emphasize the complex nature of solar–terrestrial interactions and highlight the importance of integrated observations for understanding and forecasting space weather events. Improved knowledge of flare–storm relationships during Solar Cycle 24 contributes to the development of more accurate prediction models and supports the protection of satellites, communication systems, navigation networks, and power infrastructure from adverse space weather effects.

Keywords: *Solar Cycle 24, Solar Flares, Geomagnetic Storms, Coronal Mass Ejections (CMEs), Space Weather, Solar–Terrestrial Interactions.*

SCREENING AND IDENTIFICATION OF LACTIC ACID-PRODUCING BACTERIAL ISOLATES

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ABSTRACT

Lactic acid bacteria (LAB), a broad group of Gram-positive Bacteria which are essential to food fermentation and various industrial applications such as synthesis of biodegradable polymers like polylactic acid (PLA). LAB have drawn a lot of interest in various sustainable industrial processes because of their Generally Recognized as Safe status and capacity to effectively convert carbohydrates into lactic acid. The identification and screening of viable lactic acid-producing strains are critical steps in creating economical and high-yield fermentation systems for industrial lactic acid production.

In this study, a total of 5 samples were collected for isolation of LAB. A total of 26 bacteria isolated and screened on de Man, Rogosa and Sharpe (MRS) media containing 0.04% bromocresol purple indicator. Out of 12 bacteria, 5 isolates exhibited lactic acid production in the MRS medium. To finalize maximum Lactic acid producing bacteria, patch method was used. Out of 5 bacterial isolates, MKS bacterial strain exhibited maximum production determined by yellow color zone around the growth. The selected isolate was identified using morphological, biochemical and molecular study. On the basis of molecular identification, the selected organism was found to be *Lactiplantibacillus argentoratensis*.

Keywords: *Lactic Acid, Sustainability, Biopolymers, Biodegradation.*

SOLAR WIND DISTURBANCES AND THE GENERATION OF MODERATE GEOMAGNETIC STORMS: A SOLAR–TERRESTRIAL PERSPECTIVE

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ABSTRACT

Solar wind disturbances are the primary drivers of geomagnetic storms and play a crucial role in the dynamics of the Sun–Earth system. This study investigates the relationship between solar wind disturbances and the occurrence of moderate geomagnetic storms ($-100 \text{ nT} < \text{Dst} \leq -50 \text{ nT}$) by examining variations in interplanetary plasma and magnetic field parameters. The analysis focuses on disturbances associated with interplanetary coronal mass ejections (ICMEs), corotating interaction regions (CIRs), high-speed solar wind streams (HSSs), and interplanetary shocks, which significantly modify the ambient solar wind environment.

Particular attention is given to key solar wind parameters, including velocity, proton density, temperature, dynamic pressure, and the orientation of the interplanetary magnetic field (IMF). The study highlights the importance of prolonged southward IMF-Bz conditions in facilitating magnetic reconnection at the dayside magnetopause, enabling efficient transfer of solar wind energy into the magnetosphere. Variations in these parameters are analyzed to identify the dominant processes responsible for storm initiation, main-phase development, and recovery characteristics. Statistical evaluation of geomagnetic indices and solar wind coupling functions reveals a strong association between enhanced solar wind activity and moderate geomagnetic storm intensity. The results indicate that storm magnitude is governed by the combined influence of solar wind speed, sustained southward IMF-Bz, and elevated dynamic pressure. The findings improve the understanding of solar wind–magnetosphere coupling and provide insights into the physical mechanisms underlying moderate geomagnetic storm generation. This work contributes to advancing knowledge of solar–terrestrial interactions and the dynamics of near-Earth space plasma environments.

Keywords: *Solar Wind Disturbances, Moderate Geomagnetic Storms, IMF-Bz, ICMEs, High-Speed Solar Wind Streams, Magnetosphere.*

FORECASTING INFANT MORTALITY IN INDIA IN THE GOAL OF THE SUSTAINABLE DEVELOPMENT GOALS 2030: AN ANALYSIS USING AUTO REGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA) MODEL

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ABSTRACT

Infant mortality is an important indicator of a country's health and development. Although India has made significant progress in reducing infant mortality, continuous monitoring is needed to achieve the sustainable Development Goals (SDGs) by 2030. The present study aims to analyse the trend of infant mortality in India using data from 2003 to 2023 and to forecast infant mortality rates for the period 2024-2030 using the Autoregressive Integrated Moving Average (ARIMA) model. The study aims to forecast future developments and evaluate India's expected progress in reaching the SDG-related child survival goals by 2030.

It uses annual time-series data on the Infant Mortality Rate (IMR) in India obtained from the Sample Registration System (SRS) for the period 2003-2023. The Autoregressive Integrated Moving Average (ARIMA) model was employed to analyse historical trends and forecast IMR for the period 2024-2030.

The ARIMA forecasts show a steady decline in infant mortality rates across most major states and at the national level in India during 2024–2030. India's IMR is projected to decrease from 23.2 per 1,000 live births in 2024 to 12.7 in 2030. Kerala is expected to maintain the lowest IMR, while Uttar Pradesh, Chhattisgarh, Madhya Pradesh, and Jharkhand are projected to continue having relatively high infant mortality levels. Although substantial reductions in IMR are expected in most states, considerable interstate disparities are likely to persist through 2030. These findings suggest that sustained and targeted public health interventions will be required, particularly in high-burden states, to accelerate progress towards achieving the SDG child survival targets.

Keywords: *Infant Mortality, Sustainable Development Goals, ARIMA Model.*

EXPLORING AI MODELS FOR HIGH-PERFORMANCE COMPUTING APPLICATIONS

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ABSTRACT

Artificial Intelligence and parallel computing play a vital role in accelerating innovation, scientific discovery, and technological advancement across multiple sectors. In recent years, emerging technologies such as Artificial Intelligence and parallel computing have significantly transformed traditional research methodologies. Artificial Intelligence enables intelligent data analysis, predictive modelling, pattern recognition, and automated decision-making, thereby improving the efficiency and accuracy of research processes. At the same time, parallel computing enhances computational performance by executing multiple tasks simultaneously, reducing processing time for large-scale simulations, complex calculations, and big data analytics. The integration of AI with parallel computing provides powerful capabilities for solving computationally intensive problems in fields such as healthcare, cybersecurity, climate modelling, engineering, and scientific research. This paper examines the emerging role of AI and parallel computing in modern Era, highlighting their applications, benefits, challenges, and future scope. The study also assists to explore various aspect of connectivity and Complexity, data security, and the requirement for new innovation. Artificial Intelligence models, particularly machine learning and deep learning techniques, are increasingly being integrated with High-Performance Computing (HPC) systems to process datasets and perform complex computations efficiently. It concludes that the combined use of AI and parallel computing is becoming essential for faster innovation and advanced research outcomes in the digital era.

