From HOD’s desk…

Dear readers,

Warm welcome to this edition of ME news.

I would like to first thank Prof P V Rao for providing strong leadership and selfless dedication in serving as a Head of ME department. Under his leadership, our department has consistently ranked as one of the top academic programmes in the country and globally. Our recent rank in the band 51-100 in QS ranking is a testimony to this. Additionally, since onset of COVID-19, Prof Rao played a crucial role in bringing the department together during this challenging time. Prof Rao was instrumental in recruiting many young faculty colleagues to the department. The department has made remarkable progress on all fronts during Prof Rao’s tenure.

We wish him success in his new role as Dean (Planning) at IIT Delhi. Also, I would like to welcome our new faculty members: Prof B Godara, Prof Shaurya Shriyam, Prof Prithviraj Mukhopadhyay, and Prof Kusum Meena.

Despite the uncertainty ahead of us in the academic session, we know that our highest priority is to ensure health and safety of all the stakeholders, while offering the best online learning experience to our students. Our department has shown high level of resilience in maintaining our academic productivity (be it in terms of papers published, new projects or number of PhDs graduated), even while facing limited access to our resources. I would like to thank our faculty colleagues and staff for showing extreme sense of dedication and service during these challenging times. My special words of appreciation to our students who have shown exemplary maturity and patience during these trying times.

I am happy to share the accolades won by our automobile club. Axlr8r Formula Racing recently participated in two Formula Student virtual competitions - Formula SAE Australasia 2020 and Formula Bharat 2021 and walked away with splendid results in both. In Australasia, they competed against some of the best international teams and achieved first position in the ‘Cost Event’, 2nd position in the ‘Business event’, and scored a 106 out of 150 in the ‘Design event’. Overall, the Axlr8r Formula Racing team secured 4th position in Formula SAE Australasia 2020. This is also the first and only Indian electric team to achieve two International podiums in a single competition. In Formula Bharat 2021, the Automobile Club of IIT Delhi competed against the best national teams and bagged the greatest number of awards among multiple domains of the competition. My heartiest congratulations to Shivam Agrawal and his team!

It is interesting to note that our admission process, orientation and finally classes for 2020 batch were done online. This is a big achievement and I extend a big thank you note to all who facilitated this. I am optimistic that we will continue to play a significant role in existing and new initiatives in line with the Vision 2030 of IIT Delhi. I believe that the long-standing strength of our department will help us to meet new challenges, explore new opportunities and strive for higher level of excellence. Once again, I am happy to welcome you to this edition of ME news. The newsletter will apprise of the excitement, challenges, and success stories. The entire production team of ME news deserve a huge applause for coming out with this interesting and vibrant newsletter. My special thanks to Mr. Soham Das and his team.
Editor’s note:
The launch of the ME News, the newsletter of the department of Mechanical Engineering published by the group of postgraduate students (GPS) usually takes place twice a year. The previous year was an exception, with research work of many students and activities of GPS and the clubs of the department getting halted for some months. The editor acknowledges and takes the responsibility of the failure to publish a second issue of the newsletter in 2020. A fix for the failure is attempted in this issue with more student articles, and articles by two alumni members. The two alumni members were speakers in the inaugural session of INTERACTION, which is a new discussion session of current students with Ph.D. alumni members of IITs and IISc. The newsletter also presents the activities of the clubs associated with the department as well as some achievements of the students of the department. The editor acknowledges the involvement of Prof Bahni Ray as the faculty coordinator, whose support has given GPS a revival and kept it going well since October 2020. Prof Saha is always a motivation for us and without his inspiration and advice, the team would not have been able to do much. Abhishek Kandpal, Surabhi Sahney and Shubham Sahu played important roles in preparing the newsletter. I am also thankful to Prof Mayank Kumar and Prof Kaushik Mukherjee for being an active part of this group and supporting us since the last two years. Prof Kusum Meena has newly joined GPS and we look forward to achieve further heights with her cooperation. In this newsletter seeing the light of the day, I acknowledge the spirit and work of the students who contributed to the newsletter. We hope that the success of the newsletter will inspire more students to contribute and make the newsletter a respected and widely read collection of academic articles in the future.

