**3rd IMCEET-2025/Keynote-001**

# ENHANCING DISTRIBUTION SYSTEM STABILITY: PREDICTING ELECTRIC VEHICLE CHARGING DEMAND THROUGH MACHINE LEARNING

Prof. Madya Ts. Dr. Kok Boon Ching *

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**ABSTRACT:** As the popularity of electric vehicles (EVs) continues to rise, it is essential to understand and anticipate their charging demand in order to ensure the stability of power distribution systems. This keynote presentation will focus on the application of advanced machine learning algorithms to accurately predict EV charging behaviors and analyse their implications for grid management. This presentation examines the intricacies of electric vehicle (EV) adoption, particularly emphasising how user behaviour, geographical distribution, and time dependent energy demands impact charging patterns. By employing a range of machine learning techniques—such as regression models, clustering algorithms, and deep learning frameworks—it is possible to analyse historical charging data. This analysis can provide valuable insights and facilitate the development of robust predictive models. The research demonstrates that incorporating additional influencing factors, such as weather conditions, traffic patterns, and local energy generation, significantly enhances prediction accuracy. This improvement facilitates the development of more effective dynamic demand response strategies. Furthermore, this study will address the integration of these predictive models with distribution system operations, underscoring their critical role in optimising load management, reducing peak demand, and increasing the overall resilience of the electricity grid. The findings suggest that adopting a proactive approach to forecasting electric vehicle (EV) charging demand enhances system stability, facilitates more efficient energy distribution, and promotes the increased integration of renewable energy sources. This presentation will outline the methodologies employed, present the significant findings, and evaluate the practical implications of the research. The objective of this discussion is to facilitate dialogue regarding the crucial intersection of machine learning, electric vehicle infrastructure, and sustainable power systems. Furthermore, this talk aims to promote collaborative initiatives that develop innovative solutions to address the emerging challenges within the energy sector.

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**3rd IMCEET-2025/Keynote-002**

# THE EVOLVING ROLE OF LARGE LANGUAGE MODELS (LLMS) IN CYBERSECURITY

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**ABSTRACT:** The rapid advancement of Large Language Models (LLMs) has significantly impacted various sectors, with cybersecurity being a notable beneficiary. LLMs have demonstrated capabilities in enhancing threat detection, automating incident responses, and streamlining vulnerability assessments. Their proficiency in natural language understanding allows for improved analysis of threat intelligence and more efficient handling of security logs. However, the integration of LLMs into cybersecurity also introduces challenges, including potential misuse for generating sophisticated phishing attacks and the risk of model exploitation through adversarial inputs. This presentation will delve into the dualistic nature of LLMs in cybersecurity, exploring their potential to both fortify defenses and be leveraged maliciously. By examining current applications, associated risks, and future prospects, we aim to provide a comprehensive overview of how LLMs are reshaping the cybersecurity landscape.

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**3rd IMCEET-2025/Keynote-003**

# FLEXIBLE SENSORS FOR WEARABLE AND ROBOTICS APPLICATIONS

Dr, Afaque Manzoor

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**ABSTRACT**: Flexible sensors are revolutionizing the future of electronics by enabling novel applications in wearable devices, soft robotics, and health monitoring. These sensors, fabricated using materials like PDMS, Ecoflex, and liquid metals, exhibit stretchability, conformability, and biocompatibility, making them ideal for use on human skin and other complex surfaces. This keynote will delve into various classes of flexible sensors—strain, pressure, and humidity—and explore their fabrication through cutting-edge techniques such as reverse offset printing, electrospinning, and 3D printed molding. The talk will highlight high-performance materials including graphene, silver nanoparticles, PEDOT:PSS, and KCl-Gly based composites, presenting performance metrics such as sensitivity, robustness, and linearity. Emphasis will also be placed on integrating these sensors into soft robotic platforms, showcasing their potential for future applications in environmental monitoring, biomedical diagnostics, and human-machine interfaces. Finally, future prospects including multi-array sensing and biodegradable sensor platforms will be discussed, underlining the interdisciplinary efforts needed to advance this exciting field. connectivity, and digitalization. Embracing these emerging and disruptive trends is essential for industry stakeholders to remain competitive and address the evolving needs of consumers in the rapidly changing mobility landscape.

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**3rd IMCEET-2025/Keynote-004**

# POSITION SENSOR-LESS CONTROL FOR LOM BASED ON DOUBLE POWER SLIDING MODE OBSERVER WITH THIRD-ORDER GENERALIZED INTEGRATOR

Dr. Abdul Khalique Junejo

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*Wuhan , China*

**ABSTRACT:** In this talk, a double power sliding mode observer (DPSMO) is developed to estimate piston stroke of a linear oscillatory machine (LOM) to achieve robust sensor-less control. The DPSMO integrates the double power reaching law (DPRL) with an integral sliding mode surface. Both DPRL and integral sliding mode surface enhance the convergence rate of the sliding state, reduce the steady-state errors, and minimize the chattering phenomenon effectively. Furthermore, a third-order generalized integrator (TOGI) is introduced to address the integral saturation issue by effective elimination of the inherent DC components. The proposed method has been designed, assessed, and validated by full comparison with existing methods. Finally, the simulation and experimental results have confirmed its superiority over conventional methods.

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**3rd IMCEET-2025/Keynote-005**

# PATHWAY FOR SUSTAINABLE DEVELOPMENT: ENERGY CERTIFICATION FOR ENERGY-EFFICIENT URBAN DEVELOPMENT IN SOUTH ASIA

Dr. Kashif Hussain Mangi
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**ABSTRACT**: Rapid urbanization in South Asia is straining energy and environmental resources. The region's surging electricity demand in India, Pakistan, and Bangladesh is projected to more than double by mid-century [International Energy Agency, 2024]. This demand is primarily met by fossil fuels (around 80%) [World Bank Data, 2023], with coal being dominant. While renewable energy adoption (especially solar and wind) is growing, an accelerated transition is needed to meet rising energy needs and sustainability goals [UN Environment Programme, 2024]. India is a significant renewable energy producer, ranking as the world's third-largest generator of wind and solar electricity in 2024 [Government of India, Ministry of New and Renewable Energy, 2024]. Notably, electricity access has expanded significantly across South Asia (over 95% of households) [World Bank Data, 2023]; however, ensuring universal access to clean cooking remains a major challenge [WHO/World Bank, 2024]. The rapid pace of urbanization with projections indicating population of 1.75 billion by 2050, exacerbates environmental challenges. This growth leads to increased energy consumption in various sectors, including transportation, construction, and industries, consequently driving up carbon emissions. The building sector alone contributes over 30% of the region's energy-related carbon footprint. Unplanned urban expansion often results in urban sprawl, encroaching upon valuable agricultural land and natural ecosystems, leading to biodiversity loss and ecological disruption. Moreover, South Asia's high vulnerability to climate change impacts, such as rising temperatures and extreme weather events, further complicates the pursuit of sustainable urban development. Despite challenges, South Asia has significant untapped energy efficiency potential [Asian Development Bank, 2020]. Sustained policy support is vital for wider renewable energy deployment. Building energy efficiency efforts face implementation issues. Regional initiatives like SAREP support capacity building. India drives renewable growth with grid expansion and efficiency focus. Pakistan needs better urban planning amidst urbanization. Bangladesh prioritizes energy diversification and industrial efficiency after improving electricity access. Nepal relies on hydropower despite declining energy intensity [World Bank, 2022]. Sustainable urban development in South Asia requires addressing key challenges: balancing economic growth with environmental sustainability [United Nations, 2015], overcoming infrastructure deficits (housing, transport, water, waste) [ESCAP, 2023], tackling social inequalities creating a "green divide," and improving governance/urban planning for effective strategy implementation [UN-Habitat, 2020]. South Asia must embrace integrated energy certification for buildings, leveraging its significant untapped efficiency potential through supportive policies and collaborative governance for a sustainable future. This unified approach will be key to unlocking resilient, equitable, and environmentally sound urban development across the region.

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**3rd IMCEET-2025/Keynote-006**

# AI AGENTS FOR INDUSTRIAL ROBOTICS

Dr. Sunny Katyara*

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**ABSTRACT**: The emergence of AI agents in industrial robotics marks a pivotal shift from rigid automation toward systems capable of perception, reasoning, decision-making and autonomous action planning in real-world manufacturing environments. These agents whether rule-based or learning-based serve as intelligent intermediaries between high-level objectives and low-level control that are enabling industrial robots to adapt to dynamic tasks, collaborate with humans and optimize performance across complex workflows. Emerging trends such as large language model (LLM)-augmented agents, goal-conditioned policies and digital twin-based simulation offer promising directions for more intuitive and resilient agentic workflows for factories of the future. This talk will explore the architecture, capabilities and real-world applications of AI agents in industrial robotics. Emphasis will be placed on modular and hierarchical agent designs that integrate vision, motion planning, reinforcement learning and symbolic reasoning. Case studies will highlight agents used in real-time task allocation, predictive maintenance and adaptive assembly in smart factories. The talk will conclude by outlining research directions for trustworthy, scalable and human-aligned AI agents that can serve as the cognitive layer in the next generation of industrial robotic systems

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**3rd IMCEET-2025/Keynote-007**

# CLEAN COAL TECHNOLOGIES FOR POWER GENERATION

Prof. Dr. Ahmad Hussain*

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**ABSTRACT**: When we talk about the development of power stations based on sub bituminous coals, it is important to take into account certain characteristics of coals that require special consideration when selecting the type of equipment for mining and power generation, e.g. high moisture content will reduce the efficiency of power generation and add to the cost of capital for the equipment required to burn the coal. Fluidized Bed Combustion is a proven technology for low-grade coal combustion for producing power. In addition, it helps in achieving a significant reduction of pollutant emission as well greenhouse gases. One of the potential objective of this talk is focused on utilization of low-grade coal from Thar, which is to be used in a circulating fluidized bed combustor (CFBC). In order to investigate the suitability of coal for combustion, it is necessary to understand the its fluidization as well as thermal behavior before it could be commercially utilized in large coal power plants. Smart Combustion of low grade of coal and is a relatively new area. Its applications in fluidized bed boilers is associated with many technical issues related to fuel and need investigation. Influence of fluidizing air on the fluidization behavior is important to understand. It is evident that voidage along the riser height is affected by riser geometry. The influence of the fluidizing air on the combustion performance was examined and their effect on emissions can also be established in coal power plants working in Pakistan. The temperature in the riser of the CFB can rise quickly to around 900°C. This rise in temperature can cause an increase in the amount of exhaust gasses, which has their influence on the suspension density. In this talk, a firsthand experience of combustion behavior of low-grade Pakistani coals is will be presented.

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**3rd IMCEET-2025/Keynote-008**

# STUDY OF BARRIERS IN IMPLEMENTATION OF 1 ADVANCED MANUFACTURING TECHNOLOGIES IN SMALL AND MEDIUM TYPE MANUFACTURING INDUSTRIES

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**ABSTRACT** Presently, these technologies are facing immense barriers in the implementation to lead-time phase exclusively in the developing economies in general and in Pakistan particular, this research work outlines these barriers during the production line as well as to delivery to the customers. The impact of such barriers has influenced the stakeholders to review their manufacturing and business strategies for the manufacturing industries to address the issues for the sustainable manufacturing environment. In this context, the conceptual model has been proposed and developed by using four parameters of AMT. An instrument was designed, and the data was collected from 60 industries of Hyderabad region of Sindh province. The collected data has been analyzed by using the Likert Scale.

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3rd IMCEET-2025/Keynote-009

# MONITORING, MODELLING AND PERFORMANCE EVALUATION OF MAR TECHNIQUES FOR SUSTAINABLE URBAN WATER RESOURCES

Engr. Prof. Dr. Habib-Ur-Rehman,

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*Lahore*

**ABSTRACT:** The groundwater table in Lahore is rapidly declining due to the effects of increasing urban development and groundwater abstraction at unsustainable rates. The abstraction rate of groundwater in Lahore has increased to 1061 MGD (55.905 cumecs) in 2022 from 44.6 MGD (2.35 cumecs) in 1960. As managed aquifer recharge (MAR) has the potential to reduce this declining trend, two trial MAR schemes have been presented in this paper. First one is using four recharge wells was established at Junaid Jamshaid Stadium of UET Lahore. A flow meter and observation wells were installed for monitoring of groundwater recharge through the recharge wells and a numerical model was established to assess the effects of the recharge wells on depletion rates. Before the installation of recharge wells, the average depletion rate for groundwater was 0.87 m per year, of which the rate was - 0.074 m per was in summer season and 1.05 m per winter season. After installing the recharge wells, the model showed that the average depletion rate for groundwater was 0.72 m per winter season based on the 2-month data that showed the reduced depletion rate due to the installation of large diameter recharge wells. Then, scenario modelling was carried out using the same rainfall data for both the cases, i.e., without and with recharge wells. It was analysed that the depletion rate could be reduced by 16.45% and 39.24% by installing four and ten recharge wells, respectively. The study underlines the importance of groundwater recharge through large diametre recharge wells to reduce the depletion rate of Lahore's aquifer. Another MAR technique used was the infiltration galleries to accelerate the groundwater recharge. In order to complete the research, temporal distribution was plotted on ArcMap. HEC-HMS was used for the calculation of discharges which were verified with analytical methods. Groundwater model prepared on Visual MODFLOW was calibrated and validated. The results indicate that due to groundwater overexploitation water levels continue to decrease with the passage of time. The average simulated water table decline is 1.1 meter per year in the study area. So in order to overcome this crisis, infiltration galleries were proposed and designed in the study area. It was seen that these infiltration galleries allow recharging the groundwater at better rate. As the model results showed that depletion rate of

groundwater reduces and the groundwater level is about 0.3m higher when there are infiltration galleries. At the end a survey results about the working status of all recharging wells installed in Lahore are presented.