Keywords: *Artificial Intelligence, Parallel Computing, AI Models, High Performance Computing (HPC), Big Data Analytics, Machine Learning.*

ENHANCED IONIC TRANSPORT IN NANOCOMPOSITE GEL POLYMER ELECTROLYTES FOR SUSTAINABLE AND RENEWABLE ENERGY STORAGE APPLICATIONS

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ABSTRACT

Gel polymer electrolytes (GPEs) are emerging as safer alternatives to conventional liquid electrolytes for energy storage applications due to their enhanced safety, flexibility, and electrochemical performance. However, their widespread utilization is often restricted by inadequate ionic conductivity, poor interfacial stability, and limited mechanical strength. In the present study, titanium dioxide (TiO₂) nanoparticles were incorporated as an inorganic nanofiller into a poly (vinyl alcohol) (PVA)–ammonium thiocyanate (NH₄SCN) gel polymer electrolyte matrix to overcome these limitations and improve ion transport characteristics. Owing to their excellent thermal stability, high surface area, and Lewis acid–base interactions, TiO₂ nanoparticles facilitate salt dissociation, enhance polymer chain dynamics, and promote the formation of highly conductive amorphous regions within the electrolyte. The electrolyte films were prepared using a facile solution-casting technique and systematically characterized to evaluate their structural, morphological, electrical, and electrochemical properties. Structural analysis using X-ray diffraction (XRD) revealed a significant increase in the amorphous phase with TiO₂ incorporation, which plays a crucial role in enhancing ionic mobility. Morphological investigations carried out by field emission scanning electron microscopy (FESEM) confirmed the homogeneous distribution of TiO₂ nanoparticles throughout the polymer matrix. The optimized electrolyte containing 8 wt% TiO₂ exhibited a maximum ionic conductivity of $4.52 \times 10^{-2} \text{ S cm}^{-1}$, representing a substantial enhancement over the pristine electrolyte. The ion transference number (t_{ion}) was found to be 0.97, confirming predominantly ionic conduction with negligible electronic contribution. Furthermore, the optimized electrolyte displayed a broad electrochemical stability window ranging from -2.2 V to $+2.5 \text{ V}$ and excellent electrochemical reversibility. These results highlight the potential of TiO₂-incorporated PVA–NH₄SCN gel polymer electrolytes for advanced rechargeable batteries and supercapacitor applications.

Keywords: Nanocomposite Gel Polymer Electrolyte, XRD, NH₄SCN, FESEM.

INFLUENCE OF TiO₂ NANOFILLER ON THE STRUCTURAL AND ELECTRICAL PROPERTIES OF PVDF-HFP/NAI NANOCOMPOSITE POLYMER ELECTROLYTES

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ABSTRACT

Polymer electrolytes have attracted considerable attention due to their potential application in modern electrochemical and energy storage devices. To enhance the ionic conductivity and improve the electrochemical performance, inorganic filler TiO₂ was added to the PVdF-HFP: NaI: DMF system. The polymer electrolyte films were prepared utilizing the solution casting method. The influence of inorganic filler on the conductivity of the PEs was investigated, and it was discovered that the addition of TiO₂ significantly increased the ionic conductivity $\sigma = 2.24 \times 10^{-2}$ S/cm. The polymer electrolytes increased amorphous character is explained by XRD analysis. The rise in ionic conductivity may be caused by this polymer electrolyte tendency. FTIR spectroscopy, reveal complexation and interaction between the constituents. The significant ionic contribution to overall conductivity was indicating by the high ionic transference number of 0.9442 found in transference number measurements.

Keywords: Polymer Electrolytes, PVdF-HFP, TiO₂, Ionic Conductivity.

QUANTUM MACHINE LEARNING-BASED CYBER ATTACK PREDICTION IN IOT NETWORK

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ABSTRACT

The rapid growth of the Internet of Things (IoT) has significantly increased the number of interconnected devices, thereby expanding the attack surface for cyber threats. Traditional machine learning techniques have been widely employed for intrusion detection and cyber-attack prediction in IoT networks; however, they often face challenges related to computational complexity, scalability, and accuracy. Quantum Machine Learning (QML), which combines quantum computing principles with machine learning algorithms, has emerged as a promising solution to overcome these limitations. This paper proposes a Quantum Machine Learning-based framework for predicting cyber-attacks in IoT networks. The proposed approach utilizes quantum-enhanced classifiers to analyse network traffic patterns and identify malicious activities. Experimental analysis demonstrates that QML models can improve prediction accuracy and reduce false positive rates compared to conventional machine learning techniques. The study highlights the potential of quantum computing in strengthening IoT cyber security systems.

Keywords: *QML Models, Internet of Things (IoT), Machine Learning, Cyber Attack.*

A MATHEMATICAL FRAMEWORK FOR INTERCONNECTION NETWORK OPTIMIZATION USING AN IMPROVED GENETIC ALGORITHM UNDER RELIABILITY AND COST CONSTRAINTS

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ABSTRACT

Interconnection network topology plays a critical role in determining the performance, scalability, reliability, and fault tolerance of parallel computing systems, distributed architectures, data centres, and network-on-chip platforms.

This paper presents a mathematical framework for interconnection network optimization using an Improved Genetic Algorithm (IGA) under reliability and cost constraints. The proposed framework models the network as a probabilistic graph and employs reliability-guided initialization, adaptive crossover and mutation, elitist preservation, and feasibility-restoring repair while satisfying budget and connectivity constraints.

The study develops a penalty-based fitness formulation together with theoretical analysis of feasibility preservation and computational complexity, providing a foundation for future simulation studies and practical deployment.