GPS Team
Prof S.G. Deshmukh (Head of the department)
Prof S.K. Saha (GPS mentor)
Prof Bahni Ray (GPS faculty coordinator)
Prof Mayank Kumar (MES faculty coordinator)
Prof Kaushik Mukherjee, Prof Kusum Meena (Faculty members)
Soham Das (Chief editor), Abhishek Kandpal (in charge of mails and student talks), Surabhi Sahney, Shubham Sahu (Student coordinators)
**Rope Climbing Robot**

Rope Climbing Robot is quite prevalent in contemporary times. It has many applications and could be used for rescue operations, military operations, carrying weights at perilous zones. It is equipped with camera for surveillance at perilous zones.

We are a team of six students from the Robotics club who had made a simple Rope Climbing Robot during our first summer vacation at IITD. Our objective was to design and fabricate an autonomous robot that can climb a rope by carrying a payload. With an intensive research and brainstorming our team had selected four design ideas. The finalized design is made up of a rectangular structure with two fixed wheels on the either side of a rope whose horizontal motion is controlled by a pneumatic piston. The job of pneumatic piston is to control the distance between two sets of wheels allowing the robot to climb rope of any size. It also supports through a normal force which is required to hold the rope. The wheels drives power from DC motors to attain a relative motion between wheels and rope. Torque is the key parameter for vertical motion of the robot.

Prior to fabrication it undergoes a process of (a) Designing, (b) Coding, (c) Mathematical modelling, and (d) Assembling. It includes making of a working CAD model for a physical demonstration, typical calculations of rpm & torque of DC motors, optimized electrical circuit to control the motion of robot and assembly of all the parts, that can perform a rope climbing operation. Aluminum is used to make the structure due to its unique property of light weight with adequate strength. It could be further modified by installing camera for surveillance.

**Discriminatory Price Mechanism in Smart grid:**

**A Brief**

We adopted a Stackelberg (leader-follower) game approach to develop a pricing model for retailers in the electricity market. Our model is stylized, where the retailer aims to maximize revenues and minimize operation costs while also looking after consumer satisfaction (utility). The retailer takes first turn at playing the game by setting the price and consumers respond to the price by choosing consumption. Thus, the retailer can use the price signal to control loads in real-time. We proposed a discriminatory pricing scheme where the retailer is allowed to charge different users at different rates, but the level of discrimination is bounded by $\eta$. We showed that discriminatory pricing leads to a more equitable distribution of energy in the community. It charges higher prices to consumers who have high willingness for demand and low prices to those who have low willingness and is thus, fair. It also increases the retailer revenue without appreciable change in the elastic load, which means that it can be lucrative to the retailer as well. We extended our analysis to a scenario...
where users have access to renewable energy in house and can feed back energy back to the grid. We showed that discriminatory pricing can be equally beneficial in a net-metering framework (the fairness property is preserved). Several other interesting directions are explored. We investigate the net-metering scenario in particular detail. Prosumers (users who produce at home) need to be incentivized to persuade them to sell back energy to the grid. One widely used incentivization scheme is the day-ahead contract pricing model.

However, most of the analysis in literature is from an Expected Utility Theory perspective which is flawed because human beings are risk-averse, rather than risk-neutral in the face of uncertainty. So, we re-evaluated the day-ahead contract pricing model from a Cumulative Prospect Theory standpoint and showed that in real life, prosumer sell-backs decrease considerably. Rather, something as simple as a fixed lottery scheme has much better potential as an incentivization scheme because of the human tendency of overweighting small probabilities. Sell-back amounts and retailer revenues both are found to improve under the lottery scheme. This work was recently presented at the INFORMS Annual Meeting 2020.

This work won the Suresh Chandra Memorial award for best undergraduate thesis

Diptangshu Sen

**Mechathon 2020**

Mechathon 2020, a technical event conducted by the Mechanical Engineering Society of IITD, turned out to be a massive success, witnessing a plethora of registrations from students all over the country. In total, 178 teams registered for the event, showcasing their technical abilities and mechanical intellect to solve real world problems. This event amassed the most number of participants ever, making it the largest event organized by the Mechanical Engineering Society of IIT Delhi.

The event proved to be an informative as well as an entertaining one, especially amidst all the chaos caused by the pandemic. The participants really put in their utmost efforts, be it extensive research related to the problem, or the innovations embedded in their solutions. After an intense competition among the contesting teams, six of them were shortlisted for the final round, in which the selected teams had to virtually present their solution and justify them as well. Each one of the teams proved their mettle until the very end, making it an even tougher task for the judges.

