



IEI EPITOME

A Century of Service to the Nation

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Members in the NEWS



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Dr Indrasen Singh was conferred the **Diamond of Asia International Award** by **Jeeva Theological Open University**, for his outstanding achievements and remarkable role in the field of Education at Chennai on 14 September 2021



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Received a Certificate of Appreciation for **outstanding performance and innovative contribution for the projects** under **Bihar Sharif Smart City Mission** by Municipal Commissioner-cum-Managing Director of Bihar Sharif Smart City, Ministry of Housing & Urban affairs, Government of Bihar.



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He stood **Second (ASSO-OLYM-09-20-331)** within 25 Rank Holders 2020 in National Engineering Olympiad Examination organised by ASSOCHAM
Supporting Link: <https://green-assochem.com/olympiad/>



Members in the NEWS



Dr Ajit Behera, AMIE

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He is one of the **Editor** of these books

Recent Advances in Manufacturing Processes

Select Proceedings of RDMPMC 2020

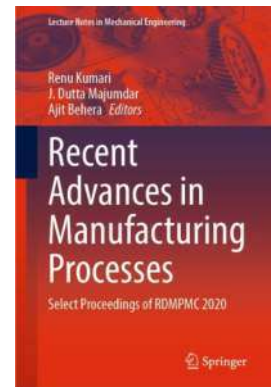
Part of the Lecture Notes in Mechanical Engineering book series (LNME)

Co-Editors: Renu Kumari & J Dutta Majumdar

Introduction

This book presents the select proceedings of the National Conference on Research and Developments in Material Processing, Modelling and Characterization (RDMPMC 2020). It covers the recent advances in manufacturing processes. The book explains various manufacturing process technologies based on surface modification, welding, mechanical deformation, and heat treatment. It also covers the topics such as microstructural characterization and properties evaluation, corrosion, and tribology. The book will be useful to researchers, students and professionals working in areas related to materials processing and characterization.

Keywords: Heat Treatment, Mechanical Deformation, Galvanized, Electro Deposition, Sol-gel, Laser Thermal Spraying, Wear Corrosion



Nickel-Titanium Smart Hybrid Materials

From Micro- to Nano-structured Alloys for Emerging Applications

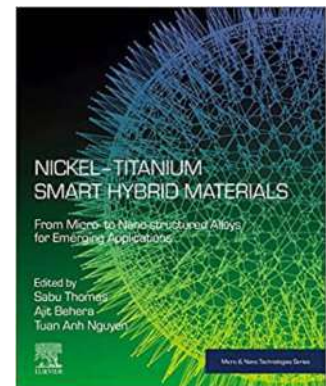
Co-editors: Sabu Thomas & Tuan Anh Nguyen

Description

Nickel-Titanium Smart Hybrid Materials: From Micro- to Nano-structured Alloys for Emerging Applications describes advanced properties that can be adapted in NiTi-alloys. Nickel-Titanium (NiTi) systems are receiving wide demand in growing industries due to their smart, high-temperature or biocompatible behavior. These influenced behaviors are carefully described in the micro-scale and nanoscale range, with NiTi smart materials described on the basis of their shape memory effect (SME) and super-elastic (SE) properties for sensor and actuator application. This book discusses novel properties of nickel-titanium systems, helping materials scientists and engineers produce smart technologies and systems for the aeronautical, automobile, mechanical, healthcare and electronics industries.

Key Features

- Describes the use of nanotechnology and microtechnology in nickel-titanium-based systems
- Outlines the major properties of Nickel-Titanium Nanoalloys
- Assesses the major challenges of manufacturing nickel-titanium nanoalloys at an industrial scale



Publication by Members



Prof (Dr) Ramadoss Perumal, FIE

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Book Chapter: **Mechanical Performance of Ultra-High-Performance Fiber-Reinforced Concrete (UHPFRC) Incorporating Slag-Based Admixtures**

Advances in Sustainable Construction Materials, Select Proceedings of ASCM 2020, Part of the Lecture Notes in Civil Engineering book series (LNCE, Volume 124), Springer, Singapore, Published (Online): 11 April 2021, ISBN (Print): 978-981-33-4589-8, ISBN (Online): 978-981-33-4590-4, pp 711-719

DOI: https://doi.org/10.1007/978-981-33-4590-4_66

Co-author: G Gautham Kishore Reddy

Abstract: This paper investigates the mechanical performance of ternary blended ultra-high-performance fiber-reinforced concrete (UHPFRC) developed by using alccofine powder (AF) and ground-granulated blast furnace slag (GGBS). Crimped steel fibers of dimensions 35 mm length and 0.5 mm diameter are used as fiber reinforcement, ranging from 0 to 2% with an increment of 0.5%. A total of six UHPFRC mixtures were prepared and tested for their mechanical performance. The test results indicated that UHPFRC mixture with 2% steel fibers by volume displayed maximum performance values of 153.57, 35.83, and 17.07 MPa for compressive, flexural, and split-tensile strengths at 28 days.

Keywords: Ultra-high-performance, Fiber-reinforced concrete, UHPFRC, Alccofine, GGBS, Mechanical performance

Book Chapter: **Mechanical and Durability Properties of High Strength Concrete Incorporating Different Combinations of Supplementary Cementitious Materials: A Review**

Chapter 45, Proceedings of Fourth International Conference on Inventive Material Science Applications, Part of the Advances in Sustainability Science and Technology book series (ASST), Springer, Singapore, First Online: 20 October 2021, pp 543-557, ISBN (Print): 978-981-16-4320-0, ISBN (Online): 978-981-16-4321-7

DOI: https://doi.org/10.1007/978-981-16-4321-7_45

Co-author: B Sankar

Abstract: Ever since the concept of high strength concrete has been first derived, supplementary cementitious materials have been an essential part of its production. The addition of such finer particles in the cementitious matrix not only enhances its mechanical property, but also improves its pore structure, resulting in a more durable and sustainable matrix. In recent years, the effects of using a combination of two SCMs instead of a single SCM are being deeply studied considering the synergy between different SCMs. Higher cement replacement levels keeping in view of sustainability and reduced carbon footprint in concrete are possible only through the usage of combined SCMs. This paper reviews the influence of different SCMs such as fly ash, GGBS, silica fume and metakaolin on both the mechanical properties and durability properties of ternary blended high strength concrete. A comparative perspective is used to present the works studied from the collected literatures.