Keywords: *Interconnection Networks, Improved Genetic Algorithm, Topology Optimization, Network Reliability, Graph Theory, Evolutionary Computing.*

RESEARCH AND DEVELOPMENT IN THE 21ST CENTURY: EMERGING TECHNOLOGIES, CHALLENGES, AND PROSPECTS

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ABSTRACT

Research and Development (R&D) plays a pivotal role in advancing scientific knowledge, technological innovation, and sustainable economic growth in the 21st century. The emergence of transformative technologies such as Artificial Intelligence (AI), Machine Learning (ML), Big Data analytics, the Internet of Things (IoT), biotechnology, and nanotechnology has significantly enhanced research capabilities and accelerated innovation across various sectors. These technologies facilitate efficient data analysis, automation, predictive modeling, and the development of innovative solutions to complex global challenges.

Contemporary R&D is increasingly characterized by interdisciplinary collaboration, digitalization, and global knowledge exchange. Open science initiatives, cloud-based research platforms, and international partnerships have expanded opportunities for collaborative research and rapid dissemination of scientific findings. Simultaneously, growing emphasis on sustainability has encouraged the development of environmentally responsible technologies and practices. Despite these advancements, several challenges remain, including funding constraints, ethical concerns surrounding emerging technologies, data privacy and cybersecurity risks, and unequal access to research infrastructure. Addressing these issues requires adaptive policies, robust regulatory frameworks, and continuous investment in human capital and innovation ecosystems.

This study explores the impact of emerging technologies on modern R&D, examines the challenges affecting research effectiveness, and highlights future prospects for innovation-driven development. Understanding these evolving trends is essential for fostering sustainable, inclusive, and impactful research that contributes to scientific progress and societal well-being.

Keywords: *Research and Development (R&D), Emerging Technologies, Artificial Intelligence, Innovation, Digital Transformation, Sustainability.*

ROLE OF BRAHMA KUMARI'S 'RAJ YOGA' MEDITATION IN MANAGING EXAMINATION STRESS AMONG MADHYAMIK STUDENTS OF UDAYNARAYANPUR BLOCK, HOWRAH

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ABSTRACT

Students are considered to be the pillars of a nation and Madhyamik examination is the first big milestone for all the students. In this regard, handling of examination stress for any Madhyamik examination is a very important task to achieve.

This study aims at evaluating the impact of regular practice of 'Raj Yoga' Meditation by the students of Class-X in handling examination stress in an experimental method. For this research work, 60 students of Class-X were selected randomly from various schools under Udaynarayanpur block in a random process. Thereafter, those 60 students were divided into two groups having 30 students each – one is control group and another is meditating group. At first, the power of handling examination stress by all 60 students has been assessed taking the assistance of standardized tool PSS-10. Thereafter, the 30 students of Meditation Group have been practised Raj Yoga Meditation for 20 minutes regularly for 30 days by trained instructors of Brahma Kumar, besides their routine school activities. The Control Group on the other hand only followed the school activities and they have not been intervened with 'Raj Yoga' Meditation. After 30 days, the stress handling of power of the students of both the groups has been again assessed with aid of PSS-10. Thereafter, the result of both the Pre-test and Post-test has been analysed using SPSS v26. It has been found that there is significant change in the stress reduction power of the students of Meditation Group in comparison to the Control Group.

Keywords: *Meditation, Raj Yoga, Brahma Kumari's.*

HARNESSING SOLAR POWER BEYOND EARTH: ORGANIC PHOTOVOLTAICS IN SPACE SCIENCES AND SOLAR ACTIVITIES

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ABSTRACT

The unpredictable nature of solar activity is closely related to the effectiveness of organic photovoltaics (OPVs) in capturing solar energy. The performance and lifespan of solar power plants may be jeopardized by space weather events caused by solar flares and coronal mass ejections that disrupt Earth's magnetosphere. This article clarifies the complex relationship between OPV efficiency and solar activity cycles using insights from decades of solar irradiance data. We identify potential for improving device architecture and material design to increase resilience against space weather-induced degradation by analyzing the effects of solar radiation on OPV materials. Additionally, OPVs' special qualities make them excellent choices for solar power generation in space, where their high power-to-weight ratio and radiation resistance can be used to assist upcoming space missions.

The potential of OPVs to support space-based solar power systems and the effects of solar activity on OPV performance are highlighted in this article, which examines the relationship between OPVs and space sciences. We highlight the necessity for interdisciplinary research to fully realize the potential of OPVs in space exploration and usage while discussing the state of OPV technology today, obstacles, and potential future paths for space applications.

Keywords: *Organic Photovoltaics (OPVs), Space Weather Events, Solar Flares, Coronal Mass Ejections.*

ASSESSMENT OF FRESHWATER FISH BIODIVERSITY IN URBAN AND SEMI-URBAN WATER BODIES OF JAIPUR DISTRICT

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ABSTRACT

Freshwater fish biodiversity in urban and semi-urban aquatic ecosystems faces unprecedented pressure from rapid urbanization, industrial effluents, sewage discharge, and habitat fragmentation. The present study was conducted across six representative water bodies of Jaipur district, Rajasthan, India, spanning natural lakes, reservoirs, semi-urban dams, peri-urban lakes, and seasonal wetlands. Sampling was carried out over four seasons (pre-monsoon, monsoon, post-monsoon, and winter) during 2024–2025 using cast nets, gill nets, drag nets, and hook-and-line methods, supplemented by local fisher interviews and historical records. A total of 22 fish species belonging to 13 families and 3 orders were recorded, representing a marked decline of approximately 40% compared to historical inventories from the 1990s. Species richness and diversity indices (Shannon-Wiener H' : 0.78–2.67; Simpson D: 0.47–0.91) showed a strong negative correlation with urbanization gradient parameters including BOD ($r = -0.89$, $p < 0.01$) and TDS ($r = -0.84$, $p < 0.01$). Semi-urban sites (Chandlai Lake, Ramgarh Reservoir) exhibited significantly higher diversity compared to peri-urban watercourses (Chaksu Dam, Nevta Lake, Kanota Dam). Critically, Tor tor (Endangered) and Catlacatla (Vulnerable) were restricted to least-disturbed sites. The exotic invasive Oreochromis niloticus (Nile Tilapia) and Gambusia affinis (Mosquitofish) were documented at disturbed sites, posing competitive threats to native species. Index of Biotic Integrity (IBI) scores ranged from 'Poor' to 'Good', with 50% of sites scoring 'Moderate' or below. Physicochemical analysis revealed elevated BOD and reduced DO levels at anthropogenically impacted sites. The study underscores the urgent need for integrated watershed management, effluent treatment infrastructure, invasive species control, and riparian zone restoration to safeguard the remaining freshwater fish biodiversity of the region.

