Sl. No.	**IIT Ropar** **List of Recent Publications with Abstract** **Coverage: January, 2021**
1.	2D-Discrete Cosine Transform based Dynamically Controllable Image Compression Technique YS Kumar, R Kumar, S Kumar - IEEE 22nd Electronics Packaging Technology Conference, 2020 **Abstract:** The Discrete Cosine Transform (DCT) is commonly used for the compression of images due to its property of high power compaction. Multiplication is a key fundamental stage in the computation of Discrete Cosine Transform (DCT) of an image. In this paper, a novel low-power, high-speed run-time configurable image compression technique based on 2D-Discrete Cosine Transform (DCT) and conventional carry lookahead adder is proposed. In the proposed implementation of 2D-DCT using configurable booth multiplier, tuning of accuracy and the size of the compressed image is realized by masking the carry propagation of configurable adder at runtime. We also calculated the various performance metrics such as Mean Square Error (MSE) and Peak Signal to Noise Ratio (PSNR) of conventional multiplier based 2D-DCT and proposed designs.
2.	A comprehensive review of aluminum matrix composites reinforcement and fabrication methodologies H Singh, K Singh, S Vardhan, S Mohan, V Singh - Functional Composites and Structures, 2021 **Abstract:** Aluminium based composites extensively employed for high-performance applications in automotive and aircraft industrial on the basis of their better mechanical characteristics comprises lightweight, high specific strength and excellent malleability. Different metals and alloys are fabricated as composites using various combinations of materials with various fabrication methods. The current article explores a detailed overview of the methodologies including solid, semi-solid, liquid and vapour routes adopted by many researchers for the synthesis of reinforced based materials. The influence of reinforcement in terms of natural resources and industrial waste considered recently is briefly discussed. Based on the literature review, research work has also focused on the most economical and frequently employed synthesis method for the fabrication of aluminium matrix composites are explored.
3.	A novel method for solving constrained matrix games with fuzzy payoffs T Verma - Journal of Intelligent & Fuzzy Systems, 2021 **Abstract:** In last few years, lots of researchers have proposed different methods to solve the constrained matrix games with fuzzy payoffs. In this paper, it has been shown that the mathematical programming problem of constrained matrix games with fuzzy payoffs, considered by researchers, is mathematically invalid and hence the method, proposed by researchers to obtain the complete solution (minimum expected gain of Player I, maximum expected loss of Player II and their corresponding optimal strategies) of constrained matrix games with fuzzy payoffs by solving the mathematical programming problem with fuzzy payoffs, are also invalid. Further, in the present paper, a new method has been proposed to find the complete solution of matrix games with fuzzy payoffs. To illustrate the proposed method, some existing numerical problems of constrained matrix games with fuzzy payoffs have been solved by the proposed method.

4.	[A Review of Toxicity analysis of particulate emissions from conventional and advanced low-temperature combustion engines](#) NK Yadav, MR Saxena, RK Maurya - SAE Technical Paper, 2021 **Abstract:** Automotive engines produce pollutant species which has the potential to damage human health as well as the environment. The toxicity potential of these species depends on the concentration, route, and time of exposure. Toxicity studies are required in the current scenario due to increase in pollution level by vehicles used for transportation.The presented study is a review focused on the toxicity analysis of particulate, elemental and organic carbon emission from the internal combustion engine with conventional and alternative fuels like biodiesel and alcohols. The study is focused on the formation, characterization and quantification of particulate matter, elemental and organic carbon, and their effect on human health. The other part of the study is focused on mutagenicity (mutation in DNA), Cytotoxicity (cell toxicity), ecotoxicity (plant and ambient toxicity) analysis of the particulate emitted from the engines. Mutagenicity analysis determines the carcinogenic nature of a chemical species. The study investigates the reasons for the formation of such pollutant, their morphology, and role in the toxicity of ambient air. This paper provides new insight for the investigation of nature of particulate and their effect on human health and the environment.
5.	[A survey to gauge confidence of Indian clinicians on three primary devices for blood pressure measurement](#) R Kumar, AK Sahani, GS Wander - Blood Pressure Monitoring, 2021 **Abstract:** Purpose As per its commitment at Minamata convention, and in line with other developed economies, the Indian government is set to ban the use of mercury sphygmomanometers by end of the year 2020. However, the Mercury sphygmomanometer is still widely used by clinicians in India. We conducted a survey to gauge the confidence of Indian clinicians on three primary devices of blood pressure (BP) measurement - mercury sphygmomanometer, aneroid sphygmomanometer and automatic digital BP monitor. Materials and methods We conducted an anonymous online survey through various clinician forums asking questions related to accuracy, reliability and expectations from BP monitors. Results A total of 139 responses were received from clinicians across specialties. The results show that more than 80% of clinicians believe that mercury sphygmomanometers are the most accurate and nearly 50% find it most reliable. For most respondents, accuracy is the most important parameter and convenience of use and portability are secondary considerations. If a mercury-free sphygmomanometer is offered with the same accuracy and reliability, 88% of respondents said they are willing to buy it. Conclusions Mercury sphygmomanometer is still perceived favorably over other non-mercury alternatives by most Indian clinicians. Validated oscillometric devices should be promoted to bring about change in the perspectives of clinicians towards adopting non-mercury alternatives of BP measurement in India.

6.	[Accessing the Predictabilities in Cyclic Combustion and Emission Variations in SI Engines for their Modelling and Control: A Review](#) A Singh, RK Maurya - SAE Technical Paper, 2021 **Abstract:** Cyclic variations are inherent in the combustion of internal combustion engines. However, extreme cyclic combustion variations limit the operation of spark-ignition (SI) engines, particularly at highly lean and diluted charge operation. Lean charge operation is desired due to its expected benefits in fuel efficiency and engine-out NOx and HC emissions. Studies suggested the existence of the low-dimensional deterministic nature of cyclic variations, which is essential from the perspective of designing a high-frequency controller. The lean limit of a SI engine operation may be extended by controlling the deterministic component of cyclic variations to meet the future strict emissions and fuel economy regulations. This paper presents a review of the evolution of the experimental and analytical understanding of cyclic combustion variations of spark-ignition engines. First, the methods of characterization of cyclic combustion variations and their contributing factors are discussed, which is a prerequisite for developing a controller. Additionally, the recent studies related to cyclic emission variations and their relation with cyclic combustion variations are also discussed. Various nonlinear dynamics and chaotic methods are also discussed, along with their respective results. Nonlinear dynamical and chaotic methods are a better tool for the analysis of cyclic variations in comparison to statistical methods. It is found that engine combustion dynamics include both deterministic and stochastic components; one dominates over the other depending upon operating conditions.
7.	[An Adaptive Neuro-Fuzzy based Methodology for Harmonic Analysis of a Power Transformer](#) S Urooj, M Amir, A Khan, M Tariq - Journal of Power Technologies, 2021 **Abstract:** The interfering nature of harmonics always causes various power quality issues that impacts on both efficiency, and expected transformer life. Optimal analysis of the three-phase core power transformers using harmonic spectrum can limit these power quality issues. This paper designs the Adaptive Neuro-Fuzzy Inference System (ANFIS) based model for the estimation of losses. Further optimal parameters selection of three-phase power transformer using iron and ferrite core materials. This paper demonstrates factors that deteriorate the power quality, responsible for harmonics distortions and inefficiency in power transformers. The proposed ANFIS based analysis provides an optimal solution to harmonic reduction and improves overall efficiency. Also, providing a comparative study of various core parameters that will be suitable for a three-phase core transformer. The proposed parameters are demonstrated for improving the overall transformer efficiency using iron and ferrite core material. ANSYS Maxwell simulation estimates the Total Harmonic Distortion (THD) and enhances THD in contributing to the optimal core material. The design of a three-phase power transformer and the performance evaluation of the proposed methodology performed in MATLAB simulation environment.
8.	[An explicitly designed paratope of Amyloid-β prevents neuronal apoptosis in vitro and hippocampal damage in rat brain](#) A Paul, S Kumar, S Kalita, S Kalita, D Sarkar… A Bandyopadhyay… - Chemical Science, 2021 **Abstract:** Synthetic antibodies hold great promise in combating diseases, diagnosis, and a wide range of biomedical applications. However, designing a therapeutically amenable, synthetic antibody that can arrest the aggregation of amyloid-β (Aβ) remains challenging. Here, we report