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**3rd IMCEET-2025/Keynote-010**

# PRESERVING OUR HERITAGE: SUSTAINABLE SOLUTIONS FOR RESTORING PAKISTAN'S HISTORIC LANDMARKS

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**ABSTRACT**: The preservation of historical heritage sites is a fundamental responsibility that bridges the past with the future. Pakistan, with its rich cultural history, is home to several heritage structures that stand as testaments to ancient engineering marvels. However, rapid urbanization, environmental factors, and neglect pose significant threats to these irreplaceable assets. This keynote address will explore contemporary civil engineering strategies for the restoration and preservation of national heritages, emphasizing the integration of traditional construction techniques with modern sustainable solutions. By analysing centuries-old architectural methods that have ensured the longevity of structures such as Mohenjo-Daro, Katas Raj Temple, and Rohtas Fort, we can extract valuable insights for modern restoration practices. The use of locally sourced materials, eco-friendly reinforcement techniques, and adaptive reuse strategies will be highlighted as essential components of sustainable preservation. This presentation aims to encourage the engineering community to take an active role in protecting Pakistan's architectural heritage, ensuring these treasures continue to tell their stories for generations to come. By combining historical insight with modern advancements, we can develop durable and sustainable restoration methodologies.

**Keywords:** Heritage Restoration, Traditional Construction Techniques, Structural Rehabilitation, Cultural Preservation, Eco-Friendly Materials.

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**3rd IMCEET-2025/Keynote-011**

# MIMO RELAY NETWORKS: A COST-EFFECTIVE SOLUTION IN A BANDWIDTH-HUNGRY WORLD

Prof. Dr. Abdul Sattar Saand*

*Chairman, Department of Electrical Engineering, QUEST Nawabshah*

**ABSTRACT:** In today's rapidly evolving digital landscape, the demand for high data rates and seamless connectivity continues to surge, leading to a growing scarcity of available bandwidth. Multiple-Input Multiple-Output (MIMO) relay networks present a promising solution to address these challenges. By combining the spatial multiplexing and diversity advantages of MIMO systems with the extended coverage and energy efficiency of relay networks, this technology offers a cost-effective and scalable approach to enhance spectral efficiency and network capacity. This speech explores the architecture, benefits, and implementation challenges of MIMO relay networks, positioning them as a viable solution in our bandwidth-hungry world.

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**3rd IMCEET-2025/Keynote-012**

# SYNCHROTRON-DRIVEN FRONTIERS IN MATERIALS SCIENCE

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**ABSTRACT:** We explore the growing role of synchrotron radiation in advancing materials science and engineering research, emphasizing the opportunities available to Pakistani scientists through SESAME (Synchrotron-light for Experimental Science and Applications in the Middle East). With its high brightness, tunable polarization, coherence, and nanosecond-scale pulse durations, synchrotron radiation enables precise, high-resolution investigations into the structural, chemical, and electronic properties of complex materials at the molecular and atomic levels. SESAME's advanced experimental capabilities are particularly relevant for studying engineering materials, tracking environmental pollutants, and analyzing biological macromolecules under near-native conditions.

Pakistan's active engagement with SESAME not only signals a commitment to international scientific collaboration but also strengthens regional partnerships. In this context, the University of Karachi's ongoing interuniversity collaboration with Turkish research institutions has become a valuable conduit for knowledge exchange, joint experimentation, and mobility of scholars, helping build a robust synchrotron user base within the region. These collaborative efforts promote scientific diplomacy while enabling practical applications in materials development, biotechnology, and sustainable technologies. Equally important is the foundational experience gained at MAX-lab in Sweden. Exposure to international standards in beamline operation, experimental design, and data analysis at a world-class synchrotron facility has significantly enhanced the technical expertise and scientific vision of participating researchers. This background continues to shape Pakistan's preparedness to fully utilize SESAME's potential and to contribute meaningfully to global research initiatives. Taken together, these regional collaborations and international experiences position Pakistan's scientific community to benefit substantially from synchrotron-based techniques. The paper advocates for the development of a structured, well-supported national framework to promote synchrotron research, build interdisciplinary capacity, and integrate Pakistan more deeply into the global network of advanced materials and engineering science.

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**3rd IMCEET-2025/Keynote-013**

# Agent AI: The Future of Autonomous Intelligence

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**ABSTRACT**: Digital safe spaces represent virtual sanctuaries aimed at fostering supportive and respectful environments for women encountering various forms of abuse, discrimination, or harassment in the online realm. These spaces serve not only as platforms for empowerment but also underscore the pivotal role of digital technologies in democratization efforts. By providing forums for women to address pressing issues, share narratives, and cultivate a sense of community, these safe spaces empower women and promote solidarity among them. However, the prevalence of online suppression and dismissal of women's voices underscores the importance of leveraging machine learning to enhance the detection and prevention of harmful content, support user engagement and moderation, and deliver personalized and empowering experiences for women. This talk will share and evaluate the roles of technology firms and governments in fostering the establishment and sustainability of secure digital environments. Recommendations will be proposed to enhance the efficacy of these spaces and address potential challenges, emphasizing the significance of collaborative efforts among online communities, technology developers, and advocacy groups. By shedding light on the evolving dynamics of gendered interactions in the digital sphere, this speech will provide valuable insights into how digital safe spaces can catalyze positive transformations. It offers guidance on leveraging technology to create safe and inclusive online environments for women in today's digital landscape.

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**3rd IMCEET-2025/Keynote-014**

# MULTIMODULAR CONVERTERS: A GAME-CHANGER IN MODERN POWER SYSTEMS

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**ABSTRACT:** Multimodular converters are emerging as a transformative technology in modern power systems, offering significant advantages in efficiency, flexibility, and reliability. Unlike traditional single-unit converters, multimodular systems consist of multiple coordinated modules that share the power conversion workload. This modular design enhances fault tolerance, allows for redundancy, and ensures continued operation even during partial failures—making them ideal for critical applications such as renewable energy integration, HVDC systems, electric vehicles, and smart grids. These converters enable advanced control strategies that optimize power flow, reduce losses, and improve power quality. Their scalability and adaptability make them well-suited to handle the dynamic demands of decentralized and renewable energy sources. Moreover, modularity simplifies system design, maintenance, and future upgrades, supporting seamless integration into existing infrastructure. As the global energy landscape shifts toward cleaner and more resilient grids, multimodular converters are playing a key role in enabling this transition. Ongoing advancements in semiconductor technology, digital control, and thermal management continue to boost their performance and cost-effectiveness. In summary, multimodular converters are redefining how power is managed and delivered, positioning themselves as a gamechanger in the evolution of efficient, reliable, and sustainable power systems.

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**3rd IMCEET-2025/Keynote-015**

# HARNESSING THE WIND: DESIGNING GENERATORS FOR COUNTER-ROTATING WIND TURBINE APPLICATION

Dr. Faisal Khan
*COMSATS University Islamabad, Abbottabad Campus, Pakistan*

**ABSTRACT:** Harnessing the Wind: Designing Generators for Counter-Rotating Wind Turbine ApplicationAcross the globe, wind turbines are essential for capturing renewable energy, cutting carbon emissions, and advancing sustainable electricity. A wind turbine with two sets of rotors produces twice as much power density as a single rotor wind turbine. Dual stator permanent magnet flux switching generators (DS-PMFSG) and dual rotor permanent magnet synchronous generator (DR-PMSG) are used in this context. However, the DS-PMFSG requires slip rings for power transmission since both the rotor and armature sections rotate. While DS-PMFSG offers reduced flux and low power density, these slip rings have the drawbacks of regular maintenance, poor speed regulation, greater cost, and additional slip ring losses. The DR-PMSG has been studied for use in wind turbines, but the literature indicated that because of its high rare earth permanent magnet consumption, it is not a good option for wind turbines. To overcome the demerits of DS-PMFSG and DR-PMSG as mentioned earlier, dual rotor counter-rotating permanent magnet flux switching generator and counter-rotating permanent magnet vernier machine are proposed for wind turbine applications that eliminate the requirements of slip rings and retain brushless operation. The validity of proposed design is verified with prototype of DS-PMFSG that validated finite element analysis (FEA) results. Comparing the suggested DRCR-PMFSG to rare-earth magnet machines, the utilization of ferrite magnets significantly lowers the total machine cost.

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**3rd IMCEET-2025/Keynote-016**

# EMERGING TRENDS IN THE INTEGRATION OF RENEWABLE ENERGY AND ELECTRIC VEHICLES INTO ELECTRICAL NETWORKS

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**ABSTRACT:** As the world transitions toward a more sustainable energy future, the integration of renewable energy sources and electric vehicles (EVs) into power networks is emerging as a critical focus. This keynote will explore the latest trends and technological advancements in the seamless integration of renewable energy, such as solar, wind, and hydrogen and other renewable sources, with EVs in modern power grids. The growing adoption of both renewables and electric vehicles offers significant potential to reduce carbon emissions, enhance energy efficiency, and create more resilient power networks. However, the increased penetration of these technologies presents challenges related to grid stability, energy storage, demand-response management, and system optimization. Emerging trends in smart grid technologies, advanced forecasting methods, and optimization techniques are being explored to address these challenges and enhance the performance of power systems. The integration of these technologies aims to create more efficient, flexible, and sustainable power networks capable of supporting the growing demand for clean energy and electric mobility.

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**3rd IMCEET-2025/Keynote-017**

# WIRELESS COMMUNICATION IN 2025: BEYOND 5G AND TOWARDS A HYPER-CONNECTED FUTURE

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**ABSTRACT**: As wireless communication advances rapidly toward 2025, the focus shifts beyond 5G into a future defined by 6G technologies, ubiquitous connectivity, and a hyper-connected digital ecosystem. This paper provides a strategic outlook on key innovations set to revolutionize wireless networks, including terahertz communication, AI-enhanced optimization, holographic beamforming, and the integration of satellite systems, drones, and next-gen Wi-Fi to deliver seamless global coverage. We explore the rise of the Internet of Everything (IoE), emphasizing the challenges in managing massive machine-type communication (mMTC) while ensuring energy efficiency, privacy, and security. The roles of edge computing and network slicing in enabling low-latency applications—such as autonomous systems, augmented reality, and smart industries—are examined in depth. Additionally, we offer insights into the emerging realm of quantum communication, highlighting its transformative potential for secure wireless systems. The discussion also addresses spectrum management, cybersecurity risks, and ethical implications in a globally connected society. This research aims to equip stakeholders with a forward-looking understanding of wireless communication's trajectory, offering a roadmap for innovation, societal impact, and sustainable development in the digital age.

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3rd IMCEET-2025/Keynote-018

# OPTIMIZING APPROACH OF WATER ALLOCATION AND CROP AREA DURING SHORTAGES IN IRRIGATION WATER SUPPLIES.

Dr. Muneer Ahmed Mangrio*

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*Department of Land and Water Management*
*Sindh Agriculture University Tandojam*

**ABSTRACT:** Climate change has been a big issue for all over the world and becoming a great challenge for developing countries. There is a wide imbalance between temperature, rainfall patterns, snow melting behavior and evapotranspiration, that leads to uncertain floods and droughts. Besides, drastic changes and impacts on other elements of life, its huge invasion is on agriculture in irrigated areas. This study was conducted in West Branch Canal of Jamroa canal at Mirpurkhas area. This paper covers some issues prevailing to management of irrigation canals and possible solutions to recover the damages of crop failure and economic loss caused by traditional strategies practiced in irrigated agriculture sector. A linear programing was used for water allocation and area under cultivation and economic returs. The Model 1 strategy which was crop need based canal operation, tested in the study area which resulted in saving of 30-35% of irrigation water. Under this option canal rotation was designed without suffering the critical stages of crops in situations where there is no shortage of water. The Model 2 strategy (option) was tested to supply off taking secondary canals in consideration to root growth depth and soil moisture constants in the field during reduced flows. This includes periodic supply availability at head of parent canal. Model 2 optimizes the sum of relative yields of all the crops and provides the irrigation levels of various crops for specified periods. This option seems very difficult and requires field moisture data frequently representing considerable area. The Model 3 strategy was to sacrifice cultivation of crops on reduced areas during water shortage. During reduced flows of 70, 60 and 50%, the optimal cropping intensity must be reduced to 14, 26 and 35% of major crops (Cotton, rice, sugarcane, wheat, fodder), and the emphasis is given to growing chilies, onion, tomato, lentil, and oilseeds crop to get maximum financial returns.

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3rd IMCEET-2025/Keynote-019

# MACHINE LEARNING AND DFT ASSISTED REVERSIBLE SOLID STATE HYDROGEN STORAGE: SOLVING TOMORROW'S CHALLENGES TODAY

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**ABSTRACT**: Current work is focused on safe, enhanced and reversible H2 storage by developing extrinsic 2D BeN4 NDC-SHSMs. Artificial Intelligence (AI) driven computational and experimentally validated generalized design principle will be realized to develop non-dissociative H2 storage on metal-doped, AEM atom/nanoparticle adsorbed BeN4 as an extrinsic NDC-SHSMs for enhanced and reversible H2 storage. We plan to use ML models (Random Forests & Gradient Boosting Machines) to optimize the experimental parameters for controlled synthesis of BeN4. Also, we intend to use generative adversarial networks (GAN) DL model to predict as-functionalized BeN4 having higher GHD and reversible H2 storage performance. For physico-chemical properties, dynamic and thermodynamic stability analysis, FPS-DFT, phonon and molecular dynamic (MD) calculations will be performed. Further, the reversible H2 storage behavior will be confirmed through transition state (TS) and MD investigations at requisite temperature (T) and pressure (P) conditions. As-functionalized BeN4 will be synthesized through CVD along with characterization through XRD, SEM, STM, XPS and Raman Spectroscopy techniques. To verify reversible H2 storage, experimental setup including H2 supply system, mass and pressure flow controller, H2 storage reactor filled with BeN4, vacuum pump and heating system will be developed. Main objective of this work is to achieve GHD ≥ 6.5 wt% and reversible H2 storage at 3-30 atm pressure and 298-373 K temperature range.