Keywords: Fish Diversity Indices, Invasive Species and Water Quality.

विद्यार्थियों की सामाजिक दक्षता पर सामाजिक मीडिया के प्रभाव

कुलदीप

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सारांश

सामाजिक मीडिया आधुनिक युग में विद्यार्थियों के जीवन का एक महत्वपूर्ण हिस्सा बन गया है। यह संचार, सूचना के आदान-प्रदान तथा सामाजिक सहभागिता का प्रभावी माध्यम है। प्रस्तुत अध्ययन का उद्देश्य विद्यार्थियों की सामाजिक दक्षता पर सामाजिक मीडिया के प्रभाव का विश्लेषण करना है। सामाजिक दक्षता से तात्पर्य व्यक्ति की दूसरों के साथ प्रभावी संवाद स्थापित करने, सामाजिक संबंधों को बनाए रखने तथा विभिन्न सामाजिक परिस्थितियों में उचित व्यवहार करने की क्षमता से है।

अध्ययन से स्पष्ट होता है कि सामाजिक मीडिया विद्यार्थियों को नए लोगों से जुड़ने, विचारों का आदान-प्रदान करने, सहयोगात्मक अधिगम में भाग लेने तथा आत्म-अभिव्यक्ति के अवसर प्रदान करता है, जिससे उनके संचार कौशल एवं सामाजिक सहभागिता में वृद्धि हो सकती है। इसके विपरीत, सामाजिक मीडिया के अत्यधिक उपयोग से प्रत्यक्ष सामाजिक संपर्क में कमी, सामाजिक अलगाव, समय प्रबंधन की समस्याएँ तथा पारस्परिक संबंधों में दूरी जैसी चुनौतियाँ भी उत्पन्न हो सकती हैं। इसलिए सामाजिक मीडिया का प्रभाव विद्यार्थियों की सामाजिक दक्षता पर सकारात्मक एवं नकारात्मक दोनों रूपों में देखा जा सकता है।

अतः यह आवश्यक है कि विद्यार्थी सामाजिक मीडिया का संतुलित एवं उद्देश्यपूर्ण उपयोग करें ताकि उनकी सामाजिक दक्षता का समुचित विकास हो सके और वे समाज में प्रभावी भूमिका निभा सकें।

मुख्य शब्द: सामाजिक मीडिया, विद्यार्थी, सामाजिक दक्षता, संचार कौशल, सामाजिक सहभागिता और सामाजिक संबंध।

FRESHWATER FISH DIVERSITY AND CONSERVATION STATUS IN UTTAR PRADESH, INDIA: A CRITICAL REVIEW

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ABSTRACT

Uttar Pradesh is endowed with a vast network of rivers, lakes, reservoirs and wetlands that support a rich diversity of freshwater fish species. This review critically examines the diversity, distribution and conservation status of freshwater fishes in the state. The study compiles information from published literature, research reports and biodiversity records to provide an overview of the ichthyofaunal wealth of Uttar Pradesh. It highlights the ecological and economic importance of freshwater fishes while addressing major threats such as habitat degradation, water pollution, overfishing, invasive species and climate change. The review emphasizes the need for effective conservation measures, sustainable fisheries management and regular biodiversity monitoring to ensure the long-term protection of freshwater fish resources in Uttar Pradesh.

Keywords: *Freshwater Fish Diversity, Conservation Status, Ichthyofauna, Biodiversity and Fisheries Management.*

AN OVERVIEW OF FRESHWATER FISH DIVERSITY IN RAJASTHAN, INDIA: A REVIEW STUDY

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ABSTRACT

Rajasthan, despite its predominantly arid and semi-arid climate, supports a diverse assemblage of freshwater fish species in its rivers, reservoirs, lakes and wetlands. This review provides an overview of the freshwater fish diversity of the state, highlighting species distribution, ecological importance and conservation status. The study synthesizes information from published literature and available reports to assess the current state of ichthyofaunal diversity in Rajasthan. Major threats such as habitat degradation, water pollution, overexploitation and climate variability are also discussed. The review emphasizes the need for effective conservation strategies, habitat protection and sustainable management practices to preserve freshwater fish biodiversity in the region.

Keywords: *Freshwater Fish Diversity, Rajasthan, Ichthyofauna, Biodiversity, Conservation and Review Study.*

ASSESSMENT OF HEAVY METAL TOXICITY AND HUMAN HEALTH CONSEQUENCES

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ABSTRACT

Heavy metals are persistent environmental pollutants that pose significant risks to human health due to their toxicity, bioaccumulation and long-term persistence in ecosystems. This study assesses the toxicity of major heavy metals, including lead, mercury, cadmium, arsenic and examines their effects on human health. Exposure to these metals through contaminated air, water, soil and food can lead to various health problems, including neurological disorders, kidney damage, respiratory diseases, cardiovascular complications and cancer. The study reviews the sources, pathways of exposure and toxicological impacts of heavy metals on human populations. The findings highlight the growing concern of heavy metal contamination and emphasize the need for effective environmental monitoring, pollution control measures and public health interventions to reduce exposure risks and protect human well-being.

Keywords: *Heavy Metals, Toxicity, Human Health, Environmental Pollution, Bioaccumulation and Risk Assessment.*

ANALYSIS OF LAND USE PATTERN IN DAUSA DISTRICT, RAJASTHAN: A GEOGRAPHICAL STUDY

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ABSTRACT

The present study analyses the land use pattern of Dausa District, Rajasthan, from a geographical perspective. It examines the distribution of major land use categories such as agricultural land, forest land, pasture land, barren land, and non-agricultural land. The study is based on secondary data obtained from government reports and statistical records. The findings reveal that agriculture occupies the largest share of land use in the district, while urbanization and population growth are gradually increasing non-agricultural land use. Spatial variations in land utilization are influenced by factors such as soil, water availability, and topography. The study highlights the importance of sustainable land management for balanced regional development and environmental conservation in Dausa District. This study plays vital role in the point of view the planning and development of the region.