Keywords: Supplementary cementitious materials, Binary blend, Ternary blend, Hybrid cement, High strength concrete

Title of Paper: **Review on Fiber Hybridization in Ternary Blended High-Performance Concrete**

Materials Today: Proceedings, Elsevier, Volume 45, Part 6, Available Online: 20 February 2021, pp 4919-4924, ISSN: 2214-7853

DOI: <https://doi.org/10.1016/j.matpr.2021.01.366>

Co-author: B Sankar

Abstract: The concept of adding fibers in concrete rapidly revolutionized the construction industry, making it a more superior material with enhanced engineering properties. Addition of discontinuous, randomly distributed fibers into the concrete mixture altered its inherent brittleness property. A huge number of experimental studies incorporating different types of fibers in both normal and high strength concrete have been done, leading to more practical applications. Fiber hybridization in concrete is an essential step into the future considering the fact that the composites containing two different fibers exhibit the advantages of both due to synergistic effect. High performance concretes nowadays essentially contain one or more supplementary cementitious materials. However, limited reports have been made explaining the pros and cons of a three-phase system of cementitious materials in hybrid fiber reinforced concrete. Since, the performance of fiber is largely dependent on the matrix type, the effects of ternary blends of cementitious materials such as fly ash, GGBS, silica fume and metakaolin in the hybrid fiber systems are a subject of much interest. This paper briefly discusses the performance of different types of hybrid fibers in combination with different ternary cementitious blends, and reviews the series of work done from the past to present studies and the future possibilities for hybrid fibers and SCMs for its higher utilization potential.

Keywords: Ternary blend, Supplementary cementitious materials, Hybrid fibers, High performance fiber reinforced concrete

Publication by Members



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Title of Paper: **Effect of Parboiling on Cooking Characteristics of Finger Millet and Foxtail Millet**

Agricultural Engineering Today, Indian Society of Agricultural Engineers, Volume 45, Issue 1, January-March 2021, ISSN (Print): 0970-2962, ISSN (Online): 2230-7265, pp 26-35

Journal Link: <https://isae.in/agricultural-engineering-today-AET>

Co-author: Patil Sagar Balkrishna

Abstract: Experiments on parboiling of finger millet (*Eleusine coracana*) and foxtail millet (*Setaria italica*) were conducted by soaking at 30, 40, 50, 60 and 70°C and steaming for 10, 15, 20, 25 and 30 min. The parboiled millet grains were shade dried and pearled in a laboratory scale pearler-polisher. The cooking characteristics of these parboiled millet grains were assessed in terms of cooking time, water uptake, swelling index and expansion ratio. In the case of finger millet, the cooking time, water uptake, swelling index and expansion ratio ranged 8-13 min, 1.6-3.7 g/g, 0.98-2.27 and 1.26-1.69, respectively. For foxtail millet these quality parameters ranged 9-13 min, 2.5-4 g/g, 1.32-2.75 and 1.45-2.4, respectively. Soaking at 70 and 60°C and steaming for 20 and 10 min, respectively for finger millet and foxtail millet resulted in better cooking characteristics, viz., water uptake, swelling index and expansion ratio, and lower cooking time.

Keywords: Parboiling, Finger millet, Foxtail millet, Cooking quality



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Title of Paper: **Properties of Concrete Having Treated Recycled Coarse Aggregate and Slag**

Revista de la Construcion, Volume 20, No 2, August 2021, Article 07177925

DOI: <https://doi.org/10.7764/RDLC.20.2.249>

Co-authors: D Manoj & S Jagan

Abstract: The possibility of using substitute materials for aggregates and cement in concrete were studied and reported in this paper. Concrete mixtures with untreated recycled coarse aggregates (URCA) and treated recycled coarse aggregates (TRCA) were used to prepare two mix groups of without slag (Mix I) and with slag (Mix II). The recycled aggregates were treated with hydrochloric acid (HCl) having different molarities (0.1M, 0.3M and 0.5M) before used as a substitute material for virgin aggregate in concrete. The concrete mechanical, durability properties and morphology of concrete were examined through standard experiments and analysed. In both mix groups considerable improvement in all characteristics were identified in TRCA mixes than URCA mixes. Among the two mix groups the concrete mix with slag (Mix II) showed better durability characteristics than mix without slag (Mix I). The combination of TRCA and slag in concrete substantially increases the characteristics of concrete in all means.

Keywords: Treated recycled coarse aggregate, Untreated recycled coarse aggregate, Slag, HCl, Molarity



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Title of Paper: **Study on the Performance and Emission Characteristics of Pyrolytic Waste Plastic Oil operated CI Engine using Response Surface Methodology**

Journal of Cleaner Production, Elsevier, Volume 328, Published (Online): 15 December 2021, Article ID 129646

DOI: <https://doi.org/10.1016/j.jclepro.2021.129646>

Co-authors: Tarapasrad Mohapatra, Achyut K Panda & Sudhansu S Sahoo

Abstract: Depletion of fossil fuels, strict pollution rules, and potential generation of waste plastics strive to focus another facet of value addition by conversion of plastic wastes into alternate fuel for a diesel engine. The current study is intended to optimize the combined influences of engine load, fuel blend, and compression ratio on the performance and emission of a normal diesel engine fueled with waste plastic oil diesel (WPO) blend by using response surface methodology (RSM). Optimum engine performance i.e. maximum brake thermal efficiency and minimum NOx emissions are established using the technique of response surface methodology concerning three different engine input parameters engine load, compression ratios, and fuel blend ratio. The compression ratio of 17, 10% of WPO-diesel blending at full load conditions are found to be optimum input parameters. And accordingly, the brake thermal efficiency of 28.8% and NOx emission of 162.45 ppm are obtained under multi-response optimization techniques. A sensitivity analysis has also been accomplished to clarify the significant contribution of different parameters and their orders of importance. The compression ratio has resulted as the most significant factor followed by load and % fuel blend.