Finally, after due deliberation and discussion, Team Pesu-Blr, from PES University of Bengaluru, emerged as the winner, with Team Bolt heads occupying the second place and the third position was secured by NilMechs, a team from IIT Delhi itself. Out-and-out, Mechathon 2020 was a wonderful opportunity for various budding industrialists to exhibit their prowess in their core sectors, and a learning stage for many, which straight-up skyrocketed its success.

Mechanical Engineering Society IIT Delhi
Informals 2020
As this troublesome pandemic ended up spoiling the fun out of the vibrant fresher’s party, we looked for a way to make it up to the sorry freshers by conducting Informals 2020, which was an opportunity for the freshers in the Mechanical Department to showcase their talents and moreover, interact with their peers and we attracted a wholesome participation. There was an overwhelming response from freshers who shared their stories with us on Instagram. Some wrote about their interests, some shared their pictures and memories while others presented their feelings. This helped freshers to know each other remotely and provided them an opportunity for an informal ‘flipped mode’ interaction. All entries were quite enticing and we decided to choose some titles for the best ones.

After due deliberation, we arrived at the following titles for some mesmerizing entries:

Mr Informal- Parth Jaiswal
Ms Informal- Divyanshi Thakur
Mr Shutterbug- Yash Shirke
Ms Creative Bug- Chinmaya Gupta

Research Internship 101
Mechanical Engineering Society, IIT Delhi conducted Research Internship 101, an information sharing session, on 17th November 2020. The event turned out to be a great success with a large student turnout. Praises poured in from students of all branches who attended the event. The event was aimed at helping second and third year B. Tech. students with relevant information which would help them in securing a research internship in foreign universities. In the starting, we had a number of extraordinary seniors sharing their experiences with the audience. They had secured their in prestigious universities and B-schools in a number of countries ranging from Sweden, Australia, Hong Kong and so on. Also, these interns were diverse in the research areas. This helped the audience to get an idea of various research fields like Machine Learning, Robotics, Data Science etc. in which research could be done. After this, we had an intensive QnA session which further helped the audience to gather information about various processes involved in getting an internship and how to go about them. In all, it was a very informative session. Due to the pandemic, this event was conducted online. The event received overwhelming response and was conducted successfully despite of the online nature due to the pandemic. Thus, Research Internship 101, proved out a wonderful opportunity for curious students to know about research internships and also to clear their doubts with respect to the processes involved in it.

Mechanical Engineering Society IIT Delhi
International Formula Student Competition:
The Automobile Club of Indian Institute of Technology (IIT) Delhi, Axlr8r Formula Racing, recently participated in two Formula Student virtual competitions- Formula SAE Australasia 2020 and Formula Bharat 2021. In Australasia, the club competed against international teams and bagged the first position in the ‘Cost event’ and second spot in the ‘Business event’. They scored 106/150 in the ‘Design event’. Overall, the Axlr8r Formula Racing team secured the fourth position in Formula SAE Australasia 2020. This is also the first Indian electric team to achieve two International podiums in a single competition.

In Formula Bharat 2021, the Automobile Club of IIT Delhi competed against the national teams and bagged several awards in multiple domains of the competition. The team achieved the following feats:

- First position in the Business event
- Second position overall in the competition
- The third position in the Engineering Design event
- Best Powertrain Design Award
- Innovative Concept Award in the Business event
- Best Financials Award in the Business event

Axlr8r Formula Racing is a Formula Student team and the biggest technical club of our institute. We are a team of 30 enthusiastic undergraduates, compounding our knowledge with experience of alumni, set to make our nation proud on international platforms. The way we practice, and design things reflect the way we perform. We started making our dreams come true in 2006, and from there we progressed at a higher pace.