Keywords: *Land Use Pattern, Geographical Analysis, Agriculture and Land Resources.*

MEDICO-ETHNOBOTANICAL STUDY OF SOME IMPORTANT PLANTS FROM DISTRICT JAIPUR

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ABSTRACT

The present study focuses on the medico-ethnobotanical importance of selected medicinal plants found in Jaipur District, Rajasthan. It examines the traditional knowledge and therapeutic uses of these plants among local communities. Information was collected through field surveys, interviews with traditional healers, and available literature. The study highlights the role of medicinal plants in treating common ailments and emphasizes their significance in primary healthcare. The findings reveal that several plant species possess valuable medicinal properties and continue to play an important role in indigenous healthcare practices. The study underscores the need for conservation of medicinal plant resources and documentation of traditional knowledge for future generations.

Keywords: *Ethnobotany, Medicinal Plants, Traditional Knowledge and Indigenous Healthcare.*

RECENT SOLAR ACTIVITY DURING SOLAR CYCLE 25 AND ITS RELATIONSHIP WITH GALACTIC COSMIC RAYS: OBSERVATIONAL EVIDENCE AND SPACE WEATHER IMPLICATIONS

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ABSTRACT

Solar Cycle 25 (SC25), which began in December 2019, has exhibited significantly stronger activity than initially predicted, with the smoothed international sunspot number reaching approximately 160–161 in October 2024, marking the strongest solar maximum in more than two decades. Daily sunspot numbers exceeded 299 during August 2024, accompanied by frequent X-class solar flares, coronal mass ejections (CMEs), and enhanced solar wind conditions.

These intensified solar magnetic fields modulate the transport of Galactic Cosmic Rays (GCRs) through the heliosphere, producing a well-established inverse correlation between solar activity and cosmic-ray intensity. Observations from long-term neutron monitor databases, including Oulu (Finland), Moscow (Russia), and Beijing (China), show a pronounced decrease in GCR intensity during the SC25 maximum, consistent with enhanced heliospheric shielding and recurrent Forbush decreases associated with CME passages.

The combined analysis of sunspot number (SSN), F10.7 cm solar radio flux, solar wind parameters, and neutron monitor data demonstrates that increased solar activity suppresses GCR flux reaching Earth's atmosphere. Understanding this anti-correlation is essential for improving space weather prediction, assessing radiation hazards for satellites and astronauts, and advancing models of heliospheric modulation during the evolving maximum phase of Solar Cycle 25.

Keywords: *Solar Cycle 25, Solar Activity, Galactic Cosmic Rays (GCRs), Solar Modulation, Sunspot Number, F10.7 Radio Flux.*

RASAYANA SHAstra TO CHEMISTRY: BRIDGE BETWEEN EXPLORING TRADITIONAL AND MODERNITY IN CHEMICAL SCIENCES

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ABSTRACT

This research work investigates rich and historical heritage of Indian Knowledge System (IKS) with a specific focus on science especially in the field of chemistry. The main purpose of this research paper is to bridge traditional knowledge with modern advanced scientific knowledge. A multi-pronged approach is required to review this methodology. A critical analysis of text based on ancient India, evidences based on archaeology, and different scholarly research works has been studied to review and understand documented chemical processes and concepts. These observations have been compared, contrasted and examined against recognized scientific principles in the field of modern chemistry. The practical applications of traditional Indian chemical knowledge in different sectors have been studied by exploring case studies. The research shows that scientific tradition in ancient India was very much developed and characterised by insightful observation, experimentation, and a holistic perspective of nature. The findings of this research contribute to the rejuvenation of IKS and its strong integration into modern chemistry.

Keywords: *Rasayana Shastra, Indian Knowledge System, Scientific Tradition.*

EMERGING TRENDS IN DATA WAREHOUSING TECHNOLOGY

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ABSTRACT

The research looks at the concepts associated with data warehousing. These include; Data Mart, EDWH, cloud computing and big data analytics. By analysing the growth of these technologies, it is possible to tell the trend in which data will take in the coming future. A lot of data is in use at the moment in very large packets and volumes. The technologies that are associated with data use are associated with data use are immense and greatly spread across all computing gadgets in use. Cell phones, microcomputers, and other computing gadgets all take advantage of data warehousing technology. The research presents a case for the proliferated use of big data technologies across the world. Data use, and data users are separated using the concept of 'abstraction.' As users continue to use big data analytics and warehousing more often, they are less aware of the dangers and concerns in the use and Mahindra & Mahindra of virtual computing facilities. The study seeks to establish the influence of current technologies on data warehousing and how they lead to the growth of data storage units across the globe. The survey on data warehousing trends is focused on software technologies that highly rely on the data warehousing facilities. Social media is acknowledged as one of the leading factors behind the growth of data warehousing facilities.

Keywords: *Data Warehouse, Big Data, Virtual Storage, Cloud Storage, Data Mart Storage, EDWH Storage.*

UNIFIED DISCOVERY OF CONTINUOUS AND DISCRETE LIE GROUP SYMMETRIES

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ABSTRACT

Lie group symmetries seem useful for handling continuous changes in physics and also in machine learning setups. The problem is spotting them automatically from data gets tricky when both continuous and discrete parts show up together. I think the paper tries a method that learns the actual transformations straight in the group space. It does not need you to already know the generators or stick to some fixed algebraic form. That way it can pull out hidden subgroups that explain the invariances sitting in the data.

Experiments were run on made up geometric examples and some real benchmarks too. The identification came out pretty accurate in most cases and it helped with how easy the model was to interpret. Sample efficiency got better as well. Some parts of the results feel stronger than others though and it is not totally clear how far these scales when the data gets noisier. It feels like the symmetry aware way of modelling could matter for science work and for machine learning tasks but maybe more tests are needed before saying how general it really is.

Keywords: *Lie group, Symmetries, Unified Discovery.*

CORROSION CONDITION IN MODERN ERA: A CRITICAL OVERVIEW

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ABSTRACT

Corrosion, a prevalent and widespread phenomenon, promulgates considerable challenges across various routine activities and industrial sector, adversely impacting safety, infrastructure along with their instalment and economic viability. This research paper aims to provide a brief outline of the critical condition of current research on corrosion. It discovers the comprehensive multidimensional nature of corrosion, highlighting its worst and adverse effects on materials and structures. Furthermore, this review critically examines current methodologies for corrosion detection and assessment, emphasizing the interdisciplinary approaches necessary for a comprehensive understanding and effective mitigation of corrosion. It also explores emerging trends and innovations in corrosion science, including the development of novel materials, advanced analytical techniques, and predictive modelling approaches, and concludes by highlighting the significance of sustained research efforts in addressing corrosion-related challenges and fostering sustainable, environmentally friendly technological advancements.