Keywords: Waste plastic oil, Performance, Emission, Sensitivity analysis, Optimization, RSM

Publication by Members



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Title of Paper: **Phyconano Particles: Synthesis and Antimicrobial Applications**

Materials Today Proceeding, 2021, Volume 47, Part 5, Published Online: 12 April 2021, pp 1189-1192

DOI: <https://doi.org/10.1016/j.matpr.2021.03.584>

Co-authors: D P Krishna Samal, Archana Pattanaik & Debabrata Pradhan

Abstract: Nanotechnology and its various applications have brought a new revolution in the research area. Biological synthesis of nanoparticles using the biomass of microalgae is a novel and eco-friendly technique which reduces the use of different toxic chemicals. Nanoparticles are very useful materials and have wide applications due to their unique mechanical, physical and chemical properties. They are fine particles having large surface area and energy which help them for the wide applications, especially in medical fields. Both live and dead biomasses of seaweeds and microalgae have different pharmaceutical properties. The bioactive compounds present in the microalgae biomass are the key drivers for the biosynthesis of different metallic nanoparticles. The scopes of silver and gold nanoparticles in different biomedical applications include tumor imaging and diagnostics, drug delivery, treating cancer, etc. Further they are cumulative for the antioxidant, antibacterial, antiviral and antifungal activities upon their applications. The advantage of nanoparticles in the therapeutic applications is that they help to achieve the maximum therapeutic response with the minimum adverse effects. Therefore, nanoparticles provide a new hope in the medical field minimum adverse effects.

Keywords: Nanoparticles, Microalgae synthesis, Antimicrobial activities



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Title of Paper: **Sterilization of Dry-Type Transformer Winding by Conducting Short-Circuit Test in Nuclear Power Plant: A Case Study**

Journal of The Institution of Engineers (India): Series B, Springer, Published (Online) : 30 June 2021

DOI: <https://doi.org/10.1007/s40031-021-00640-3>

Co-authors: A Singadurai & P Sivakumar

Abstract: Dry-type transformers play a vital role in power distribution to many loads at different voltage levels in a nuclear power station. Usually, dry-type transformers are located indoor with appropriate heating, ventilation and fire protection. The dry-type transformers in NPPs are less loaded due to redundancy in design. The maintenance program for transformers in NPPs calls for stringent requirements and overseen by multiple regulating authorities. Even though an effective maintenance program is in effect, there were few occasions where a dry-type transformer has failed and could not be foreseen during regular maintenance. Also with growing nature of deregulation in electrical markets, the failure probability of transformer increases simultaneously. A transformer failure in a nuclear power plant (NPP) can result in significant damage to critical loads, serious safety implications and revenue loss as well. Hence, a distinctive maintenance program should be adopted in order to ensure the healthiness of dry-type transformer. This paper describes a case study made to analyze the procedures for maintenance of dry-type transformers by conducting sterilization techniques at a specified interval in order to improve reliability. The results of this case study were extraordinary and successfully improved transformer life. Owing to the results, the revision of existing procedures followed in other NPPs is recommended.

Keywords: Dry-type transformer, Short circuit, Cleaning, Reliability, Nuclear power plant, Sterilization



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Title of Paper: **Enhanced Back Controlled Phase Fault and Earth Fault Busbar Protection Scheme using Overcurrent and Earth Fault Relays**

Journal of The Institution of Engineers (India): Series B, Published Online: 21 October 2021

DOI: <https://doi.org/10.1007/s40031-021-00675-6>

Co-author: P Loganathan

Abstract: This paper presents a simplified Busbar Protection Scheme for HT/EHT Busbars. Presently for Busbar Protection scheme, Busbar current Differential Relays are being widely used around the world. In this Paper, we evolve that the cost-effective Busbar protection is being achieved by the back-control method of the Incomer's Highset OC & EF trip function by the outgoing feeders' OC & EF start function. The objectives are achieving Busbar protection by utilizing the outgoing and incomer feeders' OC & EF Relays itself, to eliminate the CT, DC and Tripping circuits complexity that exists in the conventional Busbar protection scheme, to achieve the reduction in cost and control room area for Busbar Protection scheme, to make easiness in future expansion of bays in respect of Busbar protection.

Keywords: Busbar, Current transformer, Highset, Interlock, Numerical relay

Publication by Members



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Title of Paper: **Experimental Study on Bamboo Grid Reinforced Copper Slag Overlying Soft Subgrade**
Construction and Building Materials, Elsevier, Volume 306, Article ID 124758, Publication Date: 1 November 2021
DOI: <https://doi.org/10.1016/j.conbuildmat.2021.124758>

Co-author: JN Mandal

Abstract: Design and construction of pavements and structural foundations on soft ground are risky and costly projects for civil engineers because of the low bearing capacity of soil and the massive amount of granular fill required for replacing it. Improvement of the soft ground using natural materials is a sustainable, efficient, and cost-effective technique for providing a stable and supportive base for various civil engineering structures. This paper focuses on the use of bamboo grids to effectively improve the performance of soft subgrade underlying copper slag. Two types of bamboo grids in different aperture shapes were used to compare their effectiveness. The performance of the bamboo grids was evaluated on the basis of placement depths and their sizes. Model tests were carried out to analyse the effect of thickness of copper slag layer on footing pressure and settlement response of the base-subgrade system. A substantial improvement in footing pressure and footing settlement was observed at different levels of settlement. The tridirectional bamboo grid (hexagonal aperture) reinforced foundation base exhibited better performance than the bidirectional bamboo grid (square aperture). The footing pressure improvement ratio in the foundation bed using the tridirectional and bidirectional bamboo grid was found to be 2.28 and 1.89, respectively, while footing settlement reductions were obtained as 87% and 78%, respectively, for the same size of reinforcement. From the present study, it has been suggested that the bamboo grid and copper slag can be used for improving the soft subgrade, especially considering their availability and cost.