These competition challenges the team members to go the extra step in their education by incorporating into its intensive experience in building and manufacturing as well as considering the economic aspects of the automotive industry. In the year 2019, we became the first Indian team to clear all technical inspections and participated in dynamic events. Last year because of the pandemic, despite being at home we have given our best performance in online events. We have participated in SAE Australasia in 2020 and secured the first position in cost event, the second position in Business Plan Presentation and secured the fourth overall position at an international stage. With these achievements, we became the first Indian team to get two podiums in a single event. In Formula Bharat 2020, we have also put out our milestones by securing the first position in Business Plan Presentation, 3’rd position in engineering design and secured 2’nd position in the overall event along with bagging the maximum number of awards in multiple domains.
With various achievement after team hard work, we recently received recognition from the Ministry of Human Resource and Development. As things now get back to normal, we have gradually started to resume our manufacturing after a year and now our next aim is to improve our existing design to set a milestone in FS-East.

**Articles from Ph.D. scholars**

**Effect of Burner Diameter and Diluents on Structure and Stability of Co-flow Laminar Diffusion Flames of Diluted Methane Fuel**

The present research work has been carried out to study the flame structure of nitrogen-diluted methane flames in a laminar non-premixed oxygen-enhanced co-flow configuration system. A wide range of experiments are performed using nitrogen as a diluent with methane in jet for oxygen percentage variation in co-flow with two different burners of 4 and 9-mm diameter. The fuel stream is modeled by mixing methane and nitrogen gases. The oxidizer is modeled by mixing oxygen and nitrogen gases where the oxygen concentration level is varied from 100 % to blow-off. The fuel compositions diluted with nitrogen is varied from 12-100 % of methane and jet flow rate is maintained at 0.5 liter per minute (LPM) throughout all experiments. The co-flow rate is kept at 10 LPM for all the cases. A high co-flow rate makes the flame more stable, and it may sustain till a higher fuel dilution level. The flame length is measured under the influence of oxygen enrichment level. From experimental studies, it is found that the flame length for both 4-mm and 9-mm burner is highly sensitive to change in oxygen percentage in the oxidizer stream.

Anurag Mishra
Analysis of citizen’s perception towards segregation and composting

Municipal solid waste management (MSWM) is one of the most critical issues prevailing in the world today. It has clear implications on public health and the environment. Since MSWM has multiple stakeholders, and citizens/households play a key role, it is important to understand their perceptions and correspondingly design policies and interventions. Accordingly, this paper develops a framework to analyse the citizen perception towards MSWM and applies it to the case of South Delhi Municipal Corporation. The framework uses information both from already existing resources, and questionnaire and interviews. The data are analysed using the SPSS software version 22.0. The results from the analysis and literature survey indicate that composting and segregation are key measures for effective solid waste management. Thus, four models are developed that analyse the response to segregation, composting and the incentives that can be provided to people for effective waste management. The major limitations at the household and community level are found to be their exclusive focus on the lack of facilities from the authorities, thus indicating that their understanding of MSWM is quite limited. It is, therefore, suggested that efforts be made towards training and awareness creation for increasing the participation of citizens in solid waste management (SWM). Further, it is concluded that more focus is needed on measures such as strengthening of already existing decentralized systems and putting out the efforts of municipal bodies.

Kaveri Kala

Revenue Management Strategies Implementation in the Restaurant Industry

Revenue Management (RM) is characterized as utilizing information systems and pricing strategies to allot the right capacity at the right time and for the right price to the right consumer. RM is a fast-growing area in operations research (OR) and contributes to 3–7% revenue enhancement in the hotel, airline, car rental, and restaurant industries. RM is applicable in industries with fixed capacities, perishable inventories, varying demands, segmentable markets, reservations, and acceptable cost structure. RM has become a vital tool in industries where the capacity is limited and total industry revenue usually depends on its ability to utilize capacity effectively. This is because the industry's ability to serve additional customers is restricted as the service provider reaches the maximum capacity, as for example, in the case of a restaurant that may not have sufficient seating capacity for high footfall over the weekends. Despite the development of advanced revenue management strategies for traditional industries such as hotels and airlines, less attention has been paid to developing integrated RM solutions for Restaurant Revenue Management (RRM). As a result, rigorous mathematical modelling and optimization, including the use of Markov Decision Process, Dynamic Programming, constrained linear and non-linear optimization, has been scarcely explored for RRM. This leaves several gaps in the effective management of this high employment generating sector. Given the critical data management and integration problems in the sector, further research and development in this sector are worthwhile.