Keywords: Corrosion, Environmentally Friendly, Novel Materials.

THE IMPACT OF INFORMATION TECHNOLOGY ON ENVIRONMENT AND HUMAN HEALTH

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ABSTRACT

Information technology has become a vital component in addressing challenges in environmental management and human health by enabling efficient storage, processing, transmission, and dissemination of information. In the environmental domain, computerized databases and information systems support the systematic collection of data on wildlife, forest cover, conservation status, and various biotic communities. In India, initiatives such as ENVIS have played an important role in organizing environmental information and making it accessible to researchers, policymakers, and the public. The integration of the internet, the World Wide Web, geographic information systems (GIS), and satellite-based data has further strengthened environmental monitoring, analysis, and decision-making. In the health sector, information technology has transformed diagnosis, patient monitoring, and treatment through computerized records, medical imaging techniques such as CT and CAT scanning, and software-assisted drug design. It also supports the management of chronic diseases and improves the efficiency of healthcare delivery. Beyond these direct applications, embedded computing in devices such as pacemakers, hearing aids, automobile control systems, and spacecraft guidance mechanisms demonstrates the wide impact of information technology on human life. In addition, mass media and digital communication channels have contributed to increasing awareness of environmental and health issues among the public. Overall, information technology provides a powerful foundation for evidence-based environmental protection and improved human well-being by enabling faster access to knowledge, better coordination of resources, and more informed decision-making across society.

Keywords: *Information Technology, ENVIS, GIS, Satellite Data, Databases, Medical Informatics.*

STRUCTURAL EVOLUTION OF MECHANOCHEMICALLY SYNTHESIZED MANGANESE HYBRID POWDERS INCORPORATING BENZYL TRIMETHYLAMMONIUM AS ORGANIC CATION

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ABSTRACT

Metal halide perovskites have had a significant effect in the field of science due to their fascinating photovoltaic applications. Metal halide perovskite powders were synthesized at room temperature using the Mechano synthesis process in order to study the structural properties of the compounds. The molecular arrangement and phase purity of the compound were confirmed by powder X-ray diffraction (PXRD), and the continuous arrangement of atoms within the crystal lattice was demonstrated by scanning electron microscopy (SEM). X-ray photoelectron spectroscopy (XPS) verified the material's chemical stability by verifying its fundamental makeup and oxidation states. The crystals demonstrate modest resistance to deformation, as evidenced by the Vickers microhardness technique, which assessed mechanical resilience. Up to 400°C, the thermal endurance of the material was confirmed by DSC and TGA. The compounds displayed an unmatched photoluminescence of red and green colour when exposed to the UV light. The semiconductor's suitability for optoelectronic applications was demonstrated by the direct allowed crossover with a bandgap of 1.81 eV, as disclosed by the optical bandgap investigation. This investigation unfolds greater insights into the optical properties of compounds, making them a promising candidate in the field of LED applications.

Keywords: Hybrid Perovskites, Mechano Synthesis, Photoluminescence, Photovoltaics.

ERA OF DIGITAL TRANSFORMATION: RECENT TRENDS IN COMMUNICATION SKILLS RESEARCH

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ABSTRACT

Communication skills have emerged as a critical competency in the age of digital transformation, influenced by rapid advancements in artificial intelligence (AI), digital technologies, and global connectivity. The evolution of communication from traditional face-to-face interactions to technology-mediated and AI-assisted communication has fundamentally reshaped the nature of interpersonal, professional, and academic communication.

This paper examines the recent trends in communication skills research by analysing traditional research and emerging trends that are influencing communication practices across education, business, and society. The paper reveals that communication skills are increasingly conceptualized as multidimensional competencies encompassing digital literacy, critical thinking, ethical communication, emotional intelligence, and adaptability to technology-enabled environments. While digital transformation has created new opportunities for collaboration and knowledge sharing, it has also introduced challenges related to misinformation, digital ethics, privacy, reduced interpersonal interaction, and unequal access to digital technologies.

A future research agenda has been proposed that integrates emerging technologies with human-centred communication frameworks to enhance communication competence in and professional settings.

Keywords: *Communication Skills, Digital Transformation, Artificial Intelligence, Digital Communication, Employability Skills, Digital Literacy.*

BIOINSPIRED APPROACHES TO HEAVY METALS FILTRATION: LEVERAGING OAK SILK FIBROIN (ANTHERAEA PROYLEI JOLLY) NANOHYBRID POLYMERIC MEMBRANE

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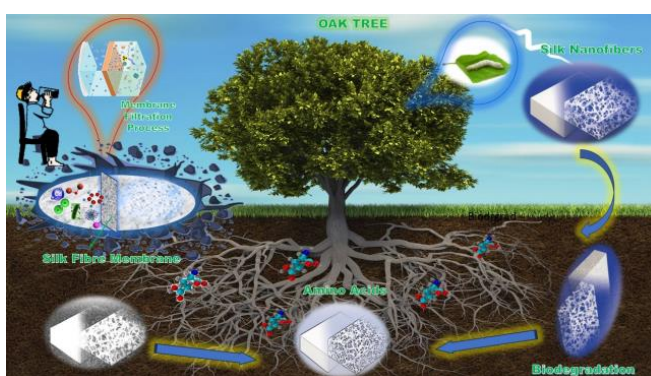
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ABSTRACT

This study explores bioinspired filtration methods for the effective removal of heavy metals from contaminated water, utilizing silk fibroin derived from “*Antheraea proylei Jolly*” in conjunction with innovative nanocomposite materials. By harnessing the unique properties of silk fibroin—such as biocompatibility, biodegradability, and high tensile strength—this approach aims to enhance the efficiency of arsenate adsorption.

The nanocomposite integrates silk fibroin with nanomaterials, optimizing surface area and adsorption capacity. Experimental results demonstrate significant arsenate removal efficiency, showcasing the potential of this bioinspired strategy in addressing environmental challenges posed by arsenic contamination. This research contributes to the development of sustainable filtration technologies that leverage natural materials for effective water purification.