a flexible, hairpin-like synthetic paratope (SP1, ~2 kDa), which prevents the aggregation of Aβ monomers and reverses the preformed amyloid fibril to a non-toxic species. Structural and biophysical studies further allowed dissecting the mode and affinity of molecular recognition events between SP1 and Aβ. Subsequently, SP1 reduces Aβ-induced neurotoxicity, neuronal apoptosis, and ROS-mediated oxidative damage in human neuroblastoma cells (SH-SY5Y). The non-toxic nature of SP1 and its ability to ameliorate hippocampal neurodegeneration in a rat model of AD demonstrate its therapeutic potential. This paratope engineering module could readily implement discoveries of cost-effective molecular probes to nurture the basic principles of protein misfolding, thus combating related diseases.

9.	**An Ultrathin Compact Polarization-Sensitive Triple-band Microwave Metamaterial Absorber** P Jain, AK Singh, JK Pandey, S Bansal, N Sardana… - Journal of Electronic Materials, 2021 **Abstract:** In this study, an ultra-compact metamaterial absorber (MMA) has been proposed for microwave applications comprising two modified square-shaped resonators printed on a dielectric substrate and terminated by a metallic plane. The proposed MMA exhibits perfect absorption at 3.36 GHz, 3.95 GHz and 10.48 GHz, covering S- and X-band applications. The absorber is ultra-compact (0.112 λ) in size and ultra-thin (0.018 λ) in thickness at the lowest resonating frequency. The normalized impedance, constitutive electromagnetic parameters, electric field and surface current distribution have been studied to understand the physical mechanism of the triple-band absorption. Furthermore, the absorber is analyzed with different polarization and incident angles for transverse electric waves. The proposed MMA has been experimentally demonstrated to verify the results obtained from simulations. Moreover, the effect of over-layer thickness is investigated to examine the sensing application of the absorber.
10.	**Burning Grids and Intervals** AT Gupta, SA Lokhande, K Mondal - Conference on Algorithms and Discrete Applied Mathematics: Part of the Lecture Notes in Computer Science book series, 2021 **Abstract:** Graph burning runs on discrete time steps. The aim is to burn all the vertices in a given graph in the least number of time steps. This number is known to be the burning number of the graph. The spread of social influence, an alarm, or a social contagion can be modeled using graph burning. The less the burning number, the faster the spread. Optimal burning of general graphs is NP-Hard. There is a 3-approx-imation algorithm to burn general graphs where as better approximation factors are there for many sub classes. Here we study burning of grids; provide a lower bound for burning arbitrary grids and a 2-approximation algorithm for burning square grids. On the other hand, burning path forests, spider graphs, and trees with maximum degree three is already known to be NP-Complete. In this article we show burning problem to be NP-Complete on connected interval graphs.
11.	**Cascade Intramolecular Rearrangement/Cycloaddition of Nitrocyclopropane Carboxylate with Alkynes/Alkenes: Access to Uncommon Bi (hetero) cyclic Systems** RK Varshnaya, P Singh, N Kaur, P Banerjee - Organic Chemistry Frontiers, 2021 **Abstract:** A straightforward approach for the one-pot synthesis of aziridinoisoxazoles via cascade intramolecular rearrangement of nitrocyclopropane carboxylates to cyclic nitronates followed by a thermal cycloaddition reaction with substituted phenylacetylenes has been demonstrated. All of the synthesized aziridinoisoxazoles were mostly obtained as single

	diastereomers, indicating a highly diastereoselective nature of the protocol. Additionally, nitrocyclopropane carboxylates were also made to react with ethyl acrylate to synthesize isoxazolo[2,3-b]isoxazole derivatives in a cascade one-pot fashion. The reactivity of nitrocyclopropane carboxylates with acetylenes and acrylates showed the synthetic divergence of the protocol towards the efficient synthesis of a less explored class of nitrogen heterocycles.
12.	Characterizations of Majorization on Summable Sequences GSR Kosurua, S Sahaa - Filomat, 2020 **Abstract:** In this paper, we prove a necessary and sufficient condition for majorization on the summable sequence space. For this we redefine the notion of majorization on an infinite dimensional space and therein investigate properties of the majorization. We also prove the infinite dimensional Schur-Horn type and Hardy-Littlewood-Po′lya type theorems.
13.	Chemical Fixation of CO2 Under Solvent and Co-Catalyst-free Conditions Using a Highly Porous Two-fold Interpenetrated Cu (II)-Metal–Organic Framework SS Dhankhar, R Das, B Ugale, RS Pillai, CM Nagaraja - Crystal Growth & Design, 2021 **Abstract:** A highly porous metal–organic framework (MOF) based on the Cu(II) ion, $\{[Cu_6(TATAB)_4(DABCO)_3(H_2O)_3]\cdot24DMF\}_n$ (Cu(II)-MOF) (where H3TATAB = 4,4′,4″-s-triazine-1,3,5-triyl-tri-p-aminobenzoic acid and DABCO = 1,4-diazabicyclo[2.2.2]octane) was prepared and structurally characterized. The Cu(II)-MOF features a 2-fold interpenetrated three-dimensional, dual-walled cage with a dimension of ∼29.8 Å composed of a high density of Lewis acidic (LA) Cu(II) ions and basic -NH sites. The MOF possesses a high surface area of 2043.7 m2/g and exhibits selective adsorption of CO_2 with a high heat of interaction (Qst) energy of 41.9 kJ mol–1. Owing to the synergetic participation of LA and basic sites, the Cu(II)-MOF acts as an efficient heterogeneous catalyst for co-catalyst- and solvent-free chemical fixation of CO_2 into cyclic carbonates. In-depth theoretical calculations were carried out using density functional theory (DFT) to elucidate the detailed mechanistic path involved in the successful co-catalyst-free conversion of CO_2 into cyclic carbonates by the Cu(II)-MOF, and the results were found to be in clear agreement with the experimental findings. Further, Cu(II)-MOF exhibits recyclable catalytic activity and can be reused for several cycles without significant loss of catalytic activity. Herein, we report the rational design of a highly porous Cu(II)-MOF for the co-catalyst- and solvent-free fixation of CO_2 into cyclic carbonates under environmentally friendly conditions.