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**3rd IMCEET-2025/Author-001**

# FEASIBILITY STUDIES OF SOLID WASTE MANAGEMENT TO ELECTRIC ENERGY POTENTIAL IN PAKISTAN-A CASE STUDY OF GUJRANWALA CITY

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**ABSTRACT:** Solid waste production is rising in emerging nations like Pakistan as a result of accelerated urbanization and economic expansion. Regulating organizations are having trouble properly designing the treatment of solid waste systems in large cities due to the shortage of financial resources and information about the quantity and makeup of solid waste. Additionally, the development as well as classification of solid waste are crucial factors that influence the environmental sustainability. This study's objective is to compile data on the amount of waste produced in Pakistan's Gujranwala city and its makeup. The government can use the study's findings to create an efficient waste management framework for the nation's rapidly growing cities.

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**3rd IMCEET-2025/Author-002**

# EFFECT OF MARBLE DUST AND NYLON FIBER ON PROPERTIES OF CONCRETE

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**ABSTRACT:** The manufacturing of cement emits carbon dioxide and other harmful gases in the atmosphere due to which acid rain occurs and the environment is badly affected. The concrete is strong in compression and weak in tension. To decrease the CO2 emission and other harmful gases cement is partially replaced with marble dust and to improve the tensile strength of concrete nylon fibers are used in this research. The cement is replaced by marble dust powder as 5, 10,15, and 20% by the weight of cement and nylon fiber is added as 0.5, 1 and 1.5% by the wight of mass. One control mix and eleven modified mixes with marble dust and nylon fibers. 48 cubes are prepared to check the compressive strength of concrete while 48 cylinders were prepared to determine the tensile strength of concrete. The average of 4 specimens were recorded for the analysis of results of each mixture. The effect of marble dust on workability, compressive strength and tensile strength was investigated. It was observed that with the increase quantity of marble dust and nylon fiber the workability is decreased.

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**3rd IMCEET-2025/Author-003**

# CHARACTERIZATION OF CONVOLUTIONAL NEURAL NETWORK ALGORITHM INTO THE MAHALANOBIS TAGUCHI SYSTEM FOR THE RECOGNITION OF DATE FRUIT HARVESTING

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**ABSTRACT:** In the modern era of smart agricultural practices, precise prediction of date fruit harvesting is significant to enhance yield quality, minimize post-harvesting losses, & optimize resource utilization. This study integrates the Mahalanobis Taguchi System (MTS) with the Convolutional Neural Network algorithm to develop a robust predictive model for date fruit harvesting. The Mahalanobis Taguchi System is known for its efficiency in a high dimensional data analysis that is to be utilized to identify the critical features influencing fruit maturity. The Convolutional Neural Network Algorithm is an Image Recognition algorithm that further refines the prediction model by its ability to handle nonlinear relationships of different variables and complex data patterns. The suggested approach is being validated using a diverse dataset encompassing different environmental, phonological & biochemical parameters. Results demonstrate a superior accuracy and reliability in predicting optimal harvesting periods compared to traditional methods. This hybrid technology & methodology gives a scalable and intelligent solution for the precision in agriculture field, contributing significantly to sustainable farming practices and enhancing decision-making in the agricultural supply chain process.

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**3rd IMCEET-2025/Author-004**

# INFLUENCE OF MEMBRANE MORPHOLOGY ON HEAT AND MASS TRANSFER DYNAMICS IN MEMBRANE DISTILLATION

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**ABSTRACT:** Membrane distillation (MD) is a promising technology for water purification, desalination, and industrial wastewater treatment due to its ability to operate at low temperatures and pressures. The performance of MD systems is significantly influenced by the morphology of the membrane, which affects both heat and mass transfer processes. This study investigates the impact of membrane morphology, including pore size, porosity, thickness, and surface roughness, on the efficiency of MD systems. Advanced fabrication techniques, such as multi-step phase inversion and the incorporation of nanomaterials like carbon nanotubes and graphene oxide, were employed to develop membranes with optimized structures. Experimental evaluations, combined with computational fluid dynamics (CFD) simulations, revealed that gradient porous membranes achieved the highest vapor flux and thermal efficiency due to enhanced mass transfer pathways and reduced thermal resistance. Moreover, membranes integrated with conductive additives demonstrated lower energy consumption, highlighting the potential of tailored membrane designs to improve the overall sustainability of MD processes. The findings of this study provide insights into the design and development of next-generation membranes with superior heat and mass transfer characteristics, offering practical guidelines for enhancing the performance of MD systems in various applications.

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**3rd IMCEET-2025/Author-05**

# INCORPORATING SOCIETY 5.0 INTO THE CONSTRUCTION OF RESILIENT CITIES AND ITS FUNCTION IN ATTAINING SUSTAINABLE DEVELOPMENT GOALS

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**ABSTRACT:** The adoption of Society 5.0 concepts within urban development initiatives enables the creation of sustainable cities that uphold the United Nations Sustainable Development Goals. The Society 5.0 works to create a human-oriented society using advanced technologies including artificial intelligence along with Internet of Things and large data frameworks to tackle complex social challenges. These technologies deployed throughout cities in infrastructure and governance platforms enable cities to build resistance against natural disasters in addition to climate change effects and socio-economic disturbances. This research explores Society 5.0's contributions to sustainable urban development by focusing on resource optimization and public utility equality and community improvements. The main areas of attention involve predictive analysis for disaster management and smart grid optimization with digital platforms that support full societal inclusion. The implementation of Society 5.0 concepts matches all criteria outlined in SDG objectives 11 (Sustainable Cities and Communities), 9 (Industry, Innovation, and Infrastructure), and 13 (Climate Action). Through an analysis of case studies and emerging technologies, this paper outlines practical strategies for policymakers, urban planners, and stakeholders to facilitate the transition to resilient, technology-driven cities. The integration of Society 5.0 into urban development is presented as a critical pathway for addressing modern challenges while paving the way for a sustainable and inclusive future.

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**3rd IMCEET-2025/Author-006**

# ENHANCED MECHANICAL PROPERTIES OF TEXTILE FIBRE REINFORCED MORTAR USING COAL BOTTOM ASH AND MARBLE DUST

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**ABSTRACT:** The increasing generation of textile waste poses a significant environmental issue, particularly in terms of disposal. Concurrently, the accumulation of Coal Bottom Ash (CBA) and Marble Dust (MD) from electric power generation and stone quarrying presents another waste disposal challenge. This study evaluates the potential of utilizing waste textile fibres, CBA, and MD as reinforcement and supplementary cementing materials in mortar. The density, water absorption, and, mechanical properties such as compressive strength, splitting tensile strength, elastic modulus, and flexural strength were evaluated at 28 days of curing. The findings demonstrated that incorporating CBA and MD in textile fibre-reinforced mortar showed approximately 12%, 6%, 9%, and 17% significant enhancements in the compressive strength, elastic modulus, splitting tensile strength, and flexural strength respectively. The increase in mechanical properties is due to the pozzolanic reaction of CBA with the cement paste, filling the voids and improving the interfacial bond between the fibres and the matrix. Additionally, the fine particles of MD improve the packing density of the mortar, leading to increased strength and stiffness. Finally, empirical equations were proposed to correlate the splitting tensile strength, modulus of elasticity, and flexural strength of textile fibre-reinforced mortar with CBA and MD.

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**3rd IMCEET-2025/Author-07**

# DESIGN ANALYSIS OF PERMANENT MAGNET FLUX SWITCHING MOTOR USING FEA FOR ELECTRIC FAN

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**ABSTRACT:** Permanent Magnet Flux Switching Motors (PMFSMs) have gained attention as an alternative to traditional Field Excitation Flux Switching Motors (FEFSMs) for electric fan applications due to their high efficiency, simplified structure, and robust performance. In this context, PMFSMs eliminate the need for external field excitation, a key characteristic of FEFSMs, by utilizing permanent magnets to generate the rotor flux. This makes PMFSMs inherently more energy- efficient as they do not rely on field winding or external excitation sources, reducing losses and improving overall efficiency. Additionally, the absence of brushes and the simplicity in design lead to a reduction in maintenance requirements and enhanced reliability over time. The design and operational features of PMFSMs make them suitable for fan applications, where energy efficiency and reliability are crucial. PMFSMs offer a more compact and lighter design compared to FEFSM, providing significant weight reduction, which is advantageous in applications where space and weight are key factors. Furthermore, the ability to control speed and torque effectively within PMFSMs results in precise performance, a key requirement for electrical fan systems that often operate under variable load conditions. In comparison to FEFSMs, which require complex field excitation control, PMFSMs provide a more straightforward control strategy, simplifying system architecture and improving system cost-effectiveness. The paper explores the comparative advantages of PMFSMs over FEFSMs, focusing on key aspects such as power density, reliability, operational cost, and maintenance using FEA. In conclusion, replacing FEFSMs with PMFSMs in electrical fan applications offers significant benefits, including higher efficiency, lower maintenance, and reduced system complexity, positioning PMFSMs as a promising solution for future fan systems in various industries.

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**3rd IMCEET-2025/Author-008**

# FABRIC DEFECT DETECTION IN TEXTILES: A SYSTEMATIC REVIEW OF METHODS AND TECHNIQUES

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**ABSTRACT:** Detecting fabric defects remains essential for textile quality control since it makes both manufacturing more productive and precise while enabling early raw fabric defect identification. Human inspection methods consume too much time and generate multiple mistakes leading to poor results when examining large textile productions. This research evaluates numerous techniques that aim to eliminate the current detection problems. The research evaluates the ability of machine vision systems together with image processing approaches and Convolutional Neural Networks (CNNs) to strengthen defect recognition processes. The evaluation of these methods demonstrates which method provides superior accuracy as well as efficiency results. The fast evolution of automation technologies makes its use in textile manufacturing more important than ever before. This research paper delivers essential knowledge to both researchers in addition to professionals in the industry who want to boost quality control operations while developing better fabric inspection methods.

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**3rd IMCEET-2025/Author-009**

# ARDUINO-CONTROLLED SOLAR PARABOLIC DISH WITH AUTOMATIC SUN TRACKING SYSTEM

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**ABSTRACT:** This paper demonstrates the designing parameters of a solar parabolic dish model for rural areas where the sun irradiance rate is very high, and there is no access of electricity facilities. The solar parabolic dish prototype aims a solution for this of remedies and follows sun light to work. The parabolic dish has a polished surface, the solar radiations fall on the surface of dish and collected at a single focused central point. At this point, the collected form of energy is used for diverse thermal applications such as cooking, heating and to produce electricity using solar panels with single and double axis patterns. This paper discusses the significant stages of double axis solar parabolic dish, solar location approach, the analysis in terms of theory, structural design & material. The double axis prototype is executed through the help of Arduino chipboard that is easy to maintenance, also the prototype is configured with anti-lock H-bridge module to overcome the control circuit complexity and AVR modules. Two rotational motors of 12V are installed on 4ft designed aluminum frame with a double axis tracking system. The jerks among trackers will be reduced with this prototype which sustains the experimental declination angle. To conclude, this paper results that parabolic solar dish tracker obtains improved power efficiency in comparison of photovoltaic panel tracker.

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**3rd IMCEET-2025/Author-0010**

# REVOLUTIONIZING DEMAND RESPONSE: A BLOCKCHAIN-BASED APPROACH

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**ABSTRACT:** The electric power industry has started to undergo significant change in the past ten years. The existing electrical grid structure has undergone numerous alterations as a result of the development of smart grids (SGs). The use of electric vehicles (EVs), renewable energy sources, modern devices, and technology raises the demand for decentralized secure, and cost-effective energy management and data transactions. The current smart grid (SG) system must employ effective demand response management (DRM) methods in light of the growing demand for electricity as it is an essential requirement for managing consumers' energy demands. Blockchain technology has become a potent instrument for handling complexity in the digital world throughout that time. In this article, the integration of renewable energy sources and how they interact with blockchain technology are examined, confirming that blockchain technology is a viable means of handling the continuously increasing quantum of renewables. Decentralized energy management with a special focus on demand response (DR) of the energy network is enabled through blockchain technology while making effective utilization of smart contracts.

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**3rd IMCEET-2025/Author-011**

# A REVIEW ON DIFFERENT STRUCTURAL ANALYSIS AND DESIGN METHODS FOR HIGH-RISE IRREGULAR BUILDINGS

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**ABSTRACT:** High-rise irregular reinforced concrete (RCC) buildings poses significant challenges in structural analysis and design due to their complex geometries, varying load paths, and dynamic behavior under lateral forces. Irregularities in plan and elevation, such as setbacks, torsional effects, and mass irregularities, impact structural performance and require specialized analysis techniques. Traditional methods like the Equivalent Static Method and Response Spectrum Analysis often fall short, necessitating advanced approaches. This paper provides a comprehensive review of different structural analysis and design methods employed to address these challenges. It explores traditional approaches, such as the linear static and dynamic, as well as advanced techniques like nonlinear analysis (time-history analysis, pushover analysis). It involves rigorous review of high quality journal articles with high citations and latest journal articles are reviewed. It compares various structural analysis and design methods, focusing on their pros and cons, Findings indicate that nonlinear analysis is crucial for capturing material and geometric nonlinearities, ensuring accurate seismic response predictions. Performance-Based Design is preferred for complex irregular structures due to its tailored approach under extreme conditions, despite requiring advanced expertise. The study highlights the need for further research to refine these methods for better seismic resilience and economic efficiency.