Keywords: Bamboo grid, Copper slag, Soft subgrade, Square footing, Static loading



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Title of Paper: **Performance Optimization of Microbial Electrolysis Cell (MEC) for Palm Oil Mill Effluent (POME) Wastewater Treatment and Sustainable Bio-H₂ Production using Response Surface Methodology (RSM)**

International Journal of Hydrogen Energy, Elsevier, Available Online: 22 October 2021

DOI: <https://doi.org/10.1016/j.ijhydene.2021.09.259>

Co-authors: Abudukeremu Kadier, Junying Wang, K Chandrasekhar, Peyman Abdeshahian, M Amirul Islam, Farshid Ghanbari, Mukul Bajpai, Surjit Singh Katoch, Hui Li, Mohd Sahaid Kalil, Aidil Abdul Hamid, Hassimi Abu Hasan & Peng-Cheng Ma

Abstract: Microbial electrolysis cells (MECs) are a new bio-electrochemical method for converting organic matter to hydrogen gas (H₂). Palm oil mill effluent (POME) is hazardous wastewater that is mostly formed during the crude oil extraction process in the palm oil industry. In the present study, POME was used in the MEC system for hydrogen generation as a feasible treatment technology. To enhance biohydrogen generation from POME in the MEC, an empirical model was generated using response surface methodology (RSM). A central composite design (CCD) was utilized to perform twenty experimental runs of MEC given three important variables, namely incubation temperature, initial pH, and influent dilution rate. Experimental results from CCD showed that an average value of 1.16 m³ H₂/m³ d for maximum hydrogen production rate (HPR) was produced. A second-order polynomial model was adjusted to the experimental results from CCD. The regression model showed that the quadratic term of all variables tested had a highly significant effect ($P < 0.01$) on maximum HPR as a defined response. The analysis of the empirical model revealed that the optimal conditions for maximum HPR were incubation temperature, initial pH, and influent dilution rate of 30.23°C, 6.63, and 50.71%, respectively. Generated regression model predicted a maximum HPR of 1.1659 m³ H₂/m³ d could be generated under optimum conditions. Confirmation experimentation was conducted in the optimal conditions determined. Experimental results of the validation test showed that a maximum HPR of 1.1747 m³ H₂/m³ d was produced.

Keywords: Microbial electrolysis cell (MEC), Hydrogen production, Palm oil mill effluent (POME), Wastewater, Optimization, Response surface methodology (RSM)

Publication by Members



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Advanced Materials

An Introduction to Modern Materials Science

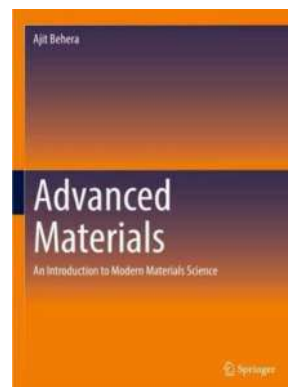
Synopsis

This book provides a thorough introduction to the essential topics in modern materials science. It brings together the spectrum of materials science topics, spanning inorganic and organic materials, nanomaterials, biomaterials, and alloys within a single cohesive and comprehensive resource. Synthesis and processing techniques, structural and crystallographic configurations, properties, classifications, process mechanisms, applications, and related numerical problems are discussed in each chapter. End-of-chapter summaries and problems are included to deepen and reinforce the reader's comprehension.

- Provides a cohesive and comprehensive reference on a wide range of materials and processes in modern materials science;
- Presents material in an engaging manner to encourage innovative practices and perspectives;
- Includes chapter summaries and problems at the end of every chapter for reinforcement of concepts.

Book information

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Publisher: Springer International Publishing
Imprint: Springer
Publication date: 25 December 2021
Edition: 1st Edition 2022
Language: English
Number of pages: 748
Binding: Hardback



Book Chapter: **Plasma Spray Coating: A Weapon to Fight with Erosion and Corrosion Phenomena**

Chapter 13, Thermal Spray Coatings, First Edition, CRC Press, Number of pages: 14, Published (Online): 04 November 2021, ISBN (Online): 9781003213185

DOI: <https://doi.org/10.1201/9781003213185>

Co-authors: Biswajit Swain & S S Mohapatra

Abstract: In the current scenario, erosion and corrosion are the most prominent material degradation phenomena which are responsible for the decrement in the efficiency and increase in overall cost of an industry. Therefore, the protection of industrial parts from the above-mentioned phenomena are the interest of the current generation researchers. However, among all the surface protection processes, plasma spray process is widely used surface coating methodology for industrial parts. In the current chapter, a detailed investigation and description of plasma spray coating for the protection from erosion and corrosion phenomena have been incorporated. In addition to the above, the association among the various process parameters and the coating have been established. Furthermore, a comparative study of plasma spray coating with other coating processes and plasma spray coating of different erosion- and corrosion-resistance materials are also discussed with experimental results. The mechanisms of different erosion and corrosion phenomena indicate the degradation of the coating. The information provided in the current chapter is beneficial for hydropower plants, offshore, chemical, oil, aviation, and automobile industries.

Keywords: Plasma spray, Surface degradation, Erosion, Corrosion, Protection

Book Chapter: **3D Printing and Nanosensors**

Chapter 8, Nanosensors for Smart Manufacturing, Micro and Nano Technologies, Elsevier, Available Online: 11 June 2021, pp 183-198

DOI: <https://doi.org/10.1016/B978-0-12-823358-0.00010-1>

Co-authors: Dipen Kumar Rajak & Patthi Bin Hussain

Abstract: In this decade additive manufacturing is playing a vital role in fabrication of various types of industrial equipment. 3D printing is a computer-aided design process offering various advantages that increase the market size for nanosensor smart manufacturing. Nanotechnology provides an advanced platform to improve the sensing properties of sensors, due to the larger surface area than that of microsensors. This chapter describes the fundamentals of 3D printing as well as nanotechnology applications for nanosensors. Various 3D printed nanosensors including physical sensors, biosensors, and chemical sensors are discussed. By incorporating 3D printing, many more complex shapes of nanosensors can be easily formed. Research is ongoing to improve the attributes of nanosensor fabrication as well as decrease the cost of the 3D printed nanosensors.