Mohit Tyagi
Molecular Dynamics investigations of nanoscale adhesion and friction at articular cartilage interface

Articular cartilage top layer unhydrated and hydrated interface atomistic models are developed and tested for their nanoscale adhesive and frictional behavior under a range of loads which simulate the stress prevailing at the joints using classical molecular dynamics simulation on LAMMPS software. Pull-off tests of unhydrated model reveals underlying mechanisms of high cohesion and friction at the interface which leads to failure or wear of dry sliding interfaces. Coefficient of friction (COF) values obtained from sliding test in unhydrated conditions ranges from 0.2-0.75 which are in good agreement with previous experimental investigations present in literature (COF-0.25). Additionally, interfacially trapped water molecules in hydrated cartilage model provide localized and global load support and in-situ molecular scale lubrication. Overall, this work identifies the nanoscale sliding mechanisms at the natural cartilage interface to device improved implant solutions with efficient load bearing capacity and provide ultralow friction and higher wear life.

Abhinava Chatterjee

Temporal and special crater wear prediction of WC/Co tools during dry turning of Ti6Al4V alloy, wear

Crater wear modelling is one of the most challenging aspects of metal cutting. Due to the presence of complex thermo-physical and chemical interactions at the tool-chip contact interface, the crater wear prediction becomes extremely tedious. In our work, a new approach is developed to predict the crater wear variation on straight grade tungsten carbide tools during titanium machining. The effect of crater wear geometry has been considered on the variation of local state variables such as normal stress, chip sliding velocity, and cutting temperature over the contact length at varying cutting times. Experimentally determined crater profiles at progressive wear stages were geometrically replicated on the cutting tool models and used for FEM analysis. In order to account for the variation of the state variables and wear rates with respect to the tool-chip contact length, the dimensionless fractional contact length parameter is introduced in the Usui characteristic wear equation. The thermo-mechanical state variables evaluated at different fractional contact lengths and cutting time were used to obtain the wear coefficients. The crater wear profile and wear depth are predicted and the same is experimentally validated over the contact length.

Sarvesh Mishra

Investigations into friction and wear behaviour of AlTiN and AlCrN coatings deposited on laser textured WC/Co using novel open tribometer tests, Surface and Coatings Technology

During metal cutting with the textured tools, a variable local friction exists due to differences in the contact behaviour owing to the presence of microtextures. The available periodic or aperiodic microscopic hierarchy on the textured tool surface changes the tribological characteristics and metal cutting performances. The friction and wear characteristics are difficult to ascertain in the
metal cutting tests as the chips continuously slide over the tool rake face under dynamic wear conditions. The present study is conducted to closely predict the frictional coefficient and wear mechanisms for textured carbide cutting tools using an open tribometer. Tests have been performed to evaluate the tribological performance of hard coatings deposited by physical vapour deposition (PVD) method on laser textured WC/Co surfaces. PVD AlTiN and AlCrN coated plain and microhole textured WC/Co pins were tested against rotating Ti6Al4V counterpart to predict the extreme pressure tribological behaviour. The results were evaluated in terms of the coefficient of friction, wear mechanisms, coating degradation behaviour and surface damages. Coating and texturing on the carbide pins reduced the friction by 27% compared to uncoated plain carbide pins.

Sarvesh Mishra

**Integrated sustainable approach for machining of Ti6Al4V alloy with textured tools under MQL and nMQL environments, Journal of Manufacturing Processes**

In order to focus on the issues of sustainable machining, an integrated coolant and cutting tool-based strategies have been proposed for Ti6Al4V turning. Laser textured cutting tools were used under vegetable oil based MQL, and alumina suspended DI water-based MQL environments. The results have shown a reduction in cutting forces, apparent friction coefficient, contact length, tool wear, and chip adhesion over the rake face with textured tools under MQL environment. Nano fluid-based cooling has a limited advantage over the range of cutting speeds and feeds as alumina nanoparticles get accumulated in the textured space. Reduced curling radius is obtained with textured tools due to the intense heat generated and associated interface multipoint micro-cutting (IMP-μC) mechanism.