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**3rd IMCEET-2025/Author-012**

# STRENGTH REGAIN OF DAMAGED BENDABLE COMPOSITE WITH CARBON FIBRE REINFORCED POLYMER SHEETS

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**ABSTRACT:** ngineered Cementitious Composites (ECC), known for their ductility and fine crack behavior, are increasingly used in small structural elements such as beamlets. However, these elements can suffer localized damage under excessive loading, requiring effective strengthening techniques. This study evaluates the strength regain of post-cracked ECC beamlets using externally bonded carbon fiber reinforced polymer (CFRP) sheets. Three beamlets were cast, pre-cracked under controlled conditions, and then rehabilitated using CFRP sheets applied with epoxy adhesive. Flexural and tensile tests were conducted to measure recovery, supported by failure mode and bond performance analysis. Results showed that flexural strength regained approximately 70%, while tensile strength recovered around 65% of the original capacity. CFRP reinforcement improved load distribution and delayed failure, confirming its potential as a practical and efficient method for localized repair in ECC components used in prefabricated elements and seismic applications.

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**3rd IMCEET-2025/Author-013**

# SYNTHESIS OF ACTIVATED CARBON FROM AGRO-INDUSTRIAL AND ITS UTILIZATION IN TEXTILE WASTEWATER TREATMENT

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**ABSTRACT:** The textile industry generates significant amounts of wastewater laden with pollutants such as COD, BOD, TDS, and colorants, posing severe environmental and public health risks. Existing treatment technologies often fall short in terms of cost-effectiveness and efficiency. This study explores the synthesis of activated carbon from agro-industrial wastes (sugarcane bagasse, coconut shells, and waste tires) and its application in textile wastewater treatment. Through meticulous experimentation, we harnessed the potential of both non-pyrolized and pyrolized activated carbon variants. Our findings illuminate a remarkable contrast: non-pyrolized activated carbon displayed impressive pollutant removal capabilities—bagasse (30%), coconut (40%), waste tires (48%)—while the pyrolized counterparts showcased even more remarkable efficiency—bagasse (50%), coconut (65%), waste tires (80%).. As we reflect on these outcomes, the question of superiority emerges. The results underscore the robust capabilities of pyrolized activated carbon, particularly derived from waste tires. This material demonstrated unparalleled effectiveness, marking a significant stride towards greener textile wastewater treatment practices

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**3rd IMCEET-2025/Author-014**

# DESIGN AND DEVELOPMENT OF ACCESSIBLE AND SUSTAINABLE MEASUREMENT SYSTEMS: THE POWER OF 3D PRINTING TECHNOLOGY

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**ABSTRACT:** 3D printing technology has immense potential to revolutionize various fields, particularly bio-signal measurement systems. This work focused on the design and development of key measurement systems using 3D printing technology and sustainable approaches, emphasizing their accessibility and precision. This work reports a 3D-printed, cost-effective multimodal Raman probe designed for high signal-to-noise ratio Raman scattering measurements. Our Raman instrument concurrently captures both Raman signals and image data. The setup has demonstrated effective analyte detection with high signal-to-noise ratios, achieved through meticulous hardware design and signal processing. Its modular design, enabled by 3D printing, allows for adaptability to diverse research needs. We demonstrate the fabrication process, where 3D printing is used to produce essential components, resulting in a fully functional Raman probe system. Comparative assessments with commercial Raman instruments confirm that our custom-designed device rivals its expensive counterparts in performance, accuracy, and reliability. This modular system removes financial barriers to Raman scattering measurements, expanding its applications to resource-limited environments and educational settings. This report also provides an overview of various sensors that we have designed and developed. Including Integrating sphere, EEG, humidity, pH, and gas sensors, developed using sustainable chitosan-based materials and 3d printing technology. These innovations further highlight the integration of sustainability and advanced technology in creating accessible and effective measurement solutions for a broad spectrum of applications.

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**3rd IMCEET-2025/Author-015**

# MICROSTRUCTURE AND COMPRESSIVE BEHAVIOR OF RECYCLED POLYPROPYLENE FOR SUSTAINABLE CONSTRUCTION APPLICATIONS

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**ABSTRACT:** The increasing demand for sustainable construction materials has driven interest in recycled plastics as viable alternatives to conventional materials. This study presents analysis of the compressive strength and failure behavior of recycled polypropylene (rPP) for potential use in civil engineering applications. Specimens were prepared in a single screw mechanical extruder. Compressive tests were conducted as per ASTM standard D695-23 on the material to evaluate its mechanical performance. Stress strain curve was analyzed, and Scanning Electron Microscopy (SEM) was utilized to examine the microstructural characteristics and failure mechanism. The results indicate that rPP exhibits encouraging compressive strength. Conversely, rPP demonstrates a less ductile failure mode, with visible cracks and surface irregularities influencing its mechanical behavior. The findings suggest that rPP shows encouraging results for structural applications. The rPP can be utilized in load bearing units where ductility is not a primary requirement. This study contributes to the advancement of sustainable material utilization in construction by assessing the feasibility of recycled plastics in civil engineering construction applications.

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**3rd IMCEET-2025/Author-016**

# ASSESSMENT OF CROP WATER REQUIREMENT AND IRRIGATION SCHEDULE FOR SESAME USING THE FAO-CROPWAT MODEL

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**ABSTRACT:** Agriculture is considered the backbone of Pakistan's economy, which relies heavily on its major crops, fruits and vegetables. A field experiment conducted to estimate the crop water requirement of sesame crop by using CROPWAT 8.0 model in climate condition of arid to semi-arid climate. The study sire was located at the experimental station of Sindh Agriculture University, Tandojam. The research study was based on RCBD which comprising 2-treatments for CROPWAT 8.0 model and traditional irrigation practice with 3 replications, respectively. The sesame seed variety traditional was sowing on 8 August 2024 with hand drill row method. Plant to plant as well as row to row spacing was practiced as per recommendation of OFWM-2005. This data were used for the calculation of reference evapotranspi¬ration using modified Penman-Monteith equation in CROPWAT 8.0 model. The soil samples were collected at depths of 0 to 100 cm from three different locations for analysis soil physical and chemical properties. The experimental site was visited on daily basis. The total volume of water applied to the sesame crop under traditional irrigation scheduling plot and CROPWAT 8.0 irrigation scheduling method was 6000 $m^3$/ha and 6036 $m^3$/ha, respectively. Plant height of sesame affected due to different irrigation scheduling methods, and other plant growth parameters were also affected among the treatments. Increase in yield of sesame crop and water use efficiency under CROPWAT 8.0 irrigation scheduling over traditional irrigation scheduling plot was 15 % and 9.5 %, respectively. The findings of this study encourage the farming community to implement CROPWAT-based irrigation scheduling, as it not only enhances crop yields but also utilizes a straightforward software tool to determine the required water depth efficiently.

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**3rd IMCEET-2025/Author-017**

# AN OVERVIEW OF SYNERGIES AND DIFFERENCES OF CIRCULAR ECONOMY WITH SUSTAINABILITY, LEAN CONSTRUCTION AND ZERO WASTE MANAGEMENT APPROACHES FOR MINIMIZATION OF MATERIAL WASTE

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**ABSTRACT:** The construction industry is growing day by day due to the immense need for infrastructure and development projects. At the same time, it is generating millions of tons of waste during the execution of these projects. In this regard, a number of approaches have been used to reach out to the goal of waste minimization, such as lean construction (LC), sustainable construction (SC), zero waste management (ZWM), and circular economy (CE). Each of these approaches has its own scope and limitations, which have been reported in past studies. Thus, the goal of the current research is to outline the similarities and differences among these approaches. So, a comprehensive literature review was conducted where different articles from the last decade were consulted. It is found that there are positive synergies between CE and LC, such as value addition and waste minimization. But the difference is that LC does not define the waste in physical terms only, such as material waste, but it also covers all those activities that are extra in terms of time, cost, quality, and environment. But on the other hand, CE purely focuses on optimum utilization of material. Further, CE covers the two major dimensions of sustainability (economic and environmental) by conserving the natural resources. Social well-being is normally missed in CE. At last, ZWM mainly supports the goals of CE, such as reduction in waste and conserving materials through optimum use of resources. So, it can be established that all of these approaches for waste control are linked with each other one way or another. However, CE is a better approach to controlling material waste on construction sites due to its good compatibility with construction processes.

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**3rd IMCEET-2025/Author-018**

# CHALLENGES IN INTEGRATING TRADITIONAL AND MODERN WATER MANAGEMENT PRACTICES IN PAKISTAN: A SOCIO-TECHNICAL PERSPECTIVE

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**ABSTRACT:** Pakistan faces critical challenges as water scarcity due to conventional methods used for water resource management. Integrating traditional and modern water management practices is fundamental for mitigating the challenges of water shortage in Pakistan. However, this integration experiences prominent socio-cultural, and technological constraints. This study investigates socio-technical hindrances in integrating traditional and modern water management practices by reviewing existing literature and case studies related to Pakistan. The conclusion reveals that resistance from the community, lack of institutional coordination, lack of resilience in technology adaptation, infrastructural limitations, and requirement of a high budget for implementation of integration are major challenges. The study concludes with suggestions for decentralized governance, designing integrative policy models, a participatory governing mechanism aligning with local socio-economic conditions, and resilient technologies to overcome the gap between traditional and modern water management practices in Pakistan.

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**3rd IMCEET-2025/Author-019**

# PREDICTION OF PM2.5 IN LAHORE AND KARACHI USING ARTIFICIAL NEURAL NETWORKS (ANN): ANALYZING METEOROLOGICAL PARAMETERS

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**ABSTRACT:** Outdoor Air pollution is a major environmental issue among all the Asian regions especially becoming dangerous in places like Lahore and Karachi in Pakistan. The alarming and hazardous issue of air pollution has received less attention than it deserves in these cities. Particulate matter of a diameter of 2.5 μm (PM2.5) sets up a serious environmental health. Serious respiratory and cardiovascular health risks resulted from PM2.5 concentrations in these cities that were up to ten times higher than the annual recommendations set by the World Health Organization (WHO). The main purpose of this study is to predict the concentration of PM2.5 in Lahore and Karachi using meteorological factors that include Temperature, dew point, relative humidity, wind speed, and wind direction. The WEKA Artificial Neural Network (ANN) model was developed to estimate PM2.5 levels using data from 01/2024 to 01/2025, to detect pollution trends associated with higher health risks. The model involves input of independent variables along with hidden layers 1-10 and one output lying of PM2.5. The model allotted into training and testing sets with a 70:30 ratio. The model's performances were calculated using various metrics, including Mean Absolute Percentage Error (MAPE) with the errors being under 10% on average. The findings of this study could be highly valued by policymakers, supporting them in estimating air quality and applying public health involvement in these cities.

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3rd IMCEET-2025/Author-020

# PYROLYSIS AND CO-PYROLYSIS OF WATER HYACINTH AND EGGSHELL FOR AGRONOMIC PURPOSE BIOCHAR

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**ABSTRACT:** Modern society faces population growth, technical development, food production, and trash accumulation, requiring recycling and energy-based waste disposal for environmental sustainability. This study explores the pyrolysis and co-pyrolysis of water hyacinth (WH) and eggshell (ES) to produce biochar for agronomic purposes. A 10 kg of WH was collected from ponds and drainage channels near industrial areas in Kotri, District of Jamshoro. A 1.5 kg of ES were collected from the Sindh Agriculture University's hostel canteens. The biomass samples were sun-dried, chopped, and oven-dried at 105°C before pyrolysis. The five treatments, ES, ES+WH (1:1), ES+WH (2:1), ES+WH (1:2), and WH, were decided for pyrolysis. The biomass was pyrolyzed at 600oC for 1 hour in an electric furnace to produce biochar. A silicon packen was fixed between the surface of the reactor and its cover to create an airtight internal environment. Nitrogen gas was supplied at 0.5 liters per minute for 20 minutes and 0.1 liters per minute for one hour. After one hour, the reactor was rapidly cooled to below 100oC, and the biochar was taken out and stored in sample bags for testing. The characteristics of biochar, such as pH and electrical conductivity, were analyzed in 1:20 biochar to distilled water suspension and water holding capacity was determined gravimetrically. Plant nutrients (K, P and Na) content was tested using a spectrophotometer and flame photometer with standard protocols. Results revealed different yields of biochar obtained with pyrolysis and co-pyrolysis of water hyacinth and eggshell. The eggshell produced a higher yield of biochar than water hyacinth biochar. The treatments of water hyacinth and eggshell biomass utilized also had an impact on the fundamental characteristics of the biochar, including pH, EC, WHC, and ash content. The nature of various biochars was alkaline; WH biochar had a maximum water-holding capacity of 9.93 g/g. The biochars were also rich in some plant nutrients, with maximum K contents of 434 ppm and P contents of 270 ppm, respectively, in the water hyacinth biochar. Our results demonstrate that WH biomass can be used for biochar production and the quality of WH biochar can be enhanced by its copyrolysis with eggshell.