14.	[Collisional ferrohydrodynamics of magnetic fluid droplets on superhydrophobic surfaces](#) N Sahoo, G Khurana, D Samanta, P Dhar - Physics of Fluids, 2021 **Abstract:** The study reports the aspects of post-impact hydrodynamics of ferrofluid droplets on superhydrophobic (SH) surfaces in the presence of a horizontal magnetic field. A wide gamut of dynamics was observed by varying the impact Weber number (We), the magnetic field strength (manifested through the magnetic Bond number (Bom), which is defined as the ratio of magnetic force to surface tension force), and the Hartmann number (Ha), defined as the ratio of magnetic force to the viscous force. For a fixed We $\sim$ 60, we observed that at moderately low Bom $\sim$300, droplet rebound off the SH surface is suppressed. The noted We is chosen to observe various impact outcomes and to reveal the consequent ferrohydrodynamic mechanisms. We also show that ferrohydrodynamic interactions lead to asymmetric spreading due to variation in magnitude of the Lorentz force, and the droplet spreads preferentially in a direction orthogonal to the magnetic field lines. We show analytically that during the retraction regime, the kinetic energy of the droplet is distributed unequally in the transverse (orthogonal to the external horizontal magnetic field) and longitudinal (along the direction of the magnetic field) directions. This ultimately leads to the suppression of droplet rebound. We studied the role of Bom at fixed We $\sim$ 60 and observed that the liquid lamella becomes unstable at the onset of retraction phase, through nucleation of holes, their proliferation and rupture after reaching a critical thickness only on SH surfaces, but is absent on hydrophilic surfaces. We propose an analytical model to predict the onset of instability at a critical Bom. The model shows that the critical Bom is a function of the impact We, and the critical Bom decreases with increasing We. We illustrate a phase map encompassing all the post-impact ferrohydrodynamic phenomena on SH surfaces for a wide range of We and Bom.
15.	[Cooperative dynamics in bidirectional transport on flexible lattice](#) A Jindal, AK Verma, AK Gupta - Journal of Statistical Physics, 2021 **Abstract:** Several theoretical models based on totally asymmetric simple exclusion process (TASEP) have been extensively utilized to study various non-equilibrium transport phenomena. Inspired by the the role of microtubule-transported vesicles in intracellular transport, we propose a generalized TASEP model, where two distinct particles are directed to hop stochastically in opposite directions on a flexible lattice immersed in a three dimensional pool of diffusing particles. We investigate the interplay between lattice conformation and bidirectional transport by obtaining the stationary phase diagrams and density profiles within the framework of mean field theory. For the case when configuration of flexible lattice is independent of particle density on lattice, the phase diagram only differs quantitatively in comparison to that obtained for bidirectional transport on rigid lattice. However, if the lattice occupancy governs the global conformation of lattice, in addition to the pre-existing phases for bidirectional transport a new asymmetric shock-low density phase originates in the system. We identified that this phase is sensitive to finite size effect and vanishes in the thermodynamic limit.
16.	[Defect Detection Capabilities of Pulse Compression based Infrared Non-destructive Testing and Evaluation](#) G Dua, V Arora, R Mulaveesala - IEEE Sensors Journal, 2020 **Abstract:** Infrared Thermography is one of the widely used method for non-destructive testing and evaluation methods due to its merits (remote, full field, safe and quantitative inspection

	capabilities) for testing and evaluation of wide variety of materials (metals, semiconductors and composites). Among the various thermal non-destructive evaluation modalities such as pulse based and mono frequency excited modulated lock-in thermography, recently proposed matched filter based non-periodic infrared thermographic approaches gained their importance due to superior test resolution and sensitivity for detection of defects hidden inside the test material. Further, feasibility to implement with low peak power heat sources in moderate experimentation time in comparison with conventional (pulse based thermographic techniques and in a limited span of time in comparison with mono frequency lock-in) thermographic techniques makes these pulse compression favorable techniques more economical and reliable. The present manuscript demonstrates the advantages of pulse compression favorable frequency modulated thermal wave imaging approach for identification of flat bottom holes in a glass fibre reinforced polymer material. The obtained results have been compared with widely used principal component thermography by taking the signal to noise ratio as a figure of merit.
17.	Development and Characterization of aerosol conditioning devices for Solid Ultrafine Particle Measurement from Diesel Engines: A Review S Rana, MR Saxena, RK Maurya - SAE Technical Paper, 2021 **Abstract:** Emission regulations mandate the measurement of solid particles of size greater than 23 nm according to particle measurement protocol (PMP). The analysis of solid particles from diesel engines requires the use of aerosol conditioning systems which can remove effectively volatile particles/species with minimum solid particles losses. Two types of aerosol conditioning devices (thermodenuder and catalytic stripper) are used for the measurement of solid ultrafine particles emitted from the diesel engine. This paper reviews the recent literature related to design and operating characteristics (temperature profile, particle losses, penetration efficiency) of the thermodenuder and catalytic striper. The origin of various particle losses such as due diffusion, thermophoresis, sedimentation in these devices is discussed. Further theoretical calculation using the empirical equation of these particle losses is also described. The merit and demerit of sampling diesel aerosols from the thermodenuder and catalytic striper are discussed. Finally, the effect of engine operating conditions on non-volatile emissions sampled with catalytic stripper and thermodenuder is presented.
18.	Distributed Independent Sets in Interval and Segment Intersection Graphs B Gorain, K Mondal, S Pandit - International Conference on Current Trends in Theory and Practice of Informatics: Part of the Lecture Notes in Computer Science book series, 2021 Abstract: The Maximal Independent Set problem is a well-studied problem in the distributed community. We study Maximum and Maximal Independent Set problems on two geometric intersection graphs; interval graphs and axis-parallel segment intersection graphs, and present deterministic distributed algorithms in the local communication model. We compute the maximum independent set on interval graphs in $O(k)$ rounds and $O(n)$ messages, where k is the size of the maximum independent set and n is the number of nodes in the graph. We provide a matching lower bound of $\Omega(k)$ on the number of rounds whereas $\Omega(n)$ is a trivial lower bound on message complexity. Thus our algorithm is both time and message optimal. We also study the maximal independent set problem in bi-interval graphs, a special case of the interval graphs where the intervals have two different lengths. We prove that a maximal independent set can be computed in bi-interval graphs in constant rounds that is 16 -approximation. For axis-parallel segment intersection graphs, we design an algorithm that finds a maximal independent

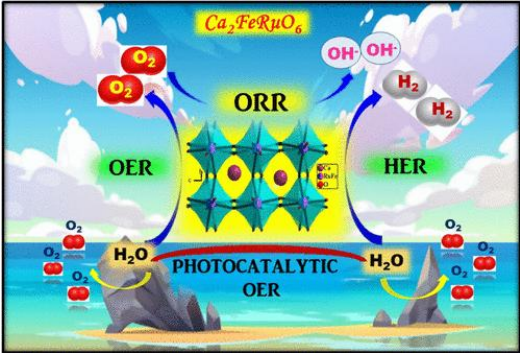|	
	set in O(D) rounds, where D is the diameter of the graph. We further show that this independent set is a 1/2 -approximation. The results in this paper extend the results of Molla et al. [J. Parallel Distrib. Comput. 2019].
19.	Domain-Specific, Semi-Supervised Transfer Learning for Medical Imaging JS Virk, DR Bathula - 8th ACM IKDD CODS and 26th COMAD, 2021 **Abstract:** Limited availability of annotated medical imaging data poses a challenge for deep learning algorithms. Although transfer learning minimizes this hurdle in general, knowledge transfer across disparate domains is shown to be less effective. On the other hand, smaller architectures were found to be more compelling in learning better features. Consequently, we propose a lightweight architecture that uses mixed asymmetric kernels (MAKNet) to reduce the number of parameters significantly. Additionally, we train the proposed architecture using semi-supervised learning to provide pseudo-labels for a large medical dataset to assist with transfer learning. The proposed MAKNet provides better classification performance with fewer parameters than popular architectures. Experimental results also highlight the importance of domain-specific knowledge for effective transfer learning. Additionally, we interrogate the proposed network with integrated gradients and perturbation methods to establish the superior quality of the learned features.
20.	Dynamic mechanical response of VO2-UHMWPE polymer composite across the phase transition D Verma, P Uniyal, D Singh, SK Verma, N Kumar… - Materials Today Communications, 2020 **Abstract:** We report the effect of phase transition of Vanadium dioxide (VO2) reinforcements in the ultra-high molecular weight polyethylene (UHMWPE) polymer matrix on the dynamic compressive strength of the composite. VO2 is well known for its insulator to metal transition above 68 °C along with the structural changes. VO2 –UHMWPE polymer composite is fabricated by hot-press method into a layered structure. The effect of filler's microstructure and strain rate ($\sim$ 2600 /s to 3500 /s) are also studied through the Split Hopkinson Pressure Bar (SHPB) test. The high strain rate loading test is carried out at room temperature and 75 °C via modified SHPB set-up to investigate the role of the phase transition in VO2 that occurs at 68 °C. The developed VO2 - UHMWPE composite shows 16 % and 9% enhancements in dynamic compressive strength across the phase transition for VO2 SCSFs and VO2 particles respectively. Phase transition of VO2 and composites are confirmed by DSC and the surface microstructure of the composites is confirmed by scanning electron microscope observations. Post - loading microstructural investigations are carried out with X-ray computed tomography that revealed cracks in the reinforced VO2 SCSFs. The developed composite with enhanced dynamic compressive strength provides a novel platform to design smart composites for high strain rate applications.
21.	Effect of Aerosol Charging on Energy Consumption During Pulse Jet Filtration Using Conductive Media A Mukhopadhyay, S Dutta, AK Choudhary, CC Reddy - Recent Trends in Traditional and Technical Textiles, 2021 **Abstract:** Energy consumption is an important aspect for any industry which directly relates to its profit margin. In the present study energy consumption during filtration of conductive filters has been analyzed at different dust charge levels on laboratory-based pulse jet system assisted