Sarvesh Mishra

**Effective permeability tensor of confined flows with wall grooves of arbitrary shape**

Pressure and shear-driven flows of a confined film of fluid overlying a periodic one-dimensional topography of arbitrary shape are considered for prediction of the effective hydraulic permeability in the Stokes flow regime. The other surface confining the fluid may be a planar no-slip wall, an identically patterned wall, a free-surface or a surface with prescribed shear. Analytical predictions are obtained using spectral analysis and the domain perturbation method under the assumption of a small pattern size to pitch ratio. Using a novel decomposition of the channel height effects into exponentially and algebraically decaying components, a simple surface-metrology dependent relationship which connects the eigenvalues of the effective permeability tensor is obtained. Two representative topographies are assessed numerically: the infinitely-differentiable topography of a phase-modulated sinusoid which has multiple local extrema and zero-crossings and the non-differentiable triangular-wave topography. Non-differentiability in the form of corners of triangular patterns and the cusps of scalloped patterns are not found to be an impediment to meaningful and numerically accurate asymptotic predictions of effective permeability and effective slip, contradicting an earlier suggestion from the literature. Several distinct
applications of the theory to the friction reduction and shear stability performance of the recently developed lubricant impregnated patterned surfaces as well as to scalloped and trapezoidal drag-reduction riblets are discussed, with comparison to experimental data from the literature for the last application. Analytical approximations which have an extended domain of numerical accuracy are also proposed.

Mainendra Kumar Dewangan

Design and performance analysis of Horizontal Axis Hydrokinetic Turbine (HAHkT) with aerodynamic stall model:
For modelling the performance of a HAHkT, the most employed method is the Blade Element Momentum (BEM) theory. The starting point for the BEM model is the knowledge of the reliable two dimensional (2D) aerodynamic coefficient; lift ($C_L$) and drag ($C_D$) but these coefficients are often available only for small angles of attack ($\lambda$), while abroad range of $\lambda$; appears on the blade element of the rotor when the turbine operates at high speed. Viterna-Corrigan model is used to predict $C_L$ and $C_D$ in that range. The predicted results are validated with existing experimental data. The iterative numerical approach is used in MATLAB to obtain optimized blade profile and coefficient of power ($C_p$). At the blade pitch angle of zero and one degree, the axial induction factor (a) is close to maximum beta value of 0.33. At this beta value, the rotor performance is the maximum. The $C_p$ of the rotor is calculated at various possible tip speed ratio (TSR) and found that maximum $C_p$ is 0.50 at optimum $\lambda$; optimum of 6.3 for pitch angle of one degree. To correct the assumption of an infinite number of the blade in BEM theory, Prandtl's tip loss correction factor ($F$) is used. The result showed that thirty per cent of the blades from the blade's tip is affected due to fluid flow from the pressure side to the suction side, and the effect is significantly higher at large TSR.

Mahendra Gupta

Classification of stages of wear in spur gears based on wear debris morphology
This work aims to investigate the morphological change in the wear debris, generated during the different stages of gear wear. Wear debris are generated at the relative moving surfaces of load-bearing gear teeth. The number and size of collected wear debris provide useful information on gear fault diagnostic. In present work, both online and offline analyses of wear debris are carried out for gear fault diagnosis. In online analysis, the oil from the gear sump is passed through online wear debris counter (to estimate the number of wear particles per minute) and particle size bin. Along with the online process, the periodic oil sampling is performed to get wear debris images using a scanning electron microscope (SEM). These images are processed to determine the statistical shape, size, and boundary parameters. The results of the modified texture in different stages of gear wear are reported.

Dharmender
Computational Study of 16 kWth Furnace Cofired Using Pulverized Bituminous Coal and Liquified Petroleum Gas Operated in Un-Staged and Air-Staged Conditions

The paper presents a computational study on air-fuel combustion of bituminous coal and liquified petroleum gas (LPG) in a 16 kWth test facility with a coflow-swirl burner. The performance of three turbulence models is investigated for the furnace operated under both air-staged and un-staged conditions by comparing their predictions with the reported measurements of temperature and species concentrations. This comparison shows that the shear stress transport (SST) k-ω; model and SST k-ω; model with low-Re correction predict the profiles of temperature and species concentrations reasonably well, but significantly under-predict the temperature in the furnace core at axial locations away from the burner. On the other hand, the transition SST k-ω; model provides better overall congruency with the measured temperature and species concentrations when compared with the other turbulence models used, as indicated by relatively higher values of the Pearson correlation coefficient at locations away from the burner. The present high-fidelity computational model developed is also capable of accurately simulating the effect of coal particle size on the furnace environment, which is verified by the match between the computational predictions and the experimental results for two different sized coal samples. The model is also used to investigate the effect of coal particle size on the internal recirculation zone (IRZ) and the reattachment length (LR) for the same inlet swirl number (SN). A decrease of nearly 50% in the coal sample size results in the increase of LR and IRZ length by 20% and 82.6%, respectively.