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**3rd IMCEET-2025/Author-021**

# ASSESSMENT OF SAFETY VALVE FOR THE HIGH PRESSURE BOILER USING FAILURE MODE AND EFFECTS ANALYSIS (FMEA) TECHNIQUES

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**ABSTRACT:** Failure mode and effect analysis (FMEA) is a reliability technique that describes how equipment can deviate from its intended functions within a specified period under stated environmental conditions. FMEA is a tool to identify the root cause of failures and assesses the components risk priority number (RPN). This study is conducted on safety valve for the High Pressure (H.P) Boiler which is used to raise edible oil temperatures from 205±5˚C to 245±5˚C. However, H.P Boiler control parameters are configured in such a way that the H.P Boiler burner will be cut off at 55±2 bars. If the H.P. Boiler does not put off the burner to the required set value of 55±2, and the H.P. Boiler steam pressure reaches up to 65 bar and the contact manometer could not switch off the H.P Boiler burner at set pressure 65 bar. P Boiler continues to raise steam pressure, an approximately, up to 90 bar. Ultimately the safety valve will operate at 90 bar and release excessive pressure from the H.P Boiler. If safety valve does not operate at set pressure. Then, it may cause a hazard. Hence, FMEA is a reliability technique through which organizations could benefit by frequently reducing potential errors of safety value for the H.P Boiler. This study identifies Severity (S), Occurrence (O) and Detection (D) to find out RPN for the safety valve of the H.P. Boiler. Hence, the highest RPN component is the most critical part of the safety valve for the H.P. Boiler to save an organization from hazards.

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**3rd IMCEET-2025/Author-022**

# VALIDATING THE COMPRESSIVE STRENGTH OF CALCINED CLAY CONCRETE USING MACHINE LEARNING

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**ABSTRACT:** This study explores the application of various machine learning models to predict the compressive strength of concrete, focusing on the impact of features such as calcined clay and the water-cement ratio. Through Exploratory Data Analysis (EDA), we observed a strong positive correlation between calcined clay and compressive strength, indicating that higher levels of calcined clay enhance the concrete's strength. In contrast, the water-cement ratio exhibited a strong negative correlation, suggesting that an increased ratio adversely affects compressive strength. To further validate these observations, we applied several regression models—Linear Regression, Ridge Regression, Lasso Regression, and Elastic Net Regression—to assess their efficacy in predicting compressive strength. The analysis of feature coefficients revealed that the Lasso model produced the smallest coefficient values, demonstrating its effectiveness in minimizing model complexity and reducing prediction errors. This finding underscores Lasso's capacity to better handle feature selection and regularization compared to other models, especially in mitigating the negative influence of the water-cement ratio. Moreover, common regression metrics such as Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), and R-squared were used to evaluate and compare model performance. While all models showed similar performance levels, Linear Regression slightly outperformed the others in terms of R-squared, indicating a marginally superior fit to the data. The results of this study illustrate the robust capability of machine learning techniques in predicting concrete's compressive strength, with a particular emphasis on the significant role of key features and the comparative effectiveness of different regression approaches.

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**3rd IMCEET-2025/Author-023**

# IOT BASED ELECTRIC MOTOR HEALTH MONTORING SYSTEM

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**ABSTRACT:** An IoT-based system for real-time health monitoring of electric motors, crucial components in industrial automation. Unscheduled downtime due to motor failures leads to significant production losses and increased maintenance costs. This system addresses this challenge by continuously collecting critical motor parameters using sensors, including vibration, temperature, and current. It can be measured through the sensors, like accelerometer, current sensor and thermocouple. The signals of these sensors are sent to the webserver through Wi-Fi module where it can be accessible to the receiver in any part of the globe where the internet is available. To avoid the limitation of the internet, the signals of these sensors were also sent to the receiver through global system for mobile (GSM) because it can also work in the areas where the internet is not available. The cloud platform employs machine learning algorithms to detect anomalies and predict potential failures based on historical and real-time data. These algorithms analyze patterns in the sensor data to identify deviations from normal operating conditions, indicating early signs of degradation or malfunction. The system provides a user-friendly interface for visualizing motor health status, displaying real-time data, and generating alerts for abnormal conditions. The system facilitates predictive maintenance by estimating the remaining useful life of the motor, allowing for proactive scheduling of maintenance activities and minimizing unplanned downtime. By leveraging IoT and machine learning, this system enhances the reliability and efficiency of electric motor operations, contributing to improved productivity and reduced operational costs in industrial settings.

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**3rd IMCEET-2025/Author-024**

# EFFICIENCY ENHANCEMENT OF WIRELESS CHARGING SYSTEM FOR ELECTRIC VEHICLES

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**ABSTRACT:** Currently air pollution is a serious issue. The major causes of CO2 emissions are Power Generation and Transportation. As the world is diverting towards renewable energy Technology for electricity production, similarity, The electrical vehicle is also getting more attention due to its clean and green transportation concepts. The main issue in EV technology is range anxiety and improvement in the battery charging system. The wireless charging method is also getting a promising future for electric vehicles. The increasing Electric Vehicle(EV) market is driven by the desire for more efficient, the electricity cost and reliable approaches to recharge EV batteries. As there are various charging methodologies for EVs, but Wireless Power Transfer (WPT) has get more attention in now days due to its features such as safety, comfort, low maintenance, automated operation and reliability. In this research paper we presents advancements in the efficiency of wireless charging systems for EVs through the optimization of coil alignment, enhancement of the coupling coefficient between transmitting and receiving coils and the implementation of measures to prevent interference from external objects. Precise alignment of transmitter and receiver coils is essential for maximizing power transfer efficiency in wireless charging systems. Misalignment can significantly reduce the coupling coefficient, leading to decrease system efficiency. The coupling coefficient is dimensionless parameter that represents the percentage of magnetic flux through the transmitter coil that passes through the receiver coil, it is influenced by the factors such as coil geometry, distance between coils and alignment, a higher coupling coefficient indicates more efficient power transfer. The presence of external objects can interfere with the magnetic field the coils, leading to reduced efficiency. Implementing measures to detect and prevent such interferences is crucial for the reliable and safe operation of wireless EV charging system. These advancements contribute to the development of more efficient, reliable and user friendly wireless charging solutions for electric vehicles, addressing key challenges in coil alignment, coupling efficiency and external objects interferences. This study will be beneficial for the improvement in vehicle charging systems with less time and high efficiency.

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3rd IMCEET-2025/Author-025

# ASSESSMENT OF SAFETY VALVE FOR THE HIGH PRESSURE BOILER USING FAILURE MODE AND EFFECTS ANALYSIS (FMEA) TECHNIQUES

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**ABSTRACT:** The study employs a three-point stability method, overload ratio calculations, and hydraulic stability assessments to ensure the safety and efficiency of transport operations. The stability and safety of Self-Propelled Modular Transporters (SPMTs) play a critical role in the transportation of heavy cargo across various industries, including shipbuilding, aerospace, and offshore renewable energy. This study evaluates the stability of an SPMT system transporting a 320-ton load through a comprehensive assessment using the three-point stability method, overload ratio calculations, and hydraulic stability analysis. The results indicate that the longitudinal overloading angle of 43.58° significantly exceeds the recommended limit, posing a high risk of forward tipping, while the transversal overloading angle of 11.52° suggests lateral instability concerns. However, hydraulic stability assessments reveal that the system remains within acceptable bounds, with longitudinal hydraulic stability at 27.07° and transversal hydraulic stability at 12.37°, highlighting the effectiveness of hydraulic adjustments in mitigating load imbalance risks. The findings underscore the need for dynamic load monitoring, optimized axle configurations, and structural reinforcements to enhance SPMT performance and ensure safe operations in challenging environments. This study contributes to SPMT operational strategies, particularly in offshore transport applications where stability and precision are paramount.

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**3rd IMCEET-2025/Author-026**

# IOT BASED WATER QUALITY MONITORING SYSTEMS

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**ABSTRACT:** A pressing need for effective monitoring systems to ensure safe drinking water. This research proposes an IoT-based solution utilizing the microcontroller to monitor and analyze the quality of drinking water in real-time. It is the very Low-cost systems. The system incorporates various sensors to measure parameters such as total dissolved solids (TDS), temperature, turbidity etc. By providing a cost-effective, scalable, and user-friendly solution, this project aims to contribute to the enhancement of public health and safety through continuous monitoring of drinking water quality. The advantages like real-time data, early detection of issues, and cost savings through optimized usage and leak detection. Overall, the proposed system represents a significant step forward in leveraging IoT technology for addressing water quality challenges, contributing to the preservation of aquatic ecosystems and ensuring access to clean and safe drinking water for communities worldwide.

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**3rd IMCEET-2025/Author-027**

# AXIAL TENSILE STRENGTH OF RECYCLED PLASTIC REBAR-STEEL NUT CONNECTION FOR APPLICATION IN MORTAR-FREE CONSTRUCTION

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**ABSTRACT:** Use of recycled plastic in the construction industry has gained wide attention. However, its use as an exclusive material for products lack investigations at multiple fronts. With the emergence of mortar-free construction, the connection of mortar-free reinforced masonry walls with adjoining elements becomes critical due to complexity. Keeping in view these challenges, this study explores the axial tensile strength of recycled high-density polyethylene (HDPE) plastic rebar connection with steel nut for application in wall-roof connections. This will be accomplished by testing two mechanisms categorized as nut fastened over threaded recycled HDPE rebar and nut fastened over pin-bearing steel connector. Both configurations were tested as per ASTM F606/F606M – 19. The axial stress strain behavior will be obtained and pull-out strength between threads and nut will be determined. Additionally, the failure mechanism and surfaces will be analyzed. The outcome of this study will help understanding the strength characteristics in relation to complexity of manufacturing and cost-effectiveness for application in mortar-free construction.

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**3rd IMCEET-2025/Author-028**

# TOWARDS SUSTAINABLE AND SMART WIND TURBINE BLADES: BIO-BASED COMPOSITE STRUCTURES WITH EMBEDDED SENSORS

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**ABSTRACT**: The rapid expansion of wind energy necessitates innovative materials that enhance sustainability, durability, and functionality. Traditional wind turbine blades, primarily composed of glass fiber-reinforced composites, pose environmental challenges due to their limited recyclability and end-of-life disposal concerns. This study pioneers the integration of bio-based functional composites into wind turbine blades, leveraging self-healing polymers, impact-resistant natural fibers, and electrically conductive bio-fillers to enhance structural integrity and real-time monitoring capabilities. By adopting a region-specific hybrid material strategy, this research tailors bio-composites to different sections of the blade—rigid and sensor-integrated materials at the root, fatigue-resistant and thermally stable composites in the midspan, and lightweight, impact-absorbing structures at the tip. The study further explores scalable manufacturing techniques, including resin infusion, co-extrusion, and automated fiber placement, ensuring industrial feasibility. The findings underscore the potential of bio-based smart materials in enhancing the longevity, recyclability, and efficiency of wind turbine blades while significantly reducing their environmental footprint. This research lays the groundwork for the next generation of sustainable, self-monitoring, and highperformance wind energy solutions.

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**3rd IMCEET-2025/Author-029**

# TRANSMISSION LINE FAULT DETECTION USING ARDUINO WITH GSM

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**ABSTRACT**: Now a day's transmission line protection is a key problem in power transmission lines. The electrical power system is growing in size and complexity in all sectors such as generation, transmission, distribution, so there are many types of electrical faults occurs in transmission lines system like a "line to line faults", and "line to ground fault" in power system etc. In this paper we will present the prototype of Transmission Line Fault Detection Using Arduino with GSM. In this paper we discussing the sensing device which is present on the line even though "L-L", "L-Gnd" and any unsymmetrical fault was occurred it will show on display and These faults can lead to significant power outages, equipment damage, and safety hazards. Therefore, there is a pressing need for an advanced monitoring and fault detection system for transmission lines protection. Arduino plays a major role it will detects the fault, analyses and classifies these faults and then, determined the fault distance. Additionally, indicates the faulty phase and sends the SMS to the user's mobile. As well as can easily detect the different types of faults and solve it and monitor their distance in real time, this prototype model is very effective. It is works in less time perfect distance of fault is locate. Avoid the future problem in transmission line.

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**3rd IMCEET-2025/Author-030**

# AN OVERVIEW ON SELECTION OF HYBRID NATURAL FIBRES FOR POTENTIAL OPTIMIZATION OF CONCRETE PERFORMANCE

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**ABSTRACT:** In today's world, concrete is a widely used material in construction. The behavior of concrete in extreme weather conditions is still debatable. The use of fibers, particularly natural fibers, in concrete has shown potential to overcome the concrete issues. And there is a growing trend of hybrid fiber usage in concrete. But very little is being considered about utilizing hybrid natural fibers in concrete. The purpose of this literature research is to document the concrete flaws in extreme environments and already explored natural fiber concretes. Based on these, the combination of the natural fibers for hybridization is explored for future research directions. In order to have deep insight, the papers published by highly reputed journals in the last one decade are considered. The governing properties of concrete, responsible for its performance in extreme conditions, are studied. The different natural fiber reinforced concretes having better relevant properties are reported. Finally, the compatibility of two natural fibers are made. This literature research concludes that the combination of coconut and sisal fibers in concrete can have favorable behavior in the extreme conditions. It is recommended to explore the various mechanical and durability properties of hybrid coconut and sisal fibers reinforced concrete.

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**3rd IMCEET-2025/Author-031**

# COMPREHENSIVE ASSESSMENT OF PHYSICAL, CHEMICAL AND BIOLOGICAL PARAMETERS OF DIFFERENT DRINKING WATER SOURCES OF JAMSHORO

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**ABSTRACT:** Access to safe and clean drinking water is essential for maintaining public health and preventing waterborne diseases. This study investigates the physicochemical and microbial properties of various drinking water sources in the Jamshoro district of Pakistan, including tap water, bottled stored water, boys hostel drinking water, Indus River water, and society drinking water. Key parameters such as pH, total dissolved solids (TDS), turbidity, electrical conductivity (EC), dissolved oxygen (DO), salinity, and microbial contamination (coliform test) were analyzed. The results were compared with the World Health Organization (WHO) drinking water guidelines to assess compliance and identify potential risks to human health. The analysis revealed significant disparities in water quality among the sampled sources. Indus River water displayed the highest turbidity levels (32.4 NTU) and microbial contamination (340 CFU/100 mL), significantly exceeding WHO permissible limits. Similarly, boys hostel drinking water exhibited elevated microbial counts (145 CFU/100 mL), indicating a potential health hazard for consumers. In contrast, tap water and drinking water showed minimal microbial contamination (10 CFU/100 mL), while bottled stored water was entirely free of coliform bacteria, fully complying with WHO standards. Variations in physicochemical parameters such as TDS, EC, and turbidity were also observed, with river water and hostel water demonstrating the poorest quality.