Keywords: 3D printing, Nanosensor, Nanotechnology, Layer-by-layer 3D printing, Smart manufacturing

Publication by Members

Book Chapter: **Heat Treatment Effect on the Corrosion Behaviour of Plasma Processed LM6 Alloy**

Chapter 3, Processing and Characterization of Materials, Part of the Springer Proceedings in Materials book series (SPM), Volume 13, Springer, Singapore, First Online: 02 September 2021, pp 25-36, ISBN (Print): 978-981-16-3936-4, ISBN (Online): 978-981-16-3937-1
DOI: <https://doi.org/10.1007/978-981-16-3937-1>

Co-authors: Jagadish Parida & Subash Chandra Mishra

Abstract: Al-alloys are always used increasing in marine environments because of their better resistance, low density, good mechanical properties, excellent castability and fluidity. In this work, the study on the corrosion behaviour of LM6 alloy is prepared by the plasma melting method. Some of the alloy samples were heated at temperature 350 and 450°C for 2 h then water quenched. All the alloy samples (both H.T and non-H.T) are exposed to seawater for 42 days, and then every 7 days measured the weight gain/loss. The microstructure, hardness and corrosion behaviour of the H.T and non-H.T corroded samples comparative study were carried out. The composition and morphology of corrosion products were examined with the help of an optical microscope, SEM and XRD. The results indicated that 450°C H.T samples have lower corrosion rate values and higher hardness value than 350°C H.T and non-H.T samples. Optical micrographs show that the size and number of isolated surface pits formed on H.T 450°C alloy samples are less as compared to H.T at 350°C and non-H.T alloy samples. 450°C H.T samples exhibit more corrosion resistance than 350°C H.T and non-H.T samples due to the heat treatment effect on the alloy samples. The pitting corrosion mechanism gets from the experimental investigation.

Keywords: LM6 alloy, Weight gain/loss, Water quenching, Corrosion rate, Pitting corrosion, Plasma technique

Title of Paper: **Assessing the Grip of Solar Energy Systems on Environmental Sustainability—A Review**

Micro and Nanosystems 2021, Volume 13, Issue 4, Bentham Science Publisher, ISSN (Print): 1876-4029, ISSN (Online): 1876-4037

DOI: <https://doi.org/10.2174/1876402913666210908122052>

Co-authors: Shreya Srivastava & Ramakrishna Biswal

Abstract: A sustainable energy production system fulfills its goal while being environmentally, socially, and technically sound. The intermittent availability and viability of renewable energy makes this vision a gradual and long-suffering process. In the rapid result-oriented economy, concerns regarding the environment are treated with desperate solutions that may add fuel to the fire. Although substantial research has been going on in the development of emerging technologies and refinement of established systems, we need to be reminded of the larger goal in mind: a benign and sustainable environment. Closing a door on a problem and not opening several new ones is what we must yearn to achieve. Renewable energy systems and their utility may unintentionally harm a different subset of the ecosystem. Solar energy systems are a more recent candidate with a high annual growth rate and thus, are still in the nascent stage to realise the bruised potential of the technology. By 2050, 60 million tons of solar waste will be produced if it is not resolved efficiently. To achieve environmental sustainability, it is imperative to work towards recycling redundant systems, establishing producer responsibility, fulfilling social needs and optimising future technology. By integrating aspects of the research on solar energy systems, their environmental risks, and their potential to create a sustainable ecosystem, this review article attempts to cater to environmental decision making and direct the eventual research and analysis towards their original unified objective.

Keywords: Solar energy, PV energy, CSP systems, SWH systems, Environment, Sustainability

Title of Paper: **Experimental Analysis and Mechanical Characterization of AISI P20 Tool Steel Through Heat—Treatment Process**

Journal of Bio- and Tribo-Corrosion, Volume 8, 02 November 2021

DOI: <https://doi.org/10.1007/s40735-021-00607-3>

Co-authors: M Priyadarshini, C K Biswas & Dipen Kumar Rajak

Abstract: AISI P20 is special-purpose tool steel used to produce injection molds and casting dies which should have desired properties like higher wear resistance, toughness, and hardness. The heat-treatment is established to be a vital process for the manufacturing of any product using tool steel. As the microstructure changes incurred during the process, tool steel have a greater impact on the overall characteristics. This paper investigates the changes in microstructure and phases of tool steel by following six different heat-treatment procedures. After austenitizing temperature, tool steel are cooled at -50°C , -100°C , and -150°C temperature. Surface morphology and phases analysis has been carried out using SEM and XRD, respectively. The micro-hardness, impact strength, wear test, compression test are measured using the micro-hardness tester machine, charpy test machine, pin-on-disc wear test rig, and universal testing machine, respectively. It is found that hard martensitic phase is developed for direct quenched material (both in water and in LN₂) giving maximum hardness and its percentage increases with an increase in the cooling rate. Sub-cooled metal with -150°C has higher surface hardness as compared to lower temperature processes.

Keywords: Heat-treatment, Cooling, Hardness, Compression, Impact, Wear

Title of Paper: **On the Replacement of Steel by NITINOL as Coupling Agent in Automobile Shaft**

ISSS Journal of Micro and Smart Systems, Volume 10, November 2021, pp 87–102

DOI: <https://doi.org/10.1007/s41683-021-00075-4>

Co-authors: Lokanath Barik, Saswat Samal, Dipen Kumar Rajak & Catalin I Pruncu

Abstract: Automobile couplings generally fail due to excessive misalignment in shafts and torque overload which ultimately generates vibration in the assembly. These vibrations weaken the coupling structure and ultimately get transmitted to the shaft leading to fatigue failure. Additionally, the complexity in the design of standard coupling is related to lower durability. In this system, when the radial space is larger, it triggers a bulkier transmission. Shape memory alloy such as NITINOL is a special class of smart material that possesses superelasticity which means it can retain deformation of about 8%. This material has a high degree of strength, greater elastic and shear modulus than existing coupling materials, such as steel, and has unique vibration

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damping features. Coupling made of NITINOL is simple in design and requires lesser space with minimal maintenance. They provide higher durability and are much reliable in operation over a wide range of temperatures. This paper aims to review the NITINOL material used in coupling technology industries and the parameters governing its shape memory effect. The knowledge gathered from this work enables to further extend the technological contribution to NiTi coupling at large-scale production in the automobile sector with direct effect on longer life for the transmission system.