Keywords: Bioinspired Filtration, Silk Fibroin, Arsenates, Nanocomposite, Environmental Remediation, Water Purification.



GREEN NANOMEDICINE FOR BREAST CANCER: CHITOSAN-FUNCTIONALIZED SILVER NANOPARTICLES

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ABSTRACT

Breast cancer remains one of the leading causes of cancer-related mortality worldwide, highlighting the need for environmentally sustainable and biologically selective therapeutic strategies. Green nanotechnology offers an attractive approach for developing safer anticancer agents with minimal off-target toxicity.

To synthesize eco-friendly chitosan-functionalized silver nanoparticles (AgNPs) and investigate their anticancer efficacy and underlying molecular mechanisms against human breast cancer cells. Silver nanoparticles were synthesized using tyrosine as a biological reducing agent and chitosan as a stabilizer. Physicochemical characterization was performed by UV-Visible spectroscopy, transmission electron microscopy, and dynamic light scattering. Their anticancer activity was evaluated in MCF-7 and MDA-MB-231 breast cancer cells, while biocompatibility was assessed using normal human peripheral blood lymphocytes. Oxidative stress, apoptosis, and key molecular regulators were examined through fluorescence microscopy, biochemical assays, immunofluorescence, and Western blotting.

The synthesized spherical nanoparticles (13-22 nm) demonstrated potent cytotoxicity against both breast cancer cell lines, with IC₅₀ values of approximately 6.5 ppb after 48 h, while exhibiting negligible toxicity toward normal lymphocytes. Mechanistic investigations revealed enhanced intracellular ROS generation, activation and nuclear translocation of Nrf2, upregulated p21, increased Bax/Bcl-2 ratio, activation of Caspase-9 and Caspase-3, and PARP1 cleavage. The absence of Caspase-8 activity confirmed extensive apoptotic cell death via the preferential activation of the mitochondrial intrinsic pathway.

This study demonstrates that green-synthesized chitosan-functionalized silver nanoparticles combine environmental sustainability with selective anticancer activity. Their remarkable potency at ultralow concentrations and mechanistic precision highlight their promise as next-generation nanotherapeutics for breast cancer management.

Keywords: *Silver Nanoparticles, Green Synthesis, Chitosan, Breast Cancer Therapy, Apoptosis.*

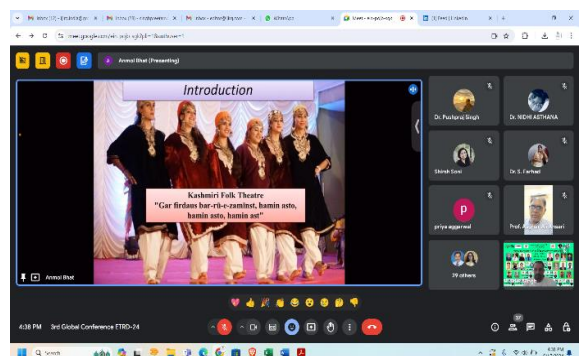
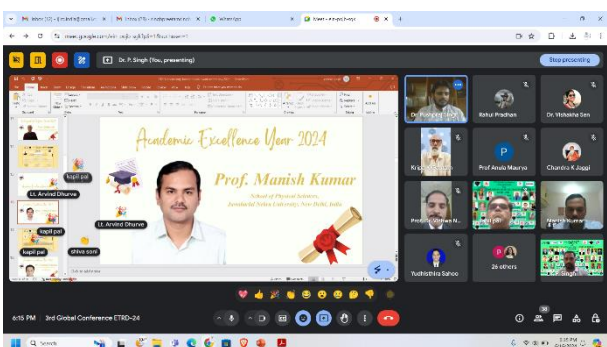
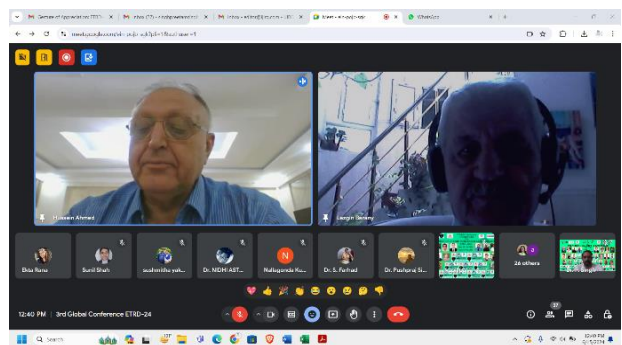
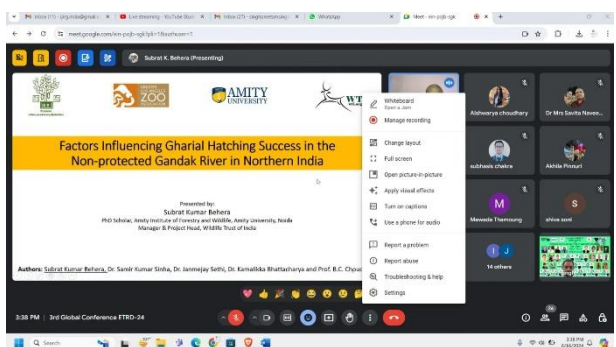
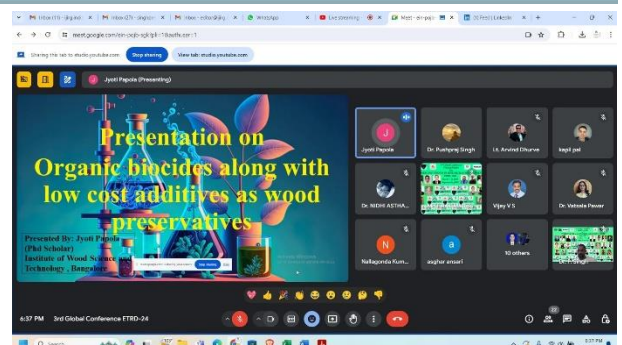
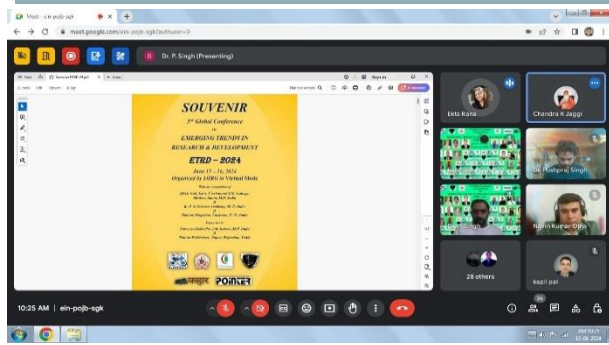
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S. No.	Award Category	Awardee with Affiliation
1.	Life Time Achievement Award	<i>Prof. Pankaj Kumar Shrivastava Former Professor, Govt. Model Science College, Rewa, M.P., India</i>
2	Distinguished Professor Award	<i>Prof. (Dr.) Radhe Shyam Gupta Professor of Physics, Government (Autonomous) P.G. College, Satna, M.P., India</i>
3.	Distinguished Researcher Award	<i>Dr. Punit Kumar Professor, University of Lucknow, U.P., India</i>
4.	Dynamic Researcher Award	<i>Prof. (Dr.) Anshuman Srivastava Indian Institute of Packaging, Ministry of Commerce and Industry, Government of India</i>
5.	Research Excellence Award	<i>Dr. Arunodaya Raj Mishra Department of Mathematics, Government Vivekanand College Maihar, M. P., India</i>
6.	Best Academician Award	<i>Dr. Rekha Israni Department of Chemistry, Bhagwant University, Ajmer, Raj., India</i>
7.	Young Scientist Award	<i>Dr. Gaurang Sharma College of Agricultural Engineering and Technology, Anand Agricultural University, Godhra, Gujarat, India</i>
8.	Young Researcher Award	<i>Dr. Ashish Kumar Meena Poornima University, Jaipur, Rajasthan, India</i>
9.	Early Graduate Student Researcher Award	<i>Raj Kumar Researcher Scholar, Indian Institute of Information Technology, Allahabad, U.P., India</i>
10.	Early Graduate Student Researcher Award	<i>Anshu Gupta Researcher Scholar, Maharaja Chhatrasal Bundelkhand University, Chhatarpur, M.P., India</i>