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**3rd IMCEET-2025/Author-032**

# GRAVITRICITY BASED ON SOLAR AND GRAVITY ENERGY STORAGE

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**ABSTRACT**: The present energy storage systems such as lead acid batteries or lithium ion batteries have many drawbacks. The most important drawback is their adverse environmental impact, disposal problem, efficiency and charging time. We have renewable sources of energy such as solar and wind which can solve the environmental problems to a great extent. We all are aware of the fact about intermittency of wind and solar, hydro has the limitation of space requirement. Resources are free but not always usable and storable. With rising demand for sustainable energy solutions, the advancement of novel energy storage systems has gained; it becomes a central topic of the energy systems research. The research presented here is aimed at the development and assessment of a gravity-based energy storage system integrated with solar energy, labelled "Gravitricity," to overcome limitations of conventional energy storage modes. While conventional batteries are limited by high costs, short life spans, environmental hazards, and relatively low scalability. Gravitricity shares the potential of the storage project, as it uses gravitational potential energy for effective long-term storage. We store energy by raising a mass to a certain height and release it by lowering it to turn a generator, which converts mechanical energy to electrical. This project intends to create a prototype of a gravity battery system, study its energy storage efficiency, optimize its mechanical and electrical components, and compare its effectiveness and environmental impact with conventional energy storage systems. The methodology includes system design and mathematical modeling, prototype development, experimental analysis and data collection, and system optimization.

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**3rd IMCEET-2025/Author-033**

# EVALUATING PERFORMANCE OF WALL CORNER-JOINTS IN MORTAR-FREE-INTERLOCKING BLOCK WALLS UNDER DYNAMIC LOADING

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**ABSTRACT:** Seismic-resistant techniques for safe housing are often only partially effective due to their economic impracticality. Mortar-free construction is viewed as a more viable option compared to traditional unreinforced masonry structures, offering improved safety and structural integrity. Corner failures results from a combination of in-plane and out-of-plane behaviors, linked to poor connections, weak materials, and substandard workmanship. Mortar-free construction allows sliding and rotation in the out-of-plane direction, which significantly reduces structural damage. The current effort is to explore the potential utilization of mortar-free-interlocking corner-joints. For this purpose, plastic block having dimensions 62 x 62 mm and height of 50 mm with 12 mm shear key are used. 1:3 scaled down prototypes corner-joint made of interlocking plastic block wall is used. A total of five accelerometers are used at various locations to capture different dynamic response. One accelerometer is positioned at the base of the shake table to measure the base excitation. Another is placed at the bottom of the structure, while a third is attached to the top corner of the structure to record its response from the top point. Additionally, two accelerometers are mounted on the top of the in-plane and out-of-plane walls to monitor the structural responses in these directions. The response of the structure is recorded in terms of acceleration-time history and, displacement time history. Out of plane wall has 38 % more contribution than in-plane wall to corner failure. Energy absorption, base shear (Q)-displacement curves (Δ) are also calculated. Corner joint absorbed 9.08 Nm energy highlighting the potential of interlocking plastic-block structures in enhancing seismic resilience.

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**3rd IMCEET-2025/Author-034**

# SMART HELMET FOR THE SAFETY OF MINE WORKERS

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**ABSTRACT:** Mining is one of the most dangerous industries, exposing workers to risks such as toxic gases, extreme temperatures, and accidents due to a lack of real-time monitoring. Ensuring worker safety in such hazardous environments is crucial to prevent fatalities and long-term health issues. Many mining accidents occur due to undetected gas leaks, high temperatures, and the absence of protective gear. Traditional safety measures are insufficient, leading to delayed responses in emergencies. This project aims to address these issues by developing a Smart Helmet that enhances worker safety through real-time monitoring. The Smart Helmet is equipped with gas sensors, temperature sensors, and a helmet-wearing detection system, all controlled by a microcontroller. Data from the sensors is transmitted wirelessly via IoT technology to a central monitoring system. Alerts are generated through buzzers and LEDs when hazardous conditions are detected, ensuring quick response times. Initial testing shows that the helmet effectively detects gas leaks and temperature variations, triggering timely alerts. The helmet-wearing detection system also ensures compliance with safety regulations. This project provides a cost-effective and efficient solution to improve mine worker safety, reducing accidents and enabling real-time hazard detection. It has the potential to revolutionize safety standards in the mining industry.

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**3rd IMCEET-2025/Author-035**

# OPTIMIZATION OF ENERGY MANAGEMENT SYSTEMS IN ISLANDED MICROGRIDS

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**ABSTRACT:** Islanded Micro Grids (IMGS) Offer A Promising Solution For Providing Reliable And Environmentally Sustainable Energy To Remote And Off-Grid Locations. However, Managing The Operation Of IMGS Is A Complex Challenge, Involving The Coordination Of Various Distributed Energy Resources And Loads With Fluctuating Characteristics In An Efficient, Stable, Reliable, Robust, Resilient, And Self-Sufficient Way. As A Result, Energy Management Systems (EMSS) For IMGS Have Garnered Significant Attention In Recent Years, Particularly From Economic And Emissions Perspectives. This Paper Provides A Comprehensive Review Of The Optimization Challenges Faced By EMSS In IMGS By Analyzing Key Representative Studies. According To The Current State-Of-The-Art, The Optimization Of EMS In IMGS Can Be Broken Down Into Six Main Areas: Framework, Time-Frame, Uncertainty Management, Optimization Methods, Objective Functions, And Constraints. Each Of These Areas Is Discussed In Detail, And An Up-To-Date Overview Of Existing EMS Approaches For IMGS, As Well As Emerging Trends, Is Provided. These Trends Include The Need For Improved Modeling Techniques, Advanced Data Analytics And Forecasting, Real-Time Performance Assessments Across The Entire Micro Grid Control Hierarchy, Fully Decentralized EMSS, Enhanced Communication and Cyber Security Measures, and Real-World Validation. Additionally, The Paper Offers A Thorough Overview Of Commonly Used Heuristic Optimization Methods In EMSS For IMGS, Outlining Their Advantages And Drawbacks. This Study Aims To Serve As A Strong Foundation For Future Research Focused On Enhancing EMSS For IMGS.

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**3rd IMCEET-2025/Author-036**

# AN OVERVIEW ON CONTROLLING MICRO-CRACKS IN NEW CONCRETE STRUCTURES WITH SELF-HEALING MECHANISM

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**ABSTRACT**: Concrete is vital in civil engineering but prone to cracks over time. Cracking is one of the main ways that concrete ages, allowing pollutants to seep within and potentially lowering the physical and mechanical strength and endurance of concrete structures. Experts debate its sustainability, cost, and environmental impact. This review explores the varying bacterial types, application methods, and environmental conditions in self-healing concrete, emphasizing the absence of a standardized method for practical construction use. This review analyzes top-tier research on bacterial self-healing concrete, focusing on crack healing efficiency, nutrient sources, and application methods. It examines calcium precipitation, geographic research trends, and the lack of a standardized approach. Despite extensive studies, no definitive recommendation exists for practical construction use. This study confirms the absence of a universal standard, as researchers adopt varying approaches based on feasibility and methodology. To enable practical implementation, future research should establish standardized, cost-effective, and user friendly self-healing concrete solutions

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3rd IMCEET-2025/Author-037

# AN OVERVIEW ON CONTROLLING MICRO-CRACKS IN NEW CONCRETE STRUCTURES WITH SELF-HEALING MECHANISM

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**ABSTRACT**: With rapid increase in population landfills in housing societies pose significant environmental and structural challenges, in terms of both public health and sustainable urban growth. This review explores the role of landfills in civil engineering, their inherent issues, and viable remedial measures. By analysing articles published in highly reputable journals over the last decade and beyond, this study aims to provide a comprehensive understanding of landfill characteristics, their long-term environmental impacts, and the strategies adopted to mitigate associated risks. However, the findings suggest that with proper stabilization and sustainable waste management practices, landfills can be transformed into stable and environmentally safe grounds for urban development.

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3rd IMCEET-2025/Author-038

# MECHANICAL AND MICROSTRUCTURE PROPERTIES OF RECYCLED HIGH IMPACT POLYSTYRENE

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**ABSTRACT**: High Impact Polystyrene (HIPS) is a widely used thermoplastic. It finds applications in packaging, consumer electronics, automotive components, and construction. Although recycled use of HIPS is limited due to processibility. This study aims to comprehensively evaluate the mechanical and microstructural properties of HIPS through experimental characterization. Tensile, shear, and flexural tests were conducted to determine its mechanical behavior under different loading conditions. Microstructural characterization was performed using Scanning Electron Microscopy (SEM), Thermogravimetric Analysis (TGA), and Fourier Transform Infrared Spectroscopy (FTIR) to assess the material's morphology, crystalline structure, thermal stability, and chemical composition. The findings provide insight into the relationship between HIPS's mechanical performance and its underlying microstructure, helping optimize its use in construction products.

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3rd IMCEET-2025/Author-039

# ENHANCING FURROW IRRIGATION EFFICIENCY FOR CLIMATE-SMART AGRICULTURE

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**ABSTRACT**: Climate-smart agriculture (CSA) aims to enhance sustainability, resilience, and efficiency in food production systems, particularly through improved water management strategies. Infiltration dynamics play a crucial role in optimizing irrigation efficiency, yet variations in soil infiltration rates impact water distribution and resource utilization. This study evaluates the performance of one-point infiltration prediction methods in furrow irrigation and compares them with the two-point method to enhance irrigation planning. Field experiments conducted in the agricultural field near District Tando Allahyar, Sindh. Study revealed that one-point methods such as Valiantzas, Shepard, Mailapalli, and Modified Mailapalli exhibit limitations in predicting advance trajectories and infiltration volumes in clay loam soils. These findings emphasize the need for method calibration to ensure precise water application, reduce losses, and improve irrigation sustainability. By refining infiltration modeling, this research supports CSA by promoting efficient water use, increasing agricultural productivity, and building resilience against climate-induced water scarcity

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3rd IMCEET-2025/Author-040

# DURABILITY ASSESSMENT OF HYBRID FIBER CONCRETE UNDER AGEING CONDITION FOR CANAL LINING APPLICATION

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**ABSTRACT**: The performance of concrete canal lining can be improved by the utilization of hybrid fibers. However, the durability of such material is not very well known. In this experimental work, the durability assessment of hybrid fiber-reinforced concrete under different ageing condition is made for canal lining application. Two types of concrete are prepared: control mix (CM) and hybrid polypropylene and Jute fibers reinforced concrete (HPJF-RC). The mix design (cement: sand: aggregate: water) for PC is 1:2:3:0.4. For HPJF-RC, 0.1% fiber content (by cement mass) of both polypropylene and jute fibers are added. For CM and hybrid polypropylene and jute fiber reinforced concrete, silica fume 10%, and superplasticizer 1.5% of cement mass are used. Both concretes have undergone alternate wetting and drying on a weekly basis for two years. The split tensile testing is done as per ASTM standard. The split tensile strength, energy absorption and toughness index are explored. It is found that the addition of hybrid polypropylene-jute fiber in concrete have helped in significantly retaining the strength, energy absorption and toughness after two years of ageing condition. Therefore, this hybrid polypropylene and jute fiber reinforced concrete has a durable behavior for canal lining application.

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**3rd IMCEET-2025/Author-041**

# MULTIVARIATE STATISTICAL APPROACH TO AMMONIUM AND PHOSPHATE RECOVERY FROM BIOGAS SLURRY

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**ABSTRACT**: Livestock biogas slurry is an effluent containing essential nutrients, such as ammonium and phosphate, which are released by various industries. As these nutrients contribute to environmental pollution, their recovery and reuse have become increasingly necessary. Recent studies have focused on using multivariate statistical analyses to explore the interrelationship between various factors involved in nutrient recovery. This research aimed to investigate the significance of ammonium and phosphate recovery from biogas slurry by employing a multivariate statistical approach. The study involved experiments with biogas slurry using a range of salts commonly found in biogas effluents, including $ZnCl_2$, $FeCl_3$, $FeCl_2$, $CuCl_2$, $Na_2CO_3$, and $NaHCO_3$. The experiments were carried out at pH 9, integrating $NH_4^+$, $Mg^{2+}$, and $PO_4^{3-}$ molar ratios of 1.0, 1.2, and 1.8, respectively. The results revealed that the removal efficiency for ammonium and phosphate increased significantly with the addition of respective ions. Ammonium removal efficiency improved from 15.0% to 71.0%, while phosphate removal efficiency increased from 18.0% to 99.0%. Furthermore, the concentration of bicarbonate ($HCO_3^-$) increased from 58.0 to 71.0, with concentrations rising from 30 mg $L^{-1}$ to 240 mg $L^{-1}$. Various multivariate statistical methods, including principal component analysis (PCA), regression, path analysis, and

Pearson correlation analysis, were employed to examine the relationships between phosphate and ammonium recovery under different conditions, including biochar type, pyrolysis temperature, ion concentration, and removal efficiencies. These statistical approaches allowed for a comprehensive evaluation of the biochar and struvite effects on ammonium and phosphate recovery from biogas slurry. The multivariate statistical analysis suggested that different factors, including ionic concentrations and biochar properties, positively or negatively impacted each other. However, Pearson correlation analysis revealed that many ionic concentrations were not statistically significant, with p-values greater than the 0.05 threshold. Despite this, the study concluded that factors such as temperature, biochar type, and varying concentrations of ions ($K^+$, $Zn^{2+}$, $Fe^{3+}$, $Fe^{2+}$, $Cu^{2+}$, $CO_3^{2-}$, and $HCO_3^-$) played a significant role in ammonium and phosphate recovery. Specifically, temperature and the addition of metal salts enhanced the recovery efficacy. In conclusion, this research demonstrated how biochar can effectively recover nitrogen and phosphate from biogas slurry, offering a sustainable and long-term solution for agricultural applications.