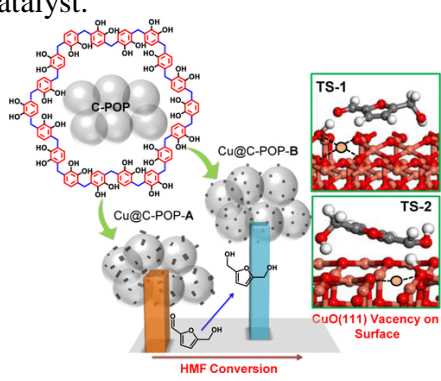|	
	with pre-charger. Five types of polyester conductive material viz. PTFE coated media, Stainless Steel Fibre blended with PET media, Stainless Steel Scrim media, Carbon Fibre blended with PET media and Carbon Filament Scrim Media have been characterized at three different charge levels viz. 4, 8, and 12 kV, and without charge. The results showed that there is a significant drop in consumption of energy with the increase in pre-charging. Energy consumption results were further compared with full scale bag house condition by calculating the power utilized for 100 bags. The outcome revealed that among all the materials the performance of PTFE coated media is the best and role of material is most significant toward the energy consumption by the filtration system. Overall energy consumption is reduced with the increase in charge level in the pre-charger. It has also been noted that percentage contribution of energy consumption for fan energy is much higher for full scale bag house as compared to flat media test rig. While for compressor energy, the difference in percentage contribution is comparatively less and for energy due to charge, there is not much variation in percentage contribution.
22.	Effect of stable stacking fault energy and crystal orientation on fracture behaviour of thin metallic single crystals R Singh, DK Mahajan - Philosophical Magazine, 2021 **Abstract:** Understanding the evolution of dislocations and twinning at the crack front is critical for designing micro-mechanical systems with improved performance. In this work, the dislocation evolution at the crack front in thin pre-cracked FCC single crystals is correlated with the associated fracture toughness, which is shown to be dependent on material specific properties such as stable stacking fault energy (γssf) and crystal orientation using atomistic simulations. For materials with high γssf value, sessile dislocations form at the crack front causing increased localised plastic flow stress that leads to low fracture toughness. Whereas the fracture process in materials with low γssf value is governed by the motion of glissile dislocations and stress-induced twinning leads to high fracture toughness. For this case, twinning occurs at high stress levels followed by un-twinning due to stress relaxation at crack front by twinning. The crystal orientation influences the type of dislocations emitted (screw/edge) from the crack front which governs the mode of crack propagation. The Mode-III crack propagation by the emission of screw type dislocations causes significant decrease in the fracture toughness compared to Mode I crack propagation which is caused by simultaneous emission of edge type dislocations on the two symmetrically inclined slip planes at the crack front. For certain pre-cracked crystal orientations, twinning is seen during the early stages of plastic deformation in materials with high γssf value. However, un-twinning is not observed in crystal orientation-based twinning at the crack front.
23.	Electro-viscoelasticity of agarose based electrorheological fluids P Dhar, V Saini, A Chattopadhyay, D Samanta - Physics of Fluids, 2021 **Abstract:** In this article, we report a new class of colloidal, micrometer-scale agarose powder based organic electrorheological (ER) fluids and its ER and viscoelastic characteristics. The steady shear ER characteristic of the colloids shows enhancements in the yield stress of the fluid, and yield stress values approaching ~1 kPa have been noted. The ER hysteresis and electro-thixotropy illustrate that the microstructure of the colloids under field effects is able to withstand dynamic and impact stresses with good repeatability. The electro-creep strain and stress relaxation characteristics of the colloids show transition to the elastoviscous state with an increase in electric field strength. The oscillatory shear ER characteristic of the colloids shows

field induced transition from a fluid-like nature to solid-like nature. Atypical regimes of loss and regain in viscoelastic nature are noted for the colloids under different field constraints. The viscoelastic dissipation and complex viscosity characteristics are also discussed for utilitarian aspects. Mathematical analysis reveals that the electric field induced viscoelastic, creep strain, and stress relaxation signatures of the colloids conform to fractional derivative elastoviscous models. The present findings may find significant implications toward the design and development of organic particle based ER fluids.

24.	**Finding the most navigable path in road networks** R Kaur, V Goyal, VMV Gunturi – GeoInformatica, 2021 **Abstract:** Input to the Most Navigable Path (MNP) problem consists of the following: (a) a road network represented as a directed graph, where each edge is associated with numeric attributes of cost and "navigability score" values; (b) a source and a destination and; (c) a budget value which denotes the maximum permissible cost of the solution. Given the input, MNP aims to determine a path between the source and the destination which maximizes the navigability score while constraining its cost to be within the given budget value. The problem can be modeled as the arc orienteering problem which is known to be NP-hard. The current state-of-the-art for this problem may generate paths having loops, and its adaptation for MNP that yields simple paths, was found to be inefficient. In this paper, we propose five novel algorithms for the MNP problem. Our algorithms first compute a seed path from the source to the destination, and then modify the seed path to improve its navigability. We explore two approaches to compute the seed path. For modification of the seed path, we explore different Dynamic Programming based approaches. We also propose an indexing structure for the MNP problem which helps in reducing the running time of some of our algorithms. Our experimental results indicate that the proposed solutions yield comparable or better solutions while being orders of magnitude faster than the current state-of-the-art for large real road networks.
25.	**First-Principle Analysis of Transition Metal Edge-Passivated Armchair Graphene Nanoribbons for Nanoscale Interconnects** VK Nishad, AK Nishad, BK Kaushik, R Sharma - IEEE Transactions on Nanotechnology, 2021 **Abstract:** In this article, the importance of edge-passivation with transition metals (TM) in armchair graphene nanoribbons (AGNRs) is described for interconnect applications. The electronic and transport properties of TM edge-passivated AGNRs structure is found to be exceptional in comparison to hydrogen edge-passivated AGNRs. Detailed analysis of binding energy, E- k diagram, density of states (DOS), transmission spectrum, current-voltage characteristics and number of conduction channels of TM edge-passivated AGNRs configuration has been performed using density functional theory and non-equilibrium Green function technique. The significant interconnect performance metrics such as delay, energy-delay-product (EDP) have also been evaluated to justify the importance of projected work. The TMs considered in this work are Palladium (Pd), Platinum (Pt), Rhodium (Rh) and Ruthenium (Ru). It is observed that both-side edge-passivation provides better results as compared to single-side. Ru is the potential TM that provides higher currents among all when used in both-edge passivated AGNRs. Ru-AGNR-Ru shows a 10.6x lesser delay and 9.2x lesser EDP as compared to H-AGNR-H interconnects. Therefore, taking all the results into account, both edge Ru-passivated AGNRs i.e., Ru-AGNR-Ru, with the most stable structure in both side TM edge passivation, proves to be the best contender for future interconnect applications.