Keywords: Coupling, Automobile, NITINOL, Shape memory effect, Coupling durability

Title of Paper: **A Critical Review on Nickel-Titanium Thin-Film Shape Memory Alloy Fabricated by Magnetron Sputtering and Influence of Process Parameters**

Transactions of the Indian Institute of Metals, Volume 74, October 2021, pp 2521–2540

DOI: <https://doi.org/10.1007/s12666-021-02418-z>

Co-authors: Bharat C G Marupalli & S Aich

Abstract: This paper discussed the fundamentals of NiTi shape memory alloy and its applications in advanced scientific fields. Currently, the world is focusing on miniaturized systems for various industrial and functional applications. The thin-film shape memory NiTi alloy plays a crucial role in MEMS/NEMS industry in fabrication of microdevices. In this article, the NiTi phase diagram along with the shape memory effect and superelasticity has also been explained. Among several types of fabrication techniques for NiTi thin films, magnetron sputtering, which yields a better homogeneous film, has been discussed. Both the operational parameters (target type, Ar pressure, applied power, target–substrate distance, substrate rotation, substrate temperature, plasma stability, deposition rate) and the material's parameters (deposition pattern, orientation of adatom, film thickness, film stress, crystal structure, grain size, intermetallic formation, oxide formation, phase transformation) have been correlated in this article. The utilization of shape memory behavior in various industrial applications has been discussed here, also the advantages and limitations of SMA have been briefly discussed.

Keywords: NiTi, Thin film, Shape memory alloy, Magnetron sputtering, Process parameters

Title of Paper: **Interchanging Characteristic of Plasma Spray Coating from Superhydrophobic to Hydrophilic under the Applied Electric Field**

Surface Engineering, Volume 37, Issue 10, 2021, pp 1328-1337

DOI: <https://doi.org/10.1080/02670844.2021.1959286>

Co-authors: B Swain, A R Pati & S S Mohapatra

Abstract: In the current work, by using NiTi plasma spray, superhydrophobic property is developed for compressor parts used in aerospace engine. The durability of the coating enhances in case of droplet impingement in cold condition (temperature = 25°C). For the hot condition the aforesaid coating needs to become hydrophilic for the retention of high durability characteristic. The discussed switching is achieved by keeping the coating with in an influence of electric field. The results revealed that the surface roughness (12.4 μm) of the coating supports the attainment of superhydrophobic characteristic depicting contact and rolling angle of 164° ± 1.5 and 8° ± 1, respectively at normal condition. By applying electric field, the coating is converted to hydrophilic in hot condition noticed by impact mapping of droplets. Furthermore, it has been observed that the coated steel plate shows better efficiency as compared to uncoated steel plate under electric field.

Keywords: Plasma spray, Superhydrophobic coating, Electric field, Dropwise, Hydrophilic

Title of Paper: **Enhancement of Flow Boiling at Very High Initial Surface Temperature by using Various Additives**

Journal of Thermal Science and Engineering Applications, Volume 13, Issue 4, August 2021, Article 041020, Number of pages: 10, ISSN (Print): 1948-5085, ISSN (Online): 1948-5093

DOI: <https://doi.org/10.1115/1.4048837>

Co-authors: B Swain, A R Pati & S S Mohapatra

Abstract: In the current work, for the simultaneous attainment of enhancement and uniformity in temperature distribution in case of quenching performed in transition and nucleate boiling regimes, the heat treatment is performed by adopting thin coolant flow boiling methodology which depicts high replacement rate of vapor and low coolant consumption rate in comparison with the other cooling methodology such as jet and spray cooling. In addition to the above, the simultaneous flow over the entire plate reduces the intensity of nonuniformity in cooling. The analysis of experimental results in case of thin-film flow boiling clearly indicates significant improvement in initial heat flux (IHF) and critical heat flux (CHF) in comparison with low mass flux jet and spray coolings. The comparative study also ensures that better enhancement and uniformity in cooling are achieved in the current case in comparison with the process such as low mass flux spray and jet coolings. Furthermore, the calculation indicates very low coolant consumption characteristic in comparison with the others, the abovementioned parameters (CHF and IHF) alter due to the change in surface tension, viscosity, specific heat, and thermal conductivity of the coolant and therefore, the role of abovementioned coolant properties in case of thin-film boiling is monitored. For this, various additives such as sodium dodecyl sulfate (SDS), polyethylene glycol (PEG), Polyoxyethylene 20 Sorbitan Monolaurate (Tween 20), and ethanol were used. In the present work, the analysis discloses that for the better Nusselt number the optimum Reynolds number is 1953 and Ohensorge number and Prandtl number are 0.0032 and 5.85, respectively.

Keywords: Transition boiling, Flow boiling, Momentum diffusivity, Thermal diffusivity, Boiling, Evaporation, Experimental/measurement techniques, Heat and mass transfer

Title of Paper: **An Overview on the Effect of Heat-treatment and Cooling Rates on Ni-based Superalloys**

Materials Today: Proceedings, Elsevier, Available Online: 22 July 2021, Volume 47, Part 11, pp 3309-3312

DOI: <https://doi.org/10.1016/j.matpr.2021.07.146>

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Co-authors: Saroj Kumar Sahu, Dinesh Kumar Mishra & Renu Prava Dalai

Abstract: Ni-based superalloys are applicable in the gas-turbine engine components and aerospace industries because they maintain their mechanical properties and tribological properties at high temperatures. Alloying with Al, Ti, Nb, and Fe, it forms the γ' and γ'' precipitates. The volume fraction and morphology of the γ' precipitates affect the mechanical properties and also they can change their morphology with heat treatment temperature, time, and cooling rates. Commonly use two-step heat treatment process for Ni-based super-alloys is heating up to 1010°C for 2 hrs plus heating up to 788°C for 8 hrs. By increasing the average size of the γ' precipitates, yield strength increases, but ductility reduces. Further, the γ' phase can precipitate coherently with the γ phase and enhance the mechanical properties. Hence in the present review focuses on the consequences of heat treatment temperature and cooling rates on the Ni-based super-alloys to efficiently optimize their performance and durability.