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**3rd IMCEET-2025/Author-042**

# DESIGN & DEVELOPMENT OF AGRICULTURE DRONE FOR SPRAYING SYSTEM

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**ABSTRACT**: The increasing demand for efficient and precise agricultural practices has led to the development of advanced technologies such as unmanned aerial vehicles (UAVs) for crop management. This project focuses on the design and development of an agriculture drone with a spraying system, built in a quadcopter shape, to address the challenges of conventional spraying methods. The proposed drone is designed to carry up to 1 litre of liquid and is capable of spraying it over a distance of 1 km, offering a significant advantage in terms of coverage and speed. The drone is powered by a battery system with an operational flight time of 15 to 20 minutes, making it suitable for a range of agricultural applications. A key feature of this drone is the integration of a 6-volt water pump motor that enables efficient liquid delivery for spraying. This ensures a consistent and controlled application of pesticides, fertilizers, or other agricultural chemicals, reducing wastage and enhancing the precision of application. The main objective of this project is to enhance the efficiency of crop spraying by reducing manual labour, minimizing the risk of exposure to harmful chemicals, and improving the accuracy and coverage of treatments. By automating the spraying process, the drone offers a sustainable solution for small to medium-scale farms, providing an eco-friendly and cost-effective alternative to traditional spraying methods. The design and development of this agriculture drone aim to contribute to the ongoing efforts toward smart farming and precision agriculture, leading to increased productivity and sustainable farming practices.

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**3rd IMCEET-2025/Author-043**

# IMPACT OF CLIMATE CHANGE ON SUSTAINABLE WATER RESOURCE PLANNING

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**ABSTRACT**: Climate change is an important global challenge that has a major impact on water resources and their sustainable management. This study examines the impact of climate change on sustainable water resource planning by analyzing patterns of change, increased evaporation rates, and depletion of freshwater sources due to glacial melts. It presents key principles of sustainable water management, including efficiency, equity, environmental compatibility, integrated resource management, and adaptability. We discuss major challenges such as climate change, population growth, pollution and aging infrastructure. The study also examines adaptation strategies such as water protection, technological innovation, political regulation, and community commitment to ensure long-term water safety. Case studies from regions such as Australia and California demonstrate the success of water management practices. The results highlight the crucial importance of proactive planning, technological advancements and political solutions to reduce the negative impacts of climate change on water resources. This study highlights the importance of integrated adaptation strategies to ensure sustainable water management for future generations.

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**3rd IMCEET-2025/Author-044**

# THE EMOTIONAL SIDE OF AI: ASSESSING CHATGPT'S HEDONIC USABILITY AND USER PERCEPTIONS

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**ABSTRACT** The rapid integration of AI-driven conversational agents like ChatGPT into educational and research settings necessitates a deeper understanding of user experiences, particularly emotional and hedonic usability. This study presents an empirical analysis of the Emotional and Hedonic Usability Survey (EHUS) conducted among 500+ university students, employing a mixed-methods approach to explore key usability factors such as emotional satisfaction, frustration, enjoy ability, and academic usefulness. Findings reveal that ease of use, accuracy, and response speed significantly influences perceived academic usefulness, while technical issues and contextual inaccuracies remain primary sources of frustration. The study aligns with Norman's Three Levels of Design and Nielsen's Usability Heuristics, offering actionable insights for enhancing ChatGPT's usability. Recommendations include the development of personalized interfaces, improved context awareness, and integration with educational platforms. This research contributes to the growing body of literature on AI usability, providing a foundation for future studies to explore longitudinal user perceptions and comparative analyses with other AI tools.

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**3rd IMCEET-2025/Author-045**

# ASSESSMENT OF OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM IN SERVICE INDUSTRY GUJRAT

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**ABSTRACT**: Occupational Health and Safety Management (OHSM) is a methodical strategy to enhancing worker well-being, reducing hazards, and guaranteeing workplace safety. In order to reduce occupational diseases and injuries, effective OHSM frameworks combine risk assessment, legal compliance, and preventative safety measures. One of Pakistan's largest shoe manufacturers is the service industry. They export their goods, which is really good for business. The service industry is one in Pakistan that solely possesses the newest shoemaking machinery, including the Desma machine. This business has also become well-known throughout the world by developing innovative products and ideas that utilize cutting-edge technologies. The results of this study are intended to assess the safety and health conditions how they contribute to resilient and sustainable workplaces.

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**3rd IMCEET-2025/Author-046**

# EFFECT OF PUMPING DURATION AND NUMBER OF BORE WELL POINTS ON QUALITY OF GROUND WATER

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**ABSTRACT**: The study was conducted at selected sites in Union Council Mir Khuda Bux, Taluka Digri, District Mirpurkhas. Three tube wells with varying numbers of well points—10, 12, and 14 bores—were selected for analysis. These tube wells were designated as TW1 (10 bores), TW2 (12 bores), and TW3 (14 bores). Each tube well was operated continuously for 360 minutes, with discharge measurements taken every 30 minutes. Additionally, water samples were collected in plastic bottles at 30-minute intervals for further analysis. The collected water samples were analyzed for various water quality parameters, including turbidity, electrical conductivity (EC), total dissolved solids (TDS), bicarbonate, carbonate, chloride, hardness, calcium, magnesium, potassium, and sodium concentrations. At the beginning of the observation period (0 minutes), turbidity, EC, TDS, bicarbonate, chloride, and sodium levels were relatively consistent across all tube wells. However, over time, distinct trends emerged. Turbidity initially increased, peaking around 150 minutes before declining, indicating the accumulation and subsequent settling of suspended particles. Similarly, EC and TDS levels rose initially, reflecting higher concentrations of dissolved ions and minerals, before stabilizing and decreasing around 180 minutes. Bicarbonate levels showed a steady increase, reaching a peak at 150 minutes, followed by a gradual decline. Chloride concentrations exhibited a similar pattern, increasing steadily before peaking at 150–210 minutes and then decreasing. Hardness and calcium concentrations gradually increased, with hardness peaking at 150 minutes and calcium reaching its highest level around 330 minutes. Magnesium concentrations fluctuated cyclically, peaking at 90 and 240 minutes before declining at 300 minutes. Potassium concentrations showed slight variations, with peaks at 120 and 180 minutes, while sodium levels fluctuated moderately, reaching their highest value at 300 minutes. These variations indicate dynamic processes influencing groundwater chemistry over time. Overall, the results suggest that most groundwater parameters initially increase as observation time progresses, likely due to the release of dissolved substances and the accumulation of suspended particles. However, after reaching a peak around 150–180 minutes, most parameters stabilize or decrease, indicating a gradual equilibrium in

groundwater composition. Furthermore, an inverse relationship was observed between the number of bores and water quality parameters. As the number of bores increased, water quality improved, with lower values of TDS, EC, Ca+Mg, Na, K, $CO_3$, $HCO_3$, and Cl observed in tube wells with more boreholes. Based on these findings, it is recommended that farmers in the area install tube wells with a minimum of 14 boreholes to enhance water quality.

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**3rd IMCEET-2025/Author-047**

# DIGITAL FARMING ERA: TRANSFORMING WATER QUALITY WITH IOT AND AI

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**ABSTRACT**: This review article discovers how the idea of water quality monitoring in the current era is being changed by the surging technology of the contrasting world Internet of Things (IoT) and artificial intelligence (AI). It discusses the trend of digitization in general, and how this trend relates to data-driven solutions for the quality evaluation of water. The paper aims to offer a comprehensive view of newly emerging digital water quality management focusing on how AI, IoT devices, machine learning (ML), and sensor technologies can be combined to enhance farming efficiency and production. It highlights robotics, drones for crop monitoring, and smart irrigation systems that employ real-time data to enhance agricultural operations It even discusses how those smart water quality solutions would be made possible by fast 5G networks, specifically how they can affect connectivity and data transfer in rural areas. With an emphasis on actual soil analysis and farmer policymaking tools, opportunities and challenges of deploying Smart Decision Support Systems (SDSS) in emerging nations are examined. A suggested cloud-based system for remote farm monitoring is also covered in the evaluation. It uses AI-based algorithms to process data efficiently and enhances farming methods. A comprehensive grasp of present and future possibilities of IoT and AI in transforming water quality management procedures, tackling issues with global food security, and promoting sustainable development is the goal of this paper.

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**3rd IMCEET-2025/Author-048**

# WIND POWER INTEGRATION

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**ABSTRACT**: Wind power integration is a crucial step toward achieving sustainable and reliable energy systems. As a clean and renewable energy source, wind power reduces reliance on fossil fuels and minimizes environmental impact. However, its integration into existing power grids presents challenges due to the intermittent nature of wind and infrastructure limitations. To address these challenges, advanced forecasting techniques and real-time grid management are employed to predict wind patterns and balance supply and demand. Energy storage systems, such as batteries and pumped hydro storage, play a vital role in storing excess energy during peak generation for use during low-wind periods. Additionally, enhancing grid infrastructure is essential, especially as wind farms are often located in remote areas. Expanding transmission networks and adopting smart grid technologies improve efficiency and reliability. Integrating wind power with other renewable sources, like solar and hydro, creates a balanced energy mix, enhancing grid stability. Demand response programs also help align energy consumption with wind power availability. Furthermore, supportive policy frameworks are key to facilitating integration. Governments can promote investment through subsidies, tax incentives, and regulatory measures, encouraging technological advancements and infrastructure upgrades. This paper highlights that overcoming the challenges of wind power integration requires a combination of technology, infrastructure development, and policy support. Successful integration not only strengthens energy security but also contributes to reducing carbon emissions and achieving long-term sustainability goals.

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**3rd IMCEET-2025/Author-049**

# LOW-COST SENSOR SYSTEMS VS. INTERPOLATION: AN EXPERIMENTAL STUDY OF AIR QUALITY DATA IN A HIGH-POLLUTION ENVIRONMENT IN PAKISTAN

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**ABSTRACT**: Pakistan, characterized by a dense population, economic challenges, and inadequate healthcare infrastructure, is highly vulnerable to the devastating impacts of air pollution. Mainly caused by local anthropogenic sources including industrial activities (i.e., Power plants, Brick Kilns etc.), Emissions-intensive transportation, the combustion of fossil fuels and domestic heating, Air pollution leads to severe environmental degradation and has now become a public health emergency in the country. Beyond its immediate and direct impact on human health, air pollution has extensive effects on the environment and economies. Despites its far-reaching consequences, the Pakistan's response to serious issue remains ineffective and inadequate. While the National Clean Air Policy (NCAP-23) exists, its effective implementation is hampered by inadequate monitoring facilities, limited data availability, insufficient public awareness and community engagement. Government efforts are mostly focused on urban cities like Islamabad, Lahore, and Karachi and neglecting the rural and highly vulnerable regions. Additionally, existing air quality monitoring and reporting mostly rely on the interpolated data instead of in-situ sensors leading to significant uncertainties in understanding of actual pollution trends, hotspots and peak pollution periods. Keeping this in view, this research aims to develop a cost-effective, user-friendly, real-time Air Quality Monitoring Station (AQMS) utilizing a Lost-cost sensor system (LCS) and IoT. The proposed station is capable of continuous monitoring, reporting (real-time and historical) and logging of multiple parameters including particulate matter (PM), carbon dioxide (CO2), nitrogen dioxide (NO2), temperature and humidity. To experimentally validate the AQMS's performance, field experiments were conducted at two carefully selected locations: 1) Agricultural Land representing typical rural environmental conditions in Pakistan, and 2) a Brick Kiln factory in Khairpur, Pakistan – a site with higher chances of adverse environmental conditions. The 1ST site was selected to establish a baseline for air quality in a relatively clean rural environment. While the Brick kilns are known to be major contributors to air pollution in Pakistan, with approximately 20,000 brick kilns and over 2 million highly vulnerable workers. To better assess the

performance of the AQMS, data reported by the AQMS was compared with IQAir's values during a 60-minute experimentation period. Results demonstrate a high level of consistency at the first site i.e., AQI and PM2.5 values recorded by the AQMS closely correlated with those reported by IQAir. However, at the second site, the Brick Kiln factory, significant variations were observed between the AQMS readings and IQAir data. The average PM2.5 value reported by IQAir was 62.3 µg/m³. In contrast, the average PM2.5 value recorded by the AQMS exceeded 500 µg/m³. These significant discrepancies in data highlight the limitations of relying on interpolated data, especially in areas with high pollution levels. Interpolated data may not accurately capture the localized variations and event-specific pollution concentrations observed at such sites. The utilization of a low-cost sensor system demonstrates the potential to significantly improve air quality (AQ) monitoring, inform effective policy decisions, and enhance public health outcomes.