26.	[Investigating the role of oxygen and related defects for the self-biased and moderate-biased performance of β-Ga2O3 solar-blind photodetector](#) K Arora, N Kumar, P Vashishtha, G Gupta, M Kumar - Journal of Physics D: Applied Physics, 2021 **Abstract:** High-performance, low-cost, and self-powered deep-UV photodetectors are essential for military and civil applications. -Ga2O3 stand-alone among all the solar-blind materials for its unique and suitable properties to meet all expectations of next-generation deep UV photodetectors. However, deep-traps by oxygen-vacancies critically affect the photogenerated carriers and, hence, the photodetector's final efficiency. Notwithstanding, both lack and excess of oxygen in -Ga2O3 ultimately lead to leakage channel, carrier scattering, and sub-bandgap absorption. Even so, no reports on the elaborated study on the impact of extreme cases of oxygen (oxygen-poor and oxygen-rich) on -Ga2O3 photodetector efficiency, are not available in the literature. Therefore, in the present work, we have done a deep insight of experimental results to understand the impact of varied oxygen flow-rate from 0-4% on -Ga2O3 material properties and photodetector performance. Photoluminescence, time-resolved photoluminescence, X-ray photoelectron spectroscopy, and electrical properties of fabricated photodetectors confirmed the critical role of oxygen in -Ga2O3. The TRPL measurements revealed that -Ga2O3 with 1% oxygen-flow took the reported least decay-time of nearly 50 picoseconds. A very low dark-current of 0.9 pA and a maximum photo-to-dark current of >103 was achieved at zero-bias for -Ga2O3 at an optimum oxygen-flow. The responsivity, external quantum efficiency, detectivity, and dark-current for a sample at moderate-bias fabricated with optimum oxygen-flow were found to be 190.08 A/W, 9.42×10^4%, 1.22×10^{15} Jones, and 21 nA, respectively. Hence, the measurements showed that for better device performance and self-powered response neither too low, nor too high oxygen concentration is needed and accordingly detailed mechanism is discussed. Beyond, the figure-of-merits comparison with other reported devices in both self-powered and high bias mode reveals the far superior performance of the present device.
27.	[Investigation of mechanical, material and compositional determinants of human trabecular bone quality in type 2 diabetes](#) P Sihota, RN Yadav, R Dhaliwal, JC Bose, V Dhiman… V Mehandia…, N Kumar - The Journal of Clinical Endocrinology & Metabolism, 2021 **Abstract:** Context Increased bone fragility and reduced energy absorption to fracture associated with type 2 diabetes (T2D) cannot be explained by bone mineral density alone. This study, for the first time reports on alterations in bone tissue's material properties obtained from individuals with diabetes and known fragility fracture status. Objective To investigate the role of T2D in altering biomechanical, microstructural and compositional properties of bone in individuals with fragility fracture. Design Femoral head bone tissue specimens were collected from patients who underwent replacement surgery for fragility hip fracture. Trabecular bone quality parameters were compared in samples of two groups: non-diabetic (n=40) and diabetic (n=30), with a mean duration of disease 7.5±2.8 years.

Results
No significant difference was observed in aBMD between the groups. Bone volume fraction (BV/TV) was lower in the diabetic group due to fewer and thinner trabeculae. The apparent-level toughness and post-yield energy were lower in those with diabetes. Tissue-level (nanoindentation) modulus and hardness were lower in this group. Compositional differences in diabetic group included lower mineral:matrix, wider mineral crystals, and bone collagen modifications - higher total fAGEs, higher non-enzymatic-cross-link-ratio (NE-xLR), and altered secondary structure (Amide bands). There was a strong inverse correlation between NE-xLR and post-yield-strain, fAGEs and post-yield energy, and, fAGEs and toughness.

Conclusion
Current study is novel in examining bone tissue in T2D following first hip fragility fracture. Our findings provide evidence of hyperglycemia's detrimental effects on trabecular bone quality at multiple scales leading to lower energy absorption and toughness-indicative of increased propensity to bone fragility.

28.

Multidimensional Analysis of Fake News Spreaders on Twitter

M Singh, R Kaur, SRS Iyengar - International Conference on Computational Data and Social Networks: Part of the Lecture Notes in Computer Science book series, 2020

Abstract: Social media has become a tool to spread false information with the help of its large complex network. The consequences of such misinformation could be very severe. The paper uses the Twitter conversations about the scrapping of Article 370 in India to differentiate the spreaders of fake news from the general spreaders. Various features were used for comparison such as bot usage, patterns and emotions in tweets posted by bots, heterogeneity among the spreaders, and geographic as well as demographic characteristics. The bots were found to be relatively more indulged in spreading fake tweets by conversing more through replies. The tweets related to bots engaged in spreading fake news are more emotionally loaded especially with anger, disgust and trust than tweets posted by any other bots. The people living outside India played a major role in the dissemination of fake news on Article 370. The social connections as well as demographic features do not distinguish the fake news spreaders on the platform, although the fewer number of older people were found among the fake news spreaders. This may help in automating the detection of fake news spreaders.

29.

Multifunctionality Exploration of Ca2FeRuO6: An Efficient Trifunctional Electrocatalyst toward OER/ORR/HER and Photocatalyst for Water Splitting

N Kumar, K Naveen, M Kumar, TC Nagaiah, R Sakla… - ACS Applied Energy Materials, 2021

Abstract: Durable multifunctional electrocatalysts with zero emission and high catalytic activity are desirable for environmentally benign clean energy technologies such as water-splitting devices, fuel cells, and rechargeable metal–air batteries. Herein, we investigate a new antisite disordered polycrystalline double-perovskite oxide Ca2FeRuO6 (CFR) material for catalytic activity. This makes it a remarkable electrocatalyst with excellent stability in a highly alkaline (1 M KOH) medium for oxygen reduction reaction (ORR), oxygen evolution reaction (OER), and hydrogen evolution reaction (HER). The bulk perovskite exhibits significant onset potentials of 0.9 V for ORR and 1.57 V vs the reversible hydrogen electrode (RHE) for OER, creating a superior bifunctional electrocatalyst. The novelty enhances for trifunctionality as it shows a moderate onset potential of -0.19 V vs RHE for HER. Substantially, the present material efficiently accelerates visible-light-driven water splitting for OER at neutral pH with excellent

recyclability. The photo-/electroactive perovskite is an exceptional example of a heterogeneous catalyst for multifunctional activity. A plausible mechanistic pathway for the synergistic effects of eg orbit-filling in perovskite oxides for OER, ORR, and HER activities is proposed by density functional theory (DFT) calculations.