Keywords: Ni-based super-alloys, γ' precipitates, γ'' precipitates, Heat treatment, Cooling rates



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Title of Paper: Analyzing the Adoption Challenges of the Internet of Things (IoT) and Artificial Intelligence (AI) for Smart Cities in China

Sustainability 2021, Volume 13, Issue 19, Article ID: 10983, Published: 3 October 2021, MDPI, Switzerland

DOI: <https://doi.org/10.3390/su131910983>

Co-authors: Ke Wang, Yafei Zhao & Zhixing Li

Abstract: Smart cities play a vital role in the growth of a nation. In recent years, several countries have made huge investments in developing smart cities to offer sustainable living. However, there are some challenges to overcome in smart city development, such as traffic and transportation management, energy and water distribution and management, air quality and waste management monitoring, etc. The capabilities of the Internet of Things (IoT) and artificial intelligence (AI) can help to achieve some goals of smart cities, and there are proven examples from some cities like Singapore, Copenhagen, etc. However, the adoption of AI and the IoT in developing countries has some challenges. The analysis of challenges hindering the adoption of AI and the IoT are very limited. This study aims to fill this research gap by analyzing the causal relationships among the challenges in smart city development, and contains several parts that conclude the previous scholars' work, as well as independent research and investigation, such as data collection and analysis based on DEMATEL. In this paper, we have reviewed the literature to extract key challenges for the adoption of AI and the IoT. These helped us to proceed with the investigation and analyze the adoption status. Therefore, using the PRISMA method, 10 challenges were identified from the literature review. Subsequently, determination of the causal inter-relationships among the key challenges based on expert opinions using DEMATEL is performed. This study explored the driving and dependent power of the challenges, and causal relationships between the barriers were established. The results of the study indicated that "lack of infrastructure (C1)", "insufficient funds (C2)", "cybersecurity risks (C3)", and "lack of trust in AI, IoT" are the causal factors that are slowing down the adoption of AI and IoT in smart city development. The inter-relationships between the various challenges are presented using a network relationship map, cause-effect diagram. The study's findings can help regulatory bodies, policymakers, and researchers to make better decisions to overcome the challenges for developing sustainable smart cities

Keywords: Smart cities, Sustainability, Artificial intelligence (AI), Internet of things (IoT), Expert opinions, DEMATEL



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Title of Paper: Floods as Agents of Vitality: Reaffirming Human-nature Synergies

Water Science Policy, Published Online: 08 November 2021, Number of pages 7

DOI: <https://dx.doi.org/10.53014/REHQ6535>

Co-author: Sayanangshu Modak

Abstract: Prevalent development on floodplains has increased exposure to high flows in rivers, shaping our understanding of floods as damaging. Flood response through structural measures severely undermines natural processes that are characterised by flows in a connected fluvial system. A new paradigm of flood governance needs to identify high flows as an intrinsic part of the fluvial system and strategically integrate this natural phenomenon within human habitations. A shift to adaptive management can reduce flood risk and enable riparian communities to reap the benefits of flows in a connected river system. These benefits include water security, replenishment of soil and river nutrients, groundwater recharge, seasonal influx of freshwater and biota into wetlands and soil formation among others.

Keywords: Flood, Ganga-Brahmaputra-Meghna (GBM), Ecohydrology, Policy

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Aerospace Engineering Division

Volume No 5

Theme : **Small Satellites Initiatives in India**

On the Theme:

The small satellite is envisaged to provide platform for stand-alone payloads, which facilitate earth imaging and science missions within a quick turnaround time. Small satellites are miniaturized satellites with wider range of users, all over the world. Small satellites have several advantages over large satellites namely cost effective ways to test newer technologies, opportunities for local industry, bigger basket of potential users and thus a large variety of mission possibilities. Small satellites are transforming the dynamics and economics of space industry and ensure that space technology is no longer monopolized by nations, but is accessible to smaller and newer entities. As a space-faring nation for over last five decades, India is set to become the hub for the small satellite launch market, which is projected to be valued a substantial amount in near future. Start-ups will be the key drivers in this space, with a few among them on the final stages of developing low-cost solutions that conform to global standards. The recent reforms by the Government of India will further accelerate private sector participation in the sector. Although small spacecraft have existed for decades, in recent years, small satellites have gained considerable importance, particularly in defense sectors, which have recently gained prominence owing to technological advances in their development and integration into the armed services of the major space faring countries across the world.

Sub-themes:

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- * Design and Advancement in Satellite Launch Vehicle
- * Business Initiatives for Components, Sub-assemblies and Spare Manufacturing in Aerospace Startups
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On the Theme:

The COVID-19 pandemic has underscored the global interdependency of nations and set in motion new trends, which is reshaping the maritime transport landscape. The Indian maritime sector is at a pivotal moment facing not only immediate concerns resulting from the pandemic but also longer-term considerations, ranging from shifts in supply-chain design and globalization patterns to changes in consumption and spending habits, a growing focus on risk assessment and resilience-building, as well as a heightened global sustainability and low-carbon agenda. The sector is also dealing with the knock-on effects of growing trade protectionism and inward-looking policies. The shipbuilding industry is now witnessing an unparalleled transformation with growing demand to build new vessels and expand geographic routes, tight budgetary measures, and most importantly, the need to deliver reliable designs at affordable costs. The shipbuilding industry is now characterized with complex value chain, which involves construction of large structures. Moreover, rising demand for flexible ships poses a challenge due to the traditional construction approach prevalent in the industry. In the presence of these demanding market requirements, advanced technologies such as Industrial Internet of Things (IIoT) plays a crucial role in modernizing fleets in a cost-effective manner and also within a shorter time span. IIoT addresses various constraints pertaining to capital allocation, design, and build, and more importantly, supports optimal utilization of vessels during the commissioning and decommissioning phase of new and existing ships.

Sub-themes:

- * Technological Advancement in Shipping Industry in New Normal
- * Global Recovery in Shipping in New Normal: The Way forward
- * Maritime Industry 4.0
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On the Theme:

Amidst the ongoing global crisis, the engineers, scientists, and professionals have so far played a stellar role and have constantly scaling up their efforts and have been responsive to the challenges posed by the COVID-19 pandemic. The application of Machine Learning (ML) and Artificial Intelligence (AI) during the first wave of pandemic encouraged the researchers to outline new angles to explore different fields of mechanical engineering contributing to uninterrupted industrial growth of the country. The rapid advancements in the field of fluid mechanics leads to, unprecedented volumes of data driven experiments, field measurements, and large-scale simulations at multiple spatiotemporal scales. Moreover, Machine Learning algorithms can augment domain knowledge and automate tasks related to flow control and optimization. Tribology is another area which has been empowered with AI, ML, Big Data tools and led to evolution of 'Tribo-informatics / Intelligent Tribology'. As we embrace the new normal, most of the facets of mechanical engineering will be data driven and AI and ML need to be vectored in to optimize workspace, product and services.