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**3rd IMCEET-2025/Author-050**

# BLOCKCHAIN-BASED ELECTRONIC DEGREE VERIFICATION AND AUTHENTICATION SYSTEM

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**ABSTRACT**: With academic credential fraud on the rise, higher education systems face increasing challenges in maintaining trust and efficiency in degree verification processes. This paper presents a Blockchain-Based Electronic Degree Verification and Authentication System, designed to ensure tamper-proof issuance and decentralized verification. Built with Flask, SQLite, and Ethereum blockchain integration, the system ensures transparency, integrity, and security of academic credentials. The system supports two primary user roles: Students, who can request verification and attestation of their degrees, and Administrative Personnel, who validate submissions, manage requests, and issue authenticated certifications. To ensure data integrity and eliminates forgery system interacts with cryptographic hashing algorithms. Each uploaded or generated degree document is hashed using secure hash functions (e.g., SHA-256), producing a unique digital hash value. These hash values are stored in the decentralized ledger(block-chain) system and used to verify document authenticity during future verification requests. Any unauthorized modification of a document is immediately detectable through mismatched hash, immediately flagging the discrepancy, thus enhancing the reliability of verification process. By transitioning from traditional paper-based methods to a digitized and cryptographically secure system, the platform greatly improves operational efficiency, strengthens fraud prevention measures, and reinforces the institution's trustworthiness and reputation.

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**3rd IMCEET-2025/Author-051**

# PERFORMANCE ANALYSIS OF HYBRID EXCITATION FLUX SWITCHING MOTOR WITH MODULAR ROTOR FOR ELECTRIC VEHICLES

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**ABSTRACT**: Electric machines are essential in modern life due to their innovation, efficiency, and ecofriendliness. As a result, researchers are working to improve motor performance for applications like aerospace and automobiles. Flux switching machines have gained attention for their strong and simple rotor structure. Many permanent magnet flux switching machines (PMFSMs) with salient rotors have been developed to boost performance. However, PM machines have some drawbacks, such as the high cost of rare earth materials and limited fluxweakening ability. In PMFSMs, when the stator tooth with a flux source aligns with a rotor tooth, the magnetic flux follows a longer path through the rotor and stator poles to complete the cycle. To address these issues, this paper proposes a novel E-core hybrid excitation motor with a modular rotor. The motor is designed using JMAG Designer software version 18.1. the performance of proposed design analyzed based on output torque, power, and torque-speed characteristics.From the results, it is observed that the proposed design is suitable for electric vehicles with the initial torque of 29.30 Nm at maximum current density 30 A/mm2

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**3rd IMCEET-2025/Author-052**

# UNIFIED MACHINE LEARNING FRAMEWORK FOR SCALABLE EV CHARGING: OPTIMIZATION WITH REAL- TIME DYNAMIC PRICING AND VEHICLE-TO-GRID (V2G) INTEGRATION

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ABSTRACT: This paper presents a novel machine learning framework for optimized electric vehicle (EV) charging, tackling grid stability and renewable energy integration challenges. By employing dynamic pricing and Vehicle-to-Grid (V2G) technology, it incentivizes off-peak charging and utilizes EVs as mobile energy storage assets. Decentralized charging decisions are facilitated through Multi-Agent Reinforcement Learning (MARL), enabling individual EVs to optimize their charging schedules according to personal needs and real-time grid conditions, with user privacy ensured by Federated Learning during collaborative model training. The framework further incorporates Prophet for accurate energy forecasting, K-Means clustering for insightful user behavior analysis, and Isolation Forest for robust anomaly detection in charging patterns. This integrated methodology aims to significantly enhance grid stability, optimize EV charging economics, and promote a more sustainable and efficient utilization of energy resources within the transportation sector.

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**3rd IMCEET-2025/Author-053**

# ANALYSIS OF AIR INSULATION BREAKDOWN CHARACTERISTICS UNDER ALTERNATING AND DIRECT CURRENT

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**ABSTRACT**: High-voltage insulation is essential for the safety and efficiency of power transmission networks, since it prevents electrical discharges between conductive elements. The dependability of air as an insulating medium is significantly affected by electric field non-uniformities resulting from varying electrode geometries. This research seeks to examine the air breakdown voltage under both Alternating Current (AC) and Direct Current (DC) high-voltage circumstances. Experiments used rod-plane, rod-sphere, and sphere-plane electrode configurations over air gaps ranging from 0.5 cm to 2.5 cm, complemented by electric field calculations done using FEMM 4.2 software. In the sphere-to-plane arrangement, the breakdown voltage for alternating current is roughly 11.89% more than that for direct current. In the rod-to-plane configuration, the AC breakdown voltage exceeds the DC breakdown voltage by about 39.16%. The results indicate that field homogeneity significantly improves dielectric strength, and optimising electrode shape is crucial for the design of dependable high-voltage insulation systems.

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**3rd IMCEET-2025/Author-054**

# DESIGN OPTIMIZATION OF DOUBLE STATOR HYBRID EXCITATION FLUX SWITCHING MACHINE (DS-HEFSM) FOR ELECTRIC VEHICLES

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**ABSTRACT**: The Double Stator Hybrid Excitation Flux Switching Machine (DS-HEFSM) has gained significant popularity in recent times owing to its relatively simple and remarkably efficient topology. To optimize the performance of the generator, recent advancements and emerging patterns in mathematical modeling and software simulation, along with the utilization of optimization techniques, have facilitated the development of a novel methodology for electrical machine design. This study investigates the configuration and optimization of a DS-HEFSM, focusing on the rotor, armature coil, and field excitation. The optimization process involves multiple sequences for each component, employing the local optimization method as an iterative approach to determine the optimal sequence that yields the highest output efficiency. Through the investigation of six rotor sequences, two armature coil sequences, and two field excitation coil sequences, a detailed optimization process was conducted. Consequently, the final output voltage of the DS-HEFSM gains an 18.55% increment of voltage compared to the initial outcomes. The output voltage performance of the generator has been influenced by several sequences during the optimization process. Therefore, modifications to the design of the arrangement contribute to the expansion of the operational range of the machine.
Keywords: Flux Switching, Electric Vehicle, Voltage Density.

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**3rd IMCEET-2025/Author-055**

# POWER SYSTEM FAULTS REMAIN A CRITICAL CHALLENGE, CAUSING WIDESPREAD POWER INTERRUPTIONS AND ECONOMIC LOSSES. IN IOT BASED IN CONTROLLER

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**ABSTRACT**: Power system faults pose significant challenges, leading to power interruptions and economic impacts. Swift fault classification and clearance are essential for grid stability restoration. This study focuses on classifying five types of short-circuit faults in transmission lines: line-to-line, line-to-ground, double line-to-ground, triple line, and triple line-to-ground. Traditional fault detection methods depend on complex mathematical models and expert analysis, which are time-consuming. This work introduces a novel approach using deep learning integrated with IoTenabled edge computing for real-time fault detection, classification, and control. Different models including Artificial Neural Networks (ANN), Long Short-Term Memory (LSTM), and LSTM with Window Regression (LSTM-WR) were compared for their accuracy. Results show that LSTM-based techniques outperform other models in capturing temporal fault patterns.The study presents a fault-responsive system using an ESP32 microcontroller and the Blynk IoT platform. Sensors continuously monitor transmission line parameters and send data to the ESP32. The optimized LSTM-WR model runs on the ESP32, enabling edge-based inference with minimal delay. Once a fault is detected, protective actions are triggered by the ESP32, such as isolating faulty sections and transmitting fault information to the Blynk app. The app provides real-time visualization of sensor data, fault alerts, and system status through interactive widgets. Users can remotely control the system, adjust settings, and initiate resets through the app.This integration combines high-accuracy fault classification with IoT-driven automation, leading to rapid response times and reduced dependence on centralized infrastructure. Machine learning at the edge ensures energy-efficient and low-latency operation, crucial for field deployments. Experimental testing under simulated fault conditions confirms the effectiveness of the ESP32-Blynk framework in enhancing grid resilience and minimizing downtime. This solution presents a scalable and cost-effective option for fault management, aligning with smart grid modernization objectives.

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**3rd IMCEET-2025/Author-056**

# COMPARATIVE ANALYSIS: MACHINE LEARNING ALGORITHMS FOR ANOMALY DETECTION IN SMART GRIDS

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**ABSTRACT**: Information and communication technology (ICT) has been integrated into smart grids, enhancing the efficiency and reliability of the power system. However, this integration has also introduced vulnerabilities, making grids more susceptible to cyber-attacks and natural disturbances.The primary objective of this paper is to address these anomaly detection challenges by providing a comprehensive research study on machine learning (ML)-based techniques aimed at securing smart grids.Various studies have demonstrated the use of ML algorithms, including Random Forest, Naive Bayes, and Support Vector Machine (SVM), for detecting cyber-attacks and disturbances. To ensure the accuracy of our dataset, we will perform several steps, such as missing value imputation, feature scaling, and outlier removal.We will explore several algorithms, including Random Forest, Gradient Boosting, and Extra Trees. During our analysis, we achieved an accuracy of 98.7% with Random Forest and 98.4% with Extra Trees

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3rd IMCEET-2025/Author-057

# OPTIMIZING METHANE YIELD FROM CO-DIGESTION OF ORGANIC FRACTION OF MUNICIPAL SOLID WASTE AND CATTLE MANURE: EFFECTS OF TEMPERATURE

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**ABSTRACT:** Karachi, the economic hub of Pakistan, faces significant challenges, which includes rising energy demands, environmental sustainability, and pollution caused due to the heavy reliance on fossil fuels. These issues severely threaten public health and the city's overall well-being. However, Bio-methane emerges as a promising avenue for addressing these concerns since the city produces large amounts of organic waste daily, particularly in the form of cattle manure (CM) and organic fraction of municipal solid waste (OFMSW).

This optimization study of methane from co-digestion of cattle manure (CM) with organic fraction of municipal solid waste (OFMSW) focuses on the effects of temperature at ambient (25 – 35 ± 2°C) and thermophilic temperature (52 ± 2°C) for bio-methane production process performance in Karachi. The performance parameter being analyzed for this study includes, daily and cumulative methane yield from experimentation against the theoretical bio-methane yield, biodegradability, pH, alkalinity, ammonia concentration, and volatile fatty acids (VFAs). For the purpose of modeling the process for better understanding, modified Gompertz model is being applied to estimate kinetic parameters such as lag phase duration, maximum methane production rate and cumulative methane yield.

The primary observations indicate a dynamic interaction between temperature and process stability. The study is expected to offer critical insights into optimizing the operational parameters for enhanced methane recovery and improved organic waste conversion. The research shall enhance Karachi's bioenergy knowledge and is a reference for policymakers, environmentalists, and researchers exploring sustainable waste-to-energy solutions within and outside this largest metropolitan city of Pakistan.

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3rd IMCEET-2025/Author-058

# DESIGN OF NEW INOVATIVE SYNCHRONOUS RELECTANCE MACHINE FOR ELECTRIC INDUSTRIAL USE

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**ABSTRACT**: This paper present the design of the new innovative synchronous reluctance machine for electric industrial application the proposed machine features a unique rotor design that combines the benefits of high saliency and flux-barrier geometries, resulting in improved efficiency, power density and reliability. A compressive design optimization process is carried out using finite element analysis and particle swarm optimization to minimize the machine losses and minimize its performance. Extensive simulations explore various machine parameters and particle testing is conducted to validated the resultant and determine the optimized dark achievement. The result demonstrate significant improvement in the motor performance compare to conventional induction motor used in similar application, the motor achieves notable advancement in term of speed efficiency and torque characteristics making it a valuable solution for an industrial application. Noteworthy advantages include superior thermal performance steadfast, constant speed operation and high efficieny. This research marks a significant stepforward in advancing synchronous reluctance motor technology, underscoring its viability and within industrial domains. The design is validated through finite element analuysis and experimental testing, demonstrating excellent performance and efficiency.

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**3rd IMCEET-2025/Author-059**

# DESIGN AND FABRICATION OF A SOLAR THERMAL POWER GENERATION SYSTEM USING SOLAR TRACKERS

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**ABSTRACT:** This paper gives the design of a solar thermal power generation system and enhances its efficiency by implementing a solar tracking system. The solar radiations come together on a thermal receiver after reflecting from parabolic surfaces, following which, the heat is transferred further to the steam generation mechanism. The impulse turbine is run by the generated steam, which results in power generation. Automation is performed on the solar tracking system using LDR's and motor drivers. Ensuring sustainability, the proposed design shows great potential for enhancing the overall efficiency of the produced energy in regions like Pakistan, which are abundant with sun exposure.

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# INVESTIGATING POTENTIAL OF PRISTINE BC6N MONOLAYER FOR SENSING SF6 DECOMPOSED GASES (SO2, SO2F2, SOF2, H2S, HF)

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**ABSTRACT**: Unavoidable partial discharges cause SF6 to decompose into low-fluorine gases in sulphur hexafluoride SF6 circuit breakers. These gases react with nearby micro-water and form acids, leading to contacts' corrosion as well as diminished arc quenching capacity. Therefore a 24/7 monitoring system essentially be equipped with circuit breakers. In this work, carbon boronitride (BC6N) monolayer is investigated for potential application of SF6 decomposed gases SO2, SO2F2, SOF2, H2S, and HF through DFT calculations. Adsorption performance through adsorption energy, charge density difference, density of states, while sensitivity through band structures, work function and transport transmission and recovery through desorption time calculations are evaluated. Results show that pristine BC6N is weakly absorbing the gas molecules, however, BC6N decorated with Fe and Co atoms chemisorbs the gas molecules with adsorption energy improved from -0.23 eV to -1.01 to -1.61 eV for Fe and -0.95 to -1.58 eV for Co decoration. Diffusion energy barrier calculation confirms that Fe and Co cannot make cluster. Desorption time calculations results show that strongest adsorbed SO2F2 molecule takes 117.5 hours to be desorbed at 498 K temperature, which is considerably shortened to 1.69 nanoseconds by UV exposure. Our proposed substrates can actively adsorb, sense and instantaneously desorb the target gas molecules, proving that Fe/BC6N and Co/BC6N can potentially be highly sensitive and reusable gas sensors.

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