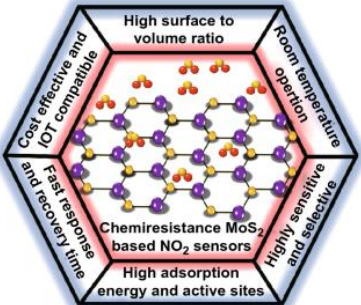| 30.	[Multi-objective optimisation framework of genetic programming for investigation of bullwhip effect and net stock amplification for three-stage supply chain systems](#) A Garg, S Singh, L Gao, X Meijuan… - International Journal of Bio-Inspired Computation, 2020 **Abstract:** In this work a multi-objective optimisation framework of genetic programming (GP) in the modelling of bullwhip effect and NSA for centralised and decentralised supply chain systems has been proposed. The individual and interactive effect of these four input factors has been investigated on bullwhip effect and NSA by adapting the parametric and sensitivity approach on the formulated models. The appropriate settings of dominant input factors (batch ordering and demand signal processing for a decentralised chain, demand signal processing and rationing shortage gaming for a centralised chain) are suggested to optimise the bullwhip effect and NSA of three-stage supply chain simultaneously. The implications and advantages of proposed optimisation framework will be useful for business practitioners to monitor and supervise the sudden demand amplification that generally faced by them in the supply chains.
31.	[Natural Convection from Two Cylinders in an Enclosure with Sinusoidal Bottom Wall: A Numerical Study](#) DK Deka, GC Pal, S Pati, PR Randive - Recent Advances in Mechanical Engineering, 2021 **Abstract:** Unsteady laminar natural convection within a square enclosure with wavy bottom wall embedded with a couple of circular cylinders placed in the vertically symmetric mid-plane is numerically investigated. Present study numerically quests for four different interspacings of the cylinders ranges $0.1 \leq S \leq 0.4$ and for Rayleigh number (Ra) in the range of 10^3–10^6. The results are discussed based on distribution of isotherms, streamlines, and temporal distribution of surface-averaged Nusselt number (Nus) along with the time-averaged Nusselt number (Nut). The outcome of the investigation infers that heat transfer takes place solely due to conduction up to $Ra = 10^3$, whereas the heat transfer shifts the mode from conduction to convection with increase in Ra. Further, Nut is found to increase with increase in S at lower values of Ra. Moreover, for higher values of Ra, the variation of Nut evaluated at the surface of the cylinders shows contrasting features with changing cylinder spacing.

32.	 **Abstract:** In recent times, selective hydrogenation of biomass-derived 5-hydroxymethylfurfural (5-HMF) to produce the novel difuranic polyol scaffold 2,5-dihydroxymethylfuran (DHMF) has attracted the interest of the many researchers due to its peculiar symmetrical structure and its widespread application as a monomer for the preparation of cross-linked polyesters and polyurethane. Copper-based catalysts have been explored for selective catalytic hydrogenation; however, hurdles are still associated with the strongly reducing H2 atmosphere and oxidizing C–O bond that make the Cu^0 and Cu^{x+} surface active species unstable, limiting the rational design of highly efficient integrated catalyst systems. To address this, herein, we built catalytic systems for 5-HMF hydrogenation with stable and balanced Cu^0 and Cu^{x+} active surface species inside the nanocage of a catechol-based porous organic polymer (POP) endowed with large surface areas, impressive stabilities, and spatial restriction inhibiting nanoparticle aggregation. Batch reactor screening identified that a superior catalytic performance (DHMF selectivity of 98%) has been achieved with our newly designed Cu@C-POP at 150 °C temperature and 20 bar H2 pressure, which was also higher than that of other reported copper catalysts. Comprehensive characterization understanding with H2-TPR and X-ray photoelectron spectroscopy (XPS) study revealed that substantially boosted activity is induced by the presence of the bulk CuO_x phase and atomically dispersed Cu species incorporating isolated Cu ions, which are further confirmed through the positive binding energy shift of Cu 2p3/2 XPS spectra (~0.4 eV). The Cu environment in our catalytic systems comprises a predominantly square planar geometry (probably Jahn–Teller distorted OH), which we gleaned from the extended X-ray absorption for fine structure (EXAFS) analysis featuring two adjacent copper atoms with the valence state in between of 0 and +2, as validated by XANES absorption edge positions. EXAFS studies further revealed a lowering of the Cu coordination number for the most active Cu@C-POP-B catalyst, suggesting the presence of metal vacancies. Density functional theory calculations showed that the presence of Cu metal vacancies stabilized the reaction intermediates formed during 5-HMF hydrogenation and decreased the hydrogenation barriers, resulting in an enhanced catalytic activity of the Cu@C-POP-B catalyst.
33.	 **Abstract:** Planning to speak is a challenge for the brain, and the challenge varies between and

within languages. Yet, little is known about how neural processes react to these variable challenges beyond the planning of individual words. Here, we examine how fundamental differences in syntax shape the time course of sentence planning. Most languages treat alike (i.e., align with each other) the 2 uses of a word like "gardener" in "the gardener crouched" and in "the gardener planted trees." A minority keeps these formally distinct by adding special marking in 1 case, and some languages display both aligned and nonaligned expressions. Exploiting such a contrast in Hindi, we used electroencephalography (EEG) and eye tracking to suggest that this difference is associated with distinct patterns of neural processing and gaze behavior during early planning stages, preceding phonological word form preparation. Planning sentences with aligned expressions induces larger synchronization in the theta frequency band, suggesting higher working memory engagement, and more visual attention to agents than planning nonaligned sentences, suggesting delayed commitment to the relational details of the event. Furthermore, plain, unmarked expressions are associated with larger desynchronization in the alpha band than expressions with special markers, suggesting more engagement in information processing to keep overlapping structures distinct during planning. Our findings contrast with the observation that the form of aligned expressions is simpler, and they suggest that the global preference for alignment is driven not by its neurophysiological effect on sentence planning but by other sources, possibly by aspects of production flexibility and fluency or by sentence comprehension. This challenges current theories on how production and comprehension may affect the evolution and distribution of syntactic variants in the world's languages.

34.

[Probability of Defect Detection in Glass Fibre Reinforced Polymers Using Pulse Compression Favourable Frequency Modulated Thermal Wave Imaging](#)
V Kher, R Mulaveesala - Infrared Physics & Technology, 2020

Abstract: Infrared Non-Destructive Evaluation (IRNDE) is an emerging approach among the Non-Destructive Testing (NDT) techniques to evaluate sub-surface defects, due to its non-contact, whole field, fast and quantitative defect detection abilities. Among various recently proposed aperiodic Thermal Non-destructive Testing and Evaluation (TNDT&E) methods, pulse compression favourable thermal wave imaging approaches gained significant importance due to their improved defect detection capability in terms of sensitivity and resolution. The present work attempts to explore the applicability of pulse-compression favourable Frequency Modulated Thermal Wave Imaging (FMTWI) approach for testing and evaluation of Glass Fibre Reinforced Polymer (GFRP) sample by considering the Peak to Side Lobe Ratio (PSLR) as a figure of merit. Results clearly depict that in pulse compression favourable FMTWI exhibits higher probability for detection of sub-surface defects of higher aspect ratio, with the subtraction of background temporal temperature distribution of the test sample in comparison with the presence of background.

35.

[Processing routes, resulting microstructures, and strain rate dependent deformation behaviour of advanced high strength steels for automotive applications](#)
T Nanda, V Singh, G Singh, M Singh, BR Kumar - Archives of Civil and Mechanical Engineering, 2021