Sub-themes:

- * Study of IC Engine in light of Artificial Intelligence (AI) and Machine Learning (ML)
- * Design, Operation and Maintenance of Turbine: A Machine Learning Approach
- * Advancement in Boiler Design, Operation & Maintenance through AI and ML Approach
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Metallurgical & Materials Engineering Division

Volume No 5

Theme: **Integrated Computational Materials Engineering**

On the Theme:

Integrated computational materials engineering (ICME) is an emergent field that aims to integrate computational materials science tools into a holistic system that can accelerate materials development, transform the engineering design optimization process, and unify design and manufacturing. Even though in its nascent state, ICME presents a grand challenge laden with prospects of achieving significant economic benefit and accelerate innovation in the engineering of materials and manufactured products. Papers from eminent engineers and technologists on contemporary issues having technical relevance to the theme shall be included in this volume. It is expected that the articles will be of academic values, and reflect experience of professional engineers.

Sub-themes:

- * Computer Simulations at Different Time Scales,
- * Multi scale Aspects of Materials,
- * Creating Newer Materials,
- * Thermodynamics of Materials Engineering,
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- * Fundamentals of Materials Science and Engineering,
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Mining Engineering Division

Volume No 4

Theme: **Future of Mining**

On the Theme:

The evolution of technology, from advanced data analytics to artificial intelligence (AI), has always had the potential to transform the mining industry by realizing operational efficiency improvements, enhancing productivity, improving safety performance, empowering employees to do more meaningful work, and allowing communities to be more prosperous. The COVID-19 crisis has exposed the siloed nature of mining companies and highlighted the need for integrated operations. This is likely to accelerate the adoption of digital technologies, artificial intelligence, and analytics in the mining industry. This volume will discuss what future has in store for the mining sector and the likelihood of vectoring in the intelligent, integrated operations in mining in a comprehensive manner. Papers from eminent engineers, technologists, professionals and researchers on contemporary issues having technical relevance to the theme shall be included in this volume.

Sub-themes:

- * Climate-Smart Mining
- * Responsible Sourcing (Decrease environmental footprint, Increase social footprint)
- * Adoption of low carbon product strategies
- * Collaboration to set new mining standards based on environmental, social and governance (ESG) principles
- * Digitalization for more sustainable use of resources & lowering input cost
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Production Engineering Division

Volume No 6

Theme :

Applications of Machine Learning, Deep Learning and Artificial Intelligence in Manufacturing — The Way Forward

On the Theme:

The advent of fourth industrial revolution ushered in huge industrial reforms and a paradigm shift in manufacturing from conventional product oriented labour intensive approach to a customer oriented data driven one and reinstated that promoting digital innovations coupled with intelligent decision making is the way forward. With the introduction of IIoT, Digital Twins, Smart Factories, Cyber-Physical Systems, Indian manufacturing sector has created a niche for itself in terms of productivity, efficiency and overall growth. Smart manufacturing revolution has enabled the manufacturing units to achieve timeless manufacturing goal with the objective to produce products with stated degree of precision and accuracy in a cost effective manner. In this context, Artificial Intelligence and Machine Learning are the core technologies which have provided stimulus for this transformation. These technologies, leveraged by Industry 4.0, namely Internet of Things, Advanced Embedded Systems, Cloud Computing, Big Data, Cognitive Systems, Virtual and Augmented Reality needs to be leveraged further as we prepare ourselves for adopting a newer, resilient and a self-reliant manufacturing ecosystem.

Sub-themes:

- * Data Driven Decision Making in Production Planning and Control
- * Advances in Machine Tools: Artificial Intelligence and Deep Learning Approach
- * Assessment of Industrial Automation in Machine Learning Environment
- * Deep Learning and Smart Manufacturing – The Way forward
- * Application of Big Data Analytics in Manufacturing
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- * Artificial Intelligence and Robotics in Welding Industry
- * Lean and Agile Supply Chain: Machine Learning Approach
- * Digital Fabrication and 3D Printing
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Textile Engineering Division

Volume No 5

Theme:

Development and Application of Functional Textiles

On the Theme:

Functional textiles, as we all know, are textiles with integrated functions of controlling or adjusting according to its application area. Functional textiles, over the years, have developed a niche for itself in textile industry and the associated fraternity. This range includes breathable, heat and cold-resistant materials, ultra-strong fabrics (e.g. as reinforcement for composites), new flame retardant fabrics (e.g. intumescent materials), optimized textile fabrics for acoustic properties, etc. Functional textiles became more and more important materials for various applications and interest in them grew year by year. Papers from eminent engineers, technologists, professionals and researchers on contemporary issues having technical relevance to the theme shall be included in this volume. It is expected that the articles will be of academic values, and will provide a comprehensive coverage of the subject.

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*5% discount for advertisement in 6 consecutive issues of IEI Epitome					
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Payments to be made by cheques / drafts drawn in favour of "The Institution of Engineers (India)". Transfer through NEFT/RTGS will be also accepted.					
Cheque / Draft No. Drawn on					
NEFT/RTGS/IMPS/Online Net Banking Transfer to IEI Account (please enclose the transaction slip generated):					
Transaction date: Name of Bank & Branch					
Transaction ID/UTR No./Payment Reference No. :					
Date:					
Mobile No.					
Email:					
GSTIN: Signature with seal					

Advertisement in **IEI Epitome**

Details required for Payment to IEI

Sr No	Particulars	Details
1	Name and address of the Beneficiary	The Institution of Engineers (India) 8 Gokhale Road, Kolkata 700 020
2	Account Number of Beneficiary	005010100002704
3	Account Classification	SB
4	Name and address of the Bank Branch (where payments are to be sent by Applicant)	Axis Bank Ltd, Kolkata Main Branch, 7 Shakespeare Sarani, Kolkata 700 071
5	Branch Code	005
6	The 9 Digit MICR code of the Branch (as appearing on the MICR cheque)	700 211 002
7	IFSC Code of the Bank Branch for RTGS mode	UTIB0000005
8	IFSC Code of the Bank Branch for NEFT mode	UTIB0000005
9	Email ID of Beneficiary for advice of payment by Bank	technical@ieindia.org
10	PAN	AAATT3439Q
11	Name in PAN	The Institution of Engineers (India)
12	GSTIN	19AAATT3439Q1ZR
13	Service Tax Registration Number	AAATT3439QSD027