Glimpses of 4th Global Conference ETRD - 2025



Glimpses of 3rd Global Conference ETRD - 2024



Glimpses of 2nd Global Conference ETRD - 2023

Initial Value Problem

Consider a fractional-order differential equation

$${}^C D_{\alpha}^{\alpha} y(x) = f(x, y(x)), \quad (44)$$

where $0 < \alpha \leq 1$, $y(0) = y_0$.
Using the two basic properties¹⁴ for $n-1 < \alpha \leq n$ and $f \in L_1[a, b]$,

$$({}^C D_{\alpha}^{\alpha} D_{\alpha}^{\alpha} f)(x) = f(x) \quad (45)$$

¹⁴Kumar, S., Ahmadian, A., Kumar, R., Kumar, D., Singh, J., Baleanu, D., and Saito, M. (2020). An efficient numerical method for fractional SIR epidemic model of infectious disease by using Bernstein wavelets. Mathematics, 8(4):558.

11:09 AM | ETRD-23 June 17-16, 2023

gy

1. Citrus limon (lemon)
2. Azadirachta indica (neem)
3. Ocimum sanctum (tulsi)
4. Zingiber officinale (ginger).

12:23 PM | ETRD-23 June 17-16, 2023

5. CFD and Modelling of Biological Problems

1. Human Respiratory System
2. Human Heart

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Dr. A. RAJENDRA KOPIL KUNWAR
ASST. PROFESSOR
ARSA INHCH INSTITUTE OF TECHNOLOGY, ETHIOPIA

2:38 PM | ETRD-23 June 17-16, 2023

Vignesh Ramamoorthy H is presenting

from at-fault to DNA storage

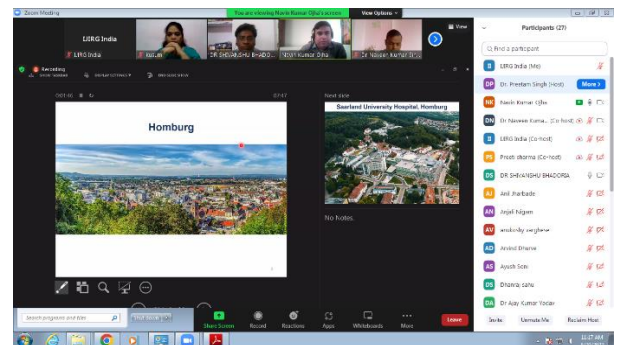
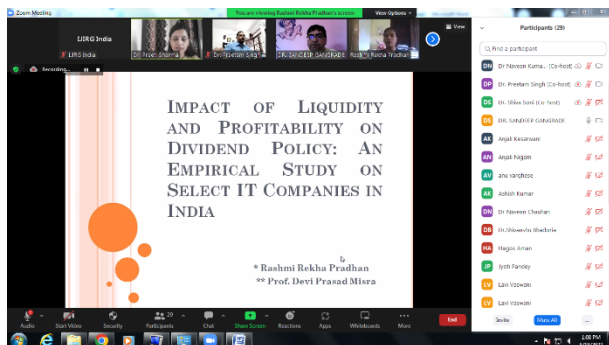
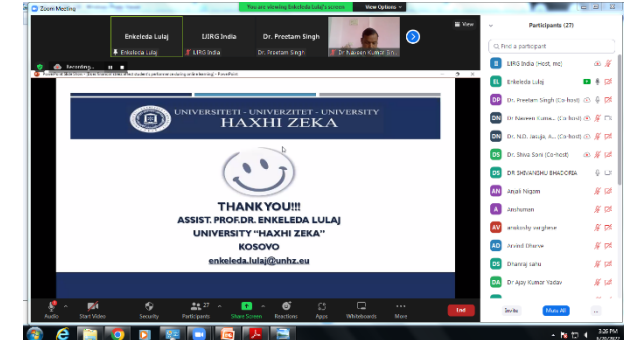
9:39 AM | ETRD-23 June 17-16, 2023

Anous Matsui is presenting

Smart Grid

11:24 AM | ETRD-23 June 17-16, 2023

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**INTERNATIONAL JOURNAL OF INNOVATIVE
RESEARCH & GROWTH (IJIRG)**

A Peer Reviewed Journal ISSN: 2455-1848,

Indexed with Crossref for DOI: 10.26671

Email: editor@ijirg.com; ijirg.india@gmail.com;

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