Abstract: Automobile industry is continuously striving to obtain light body-in-white structures to meet tightened regulations on flue-gas emissions/crash-testing parameters. 'Advanced high strength steels (AHSS)' find increased applications in the automotive industry because of improved crashworthiness/formability at reasonably low costs. AHSS category mainly includes
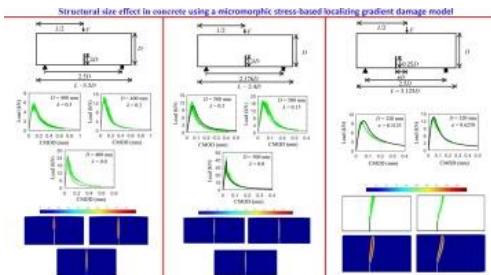
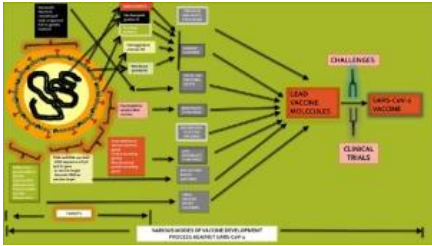|	
	transformation induced plasticity (TRIP) steels, twinning induced plasticity (TWIP) steels, dual phase (DP) steels, complex-phase (CP) steels, and quenching-partitioning (Q&P) steels. AHSSs provide superior strength-ductility combination than conventional high-strength steels by virtue of their multi-phase microstructures. Mechanical properties of AHSSs are greatly influenced by processing routes/derived microstructures. Furthermore, mechanical properties/tensile deformation behavior are also strain rate dependent. During an automobile crash, deformation occurs at strain rates which are exceedingly higher than quasi-static conditions. So, investigation of AHSS properties under both quasi-static as well as high strain rates conditions is important to check applicability for superior crash-resistance. The present work critically reviews details of processing routes, room temperature microstructures, mechanical properties, and finally strain rate dependence of tensile deformation behaviour of AHSSs. Finally, main gaps in existing literature/scope for future research with regards to high strain rate deformation dependent properties of this steel category are presented.
36.	Relay-based Communications in WBANs: A Comprehensive Survey A Vyas, S Pal, BK Saha - ACM Computing Surveys (CSUR), 2021 **Abstract:** Wireless Body Area Networks (WBANs) constitute an emerging technology in the field of health care that makes health monitoring possible from one's home itself. WBANs open many challenges by placing sensors on/inside human bodies for collecting various health-related information. Unlike traditional Wireless Sensor Networks (WSNs), communication in WBANs suffers from high channel fading and attenuation due to human body fat. Therefore, relay-based communication with data forwarding techniques is used to handle link failures and poor network connectivity. Accordingly, in this survey article, we present a comprehensive study of relay-based communication mechanisms in WBANs. We begin with a brief look at the multi-tiered architecture of WBANs, how direct communication works, and how relay-based communication is different. Subsequently, we present a detailed review of relay node selection approaches, which, in turn, also affects how a WBAN performs. In this context, we also look at the unique quality of service (QoS) demands of WBANs and how they can be assured.
37.	Rindler Physics on the String Worldsheet A Bagchi, A Banerjee, S Chakrabortty - Physical Review Letters, 2021 **Abstract:** We construct the tensionless limit of bosonic string theory in terms of a family of worldsheets with increasing acceleration and show that the null string emerges in the limit of infinite acceleration when the Rindler horizon is hit. We discover a novel phenomenon we call null string complementarity, which gives two distinct observer-dependent pictures of the emergence of open string physics from closed strings in the tensionless limit. The closed string vacuum as observed by the inertial worldsheet turns into a D instanton in the tensionless limit, while in the complementary picture from the accelerated worldsheet, one sees the emergence of a D-25 brane. We finally discuss approaching the Rindler horizon through time evolution at constant acceleration and also show how an open string picture arises very naturally.
38.	Semitotal Domination on AT-Free Graphs and Circle Graphs T Kloks, A Pandey - Conference on Algorithms and Discrete Applied Mathematics: Part of the Lecture Notes in Computer Science book series, 2021 **Abstract:** For a graph $G=(V,E)$ with no isolated vertices, a set $D\subseteq V$ is called a semitotal dominating set of G if (i) D is a dominating set of G, and (ii) every vertex in D has another

	vertex in D at a distance at most two. The minimum cardinality of a semitotal dominating set of G is called the semitotal domination number of G, and is denoted by γt2(G) . The Minimum Semitotal Domination problem is to find a semitotal dominating set of G of cardinality γt2(G) . In this paper, we present some algorithmic results on Semitotal Domination. We show that the decision version of the Minimum Semitotal Domination problem is NP-complete for circle graphs. On the positive side, we show that the Minimum Semitotal Domination problem is polynomial-time solvable for AT-free graphs. We also prove that the Minimum Semitotal Domination for AT-free graphs can be approximated within approximation ratio of 3 in linear-time. Our results answer the open questions posed by Galby et al. in their recent paper.
39.	Spatiotemporal variability of multifractal properties of fineresolution daily gridded rainfall fields over India A Sankaran, SR Chavan, M Ali, AD Sindhu, DS Dharan… - Natural Hazards, 2021 **Abstract:** This study investigated the multifractal characteristics of fine resolution (0.25ox0.25°) daily gridded rainfall fields of India over the period 1901–2013 to examine their spatiotemporal variability. The scaling characterization using Multifractal Detrended Fluctuation Analysis (MFDFA) detected short-term persistency and strong multifractality in the majority of rainfall (over 81%) of the grid points. A detailed exploration on the spatial variability of multifractal properties such as Hurst exponent, spectral width, asymmetry index, Hölder exponent are also performed for six rainfall homogenous regions and 34 meteorological subdivisions in India. The results showed that the highest persistence and complexity is noted in the mountainous terrains of northern and northeastern India. The sub-divisional scale analysis showed that the variability of persistence and complexity is the highest in Kerala and lowest at Vidarbha. Further, the evaluation of multifractal properties of rainfall series of pre- and post-1976/77 Pacific climate shift showed an increase in strength of multifractality in 62% grids after the shift. Changes in the status of persistence with respect to 1976/77 is the highest at Uttaranchal subdivision and changes from positive to negative asymmetry was the highest at northwestern (NW) region. Grid points of Peninsular India exhibited least reduction in complexity, multifractality and persistence in the post-1977 period when compared to pre-1977 period.
40.	Special Feature on Nondestructive Evaluation of Materials R Mulaveesala - Measurement Science and Technology, 2020 **Abstract:** This volume of Measurement Science and Technology contains a Special Feature on Nondestructive Evaluation of Materials. The special feature puts together research articles within the common denominator of nondestructive testing and evaluation (NDT&E) methods, in particular for inspection of composites, semiconductors and metals. This special feature tried to demonstrate the breadth of applications for which one can use nondestructive testing techniques, together with very recent research developments, some clear demonstrations of the method at work in applications and some of the necessary background theory that underpins the basic testing techniques. This special feature was based on the adopted testing methodology and the principles involved, and further sub-classified into optical, thermal, electrical, acoustical, and microwave nondestructive testing methods. These are presented as follows with a brief description of the accepted manuscripts in each sub-section.

41.	SSBC 2020: Sclera Segmentation Benchmarking Competition in the Mobile Environment M Vitek, A Das, Y Pourcenoux, A Missler, C Paumier…V Mehta… - IEEE International Joint Conference on Biometrics, 2020 **Abstract:** The paper presents a summary of the 2020 Sclera Segmentation Benchmarking Competition (SSBC), the 7th in the series of group benchmarking efforts centred around the problem of sclera segmentation. Different from previous editions, the goal of SSBC 2020 was to evaluate the performance of sclera-segmentation models on images captured with mobile devices. The competition was used as a platform to assess the sensitivity of existing models to i) differences in mobile devices used for image capture and ii) changes in the ambient acquisition conditions. 26 research groups registered for SSBC 2020, out of which 13 took part in the final round and submitted a total of 16 segmentation models for scoring. These included a wide variety of deep-learning solutions as well as one approach based on standard image processing techniques. Experiments were conducted with three recent datasets. Most of the segmentation models achieved relatively consistent performance across images captured with different mobile devices (with slight differences across devices), but struggled most with low-quality images captured in challenging ambient conditions, i.e., in an indoor environment and with poor lighting.

42.	Strategy and Future Prospects to Develop Room-Temperature-Recoverable NO 2 Gas Sensor Based on Two-Dimensional Molybdenum Disulfide AV Agrawal, N Kumar, M Kumar - Nano-Micro Letters, 2021 **Abstract:** Nitrogen dioxide (NO2), a hazardous gas with acidic nature, is continuously being liberated in the atmosphere due to human activity. The NO2 sensors based on traditional materials have limitations of high-temperature requirements, slow recovery, and performance degradation under harsh environmental conditions. These limitations of traditional materials are forcing the scientific community to discover future alternative NO2 sensitive materials. Molybdenum disulfide (MoS2) has emerged as a potential candidate for developing next-generation NO2 gas sensors. MoS2 has a large surface area for NO2 molecules adsorption with controllable morphologies, facile integration with other materials and compatibility with internet of things (IoT) devices. The aim of this review is to provide a detailed overview of the fabrication of MoS2 chemiresistance sensors in terms of devices (resistor and transistor), layer thickness, morphology control, defect tailoring, heterostructure, metal nanoparticle doping, and through light illumination. Moreover, the experimental and theoretical aspects used in designing MoS2-based NO2 sensors are also discussed extensively. Finally, the review concludes the challenges and future perspectives to further enhance the gas-sensing performance of MoS2. Understanding and addressing these issues are expected to yield the development of highly reliable and industry standard chemiresistance NO2 gas sensors for environmental monitoring.

43.	[Stress analysis in new improved differential vertical comb capacitive micro accelerometer using SOI technology](#) MK Dounkal, RK Bhan, N Kumar - Microsystem Technologies, 2021 **Abstract:** Recently a new improved differential vertical comb type capacitive accelerometer using silicon on insulator (SOI) technology reported having better performance than dissolve wafer process (DWP) technology. Effective figure of merit shown is much higher compared to other comb-based technologies presented in literature. Theoretical formulations developed for residual and working stress which can be utilized for optimizing the performance of microaccelerometer. Maximum reported experimental mean stress (500 MPa) and stress gradient (0.1 MPa/μm) is also studied in detail. A comparison of analytical and simulations for stress induced deflections are in good agreement (within 5.29% and 3.97%) for residual planar and axial stress respectively. Working shear stress in torsional beams at 30 g in proposed new differential vertical SOI comb type accelerometer is lesser by 20.9 MPa compared to DWP technology. For 1000 g shock, the SOI case, stress of 0.55 GPa having a better safety margin by a of factor of 2 compared to fracture limit (FL) of 1.1 GPa of silicon. In contrast to this, DWP has a stress of 1.25 GPa and hence it crosses FL value and has no safety margin. Warping stress induced in restrained torsional beam have been analyzed and compared with simulation results and found to be in good agreement within 1.87% for SOI technology case and 11.25% for DWP technology case. The effect of initial tip deflection (3.4 μm due to 500 MPa stress and 0.1 MPa/μm stress gradient) on sensitivity has marginal effect on milli g range but has moderate influence on limiting high g operational range.
44.	[Structural size effect in concrete using a micromorphic stress-based localizing gradient damage model](#) A Negi, U Singh, S Kumar - Engineering Fracture Mechanics, 2021 **Abstract:** The presence of a nonlinear fracture process zone (FPZ) plays a crucial role in governing the failure response of a quasi-brittle structure. One such influence is the structural size and boundary effect phenomenon, where the growth and interaction of FPZ with the boundary has a considerable impact on the load-carrying capacity of the structure. In this article, a numerical study is conducted using a micromorphic stress-based localizing gradient damage model [1], recently proposed by the authors, to capture the structural size effect phenomenon during quasi-brittle failure of geometrically similar concrete beams. The main objective is to reproduce the results of independent experimental investigations on the size effect in quasi-brittle structures using a single set of material and numerical parameters. Generally, a quasi-brittle fracture process starts with a diffuse network of microcracks, which eventually localizes in a narrow process zone before forming a macroscopic crack during the final stages of failure. To comply with this description, the micromorphic stress-based localizing gradient damage model incorporates evolving anisotropic nonlocal interactions throughout the loading process through an anisotropic interaction tensor and a damage dependent interaction function. A new arc-length control method based on rates of the internal and dissipated energy approach [2] is modified as per the localizing gradient damage formulation and implemented to trace the nonlinear behavior in numerical simulations. The damage model successfully reproduces the experimental results with localized damage profiles using low-order finite elements for both mode-I and mixed-mode cases.

Graphical Abstract:

Structural size effect in concrete using a micromorphic stress-based localizing gradient damage model

| 45. | [Suppression of interfacial oxygen vacancies for efficient charge extraction at CZTS/TiO2 heterojunction](#)

Nisika, K Kaur, MK Yadav, A Bag, M Kumar - Applied Physics Letters, 2021

Abstract: Earth abundant CZTS (Cu_2ZnSnS_4) absorber layers are promising for the development of cost-effective and large area photovoltaics; however, interfacial nonradiative recombination is a major obstruction to the pathways toward high performing CZTS devices. Elimination of interfacial recombination losses via interface engineering is paramount to obtain efficient CZTS solar cells. Herein, we report a systematic investigation of the influence of oxygen vacancies (OV) settled at the CZTS/TiO2 interface on the charge transfer rate in heterostructures. Modulation of OV by varying oxygen flow rate during TiO2 deposition was confirmed by x-ray photoelectron spectroscopy. Lower OV concentration shifted the conduction band offset from negative to positive at the CZTS/TiO2 heterojunction, which is essential for efficient charge transportation through the interface. Photoluminescence quenching of the CZTS/TiO2 heterojunction also showed a strong correlation between charge dynamics and OV at the interface. Finally, we found the fast decay response of photogenerated charge carriers for the CZTS/TiO2 device with lower OV strongly favors the suppression of carrier trapping at the interface. This work provides a critical insight into interface engineering in CZTS solar cells through regulating interfacial OV, particularly when an oxide electron transport layer is applied. |

| 46. | [Targets and strategies for vaccine development against SARS-CoV-2](#)

JA Malik, AH Mulla, T Farooqi, FH Pottoo, S Anwar… - Biomedicine & Pharmacotherapy, 2021

Abstract: The SARS-CoV-2, previously called a novel coronavirus, that broke out in the Wuhan city of China caused a significant number of morbidity and mortality in the world. It is spreading at peak levels since the first case reported and the need for vaccines is in immense demand globally. Numerous treatment and vaccination strategies that were previously employed for other pathogens including coronaviruses are now beingbeen adopted to guide the formulation of new SARS-CoV-2 vaccines.Several vaccine targets can be utilized for the development ofthe SARS-CoV-2 vaccine. In this review, wehighlightedthe potential of various antigenic targets and other modes of formulating an effective vaccine against SARS-CoV-2. There are a varying number of challenges encountered during developing the most effective vaccines, andmeasures for tackling such challenges will assist in fast pace development of vaccines. This review will give a concise overview of various aspects of the vaccine development process against SARS-CoV-2 including 1) potential antigen targets 2) different vaccination strategies from conventional to novel platforms, 3) ongoing clinical trials, 4) varying challenges encountered during developing the most effective vaccine and the futuristicapproaches. |

	Graphical Abstract:
47.	[Temperature and Dielectric Surface Roughness dependent Performance Analysis of Cu-Graphene Hybrid Interconnects](#) R Kumar, B Kumari, S Kumar, M Sahoo, R Sharma - IEEE Electrical Design of Advanced Packaging and Systems, 2020 **Abstract:** To exploit the superior performance of copper and graphene interconnects, hybrid interconnects are seen as a promising interconnect technology for future technology nodes. Dielectric surface roughness is a process induced phenomenon that affects the performance of the interconnects. This paper presents an in-depth investigation on the impact of temperature and dielectric surface roughness on performance parameters of Cu-Graphene hybrid interconnects.
48.	[Tris (pentafluorophenyl) borane catalyzed CC and C-heteroatom bond formation](#) G Kumar, S Roy, I Chatterjee - Organic & biomolecular chemistry, 2021 **Abstract:** A series of boron based Lewis acids have been reported to date, but among them, tris(pentafluorophenyl)borane (BCF) has gained the most significant attention in the synthetic chemistry community. The viability of BCF as a potential Lewis acid catalyst has been vastly explored in organic and materials chemistry due to its thermal stability and commercial availability. Most explorations of BCF chemistry in organic synthesis has occurred in the last two decades and many new catalytic reactivities are currently under investigation. This review mainly focuses on recent reports from 2018 onwards and provides a concise knowledge to the readers about the role of BCF in metal-free catalysis. The review has mainly been categorized by different types of organic transformation mediated through BCF catalysis for the C-C and C-heteroatom bond formation.