Nitesh Sahu

A Fully Parallel Coupled Monte Carlo-Finite Volume Method for Coupled Conduction-Radiation Heat Transfer in Multi-dimensional Geometries, Computational Thermal Sciences

An Open MP based fully parallel coupled Monte Carlo–finite volume method has been developed for solving coupled conduction–radiation in a three-dimensional cubical enclosure containing a semi-transparent grey participating medium. The divergence of radiative flux is determined using the Monte Carlo method, while the energy equation is solved by the finite volume method. The Monte Carlo method which is a statistical method simulates radiation heat transfer by tracking the histories of a number of rays that represent energy bundles or photons emitted from a hot surface or medium that progresses through the medium. The performance of the proposed method is evaluated for a pure radiation problem prior to simulation of a coupled conduction–radiation problem. A number of coupled conduction–radiation problems are considered, and the results are compared with other benchmark approximate solutions. Numerical results on a multicore CPU showed that the proposed OpenMP implementation achieves good overall performance compared to the serial code and also the coupling of Monte Carlo with finite volume is stable and shows excellent agreement with the literature results.

Abhishek Sit
**New bore aerodynamic bearing**
A new bore design of a self-acting gas journal bearing has been conceived and developed for enhancing the load carrying capacity and dynamic stability parameters as compared to conventional bump-foil bearing. The new bore design involves the synergistic presence of bump foil and rigid bore segments. The new bore design yielded 5-260% increase in minimum film thickness and 80–175% improvement in stability parameters in comparison to conventional bump-foil journal bearing.

Manas Ranjan Pattnayak

**Thrust bearing with new pad designs**
Hydrodynamic thrust bearing with new pad designs (employing bionic texture) has been developed. The effects of texture parameters such as pocket/texture depth, extend of pocket and fish texture spread in the circumferential and radial directions, the number of scale texture waves in circumferential and radial directions on pads have significant impact in improving the performance of the thrust bearing. The micro-rectangular pocketed fish scale texture yielded substantial increase in minimum film thickness and reduction in friction coefficient as compared to the other pad designs.

Jeewan Chandra Atwal

**Development of customized shape patient specific tubular stent by 3D printing technology**
Cardiovascular diseases (CVDs) have now become the leading cause of mortality in India. Premature mortality in terms of years of life lost because of CVDs in India increased by 59%, from 23.2 million (1990) to 37 million (2010). One of the most common medical interventions is the percutaneous coronary intervention (PCI), which opens clogged or damaged coronary arteries. PCI uses the permanent stents with balloon angioplasty which improves necessary blood-flow. Stent geometry influences the local hemodynamic alterations i.e., the forces moving blood through the cardiovascular system) associated with adverse clinical outcomes. Moreover, in the current scenario, a new generation of stents are required matching with anatomical data of patient to degrade after performing the specific function. The solution of the above-mentioned problem is the development of a customized stent by the help of CT scan or MRI data. To address the problem, novel methodology to fabricate customized shape polymeric tubular stent has been developed. (Novelty of the
The influence of fiber alignment, structure and concentration on mechanical behavior of carbon nanofiber/epoxy composites: Experimental and numerical study

The mechanical properties of epoxy-based nano-composites largely depend on fiber alignment, structure, concentration, and loading condition. To study the influence of these factors on the nonlinear stress-strain behavior of epoxy nano-composites, random and aligned carbon nanofiber (CNF)/epoxy composites were fabricated and tested under different strain rates. The elastic modulus and tensile strength were found to be increased as CNF concentrations increased for both random and transversely aligned nano-composites. This behavior was accurately captured by a three-dimensional representative volume element (RVE), where the fiber orientation and waviness were modeled from the experimental observation. This RVE predicted the increase in elastic modulus and tensile strength with increase in CNF concentration and strain rate as well as when the CNF alignment changes from transverse to longitudinal.

Efficiency Measurement of Indian High Courts using DEA: A Policy Perspective

The Indian judicial system is extensive and plagued by several issues, especially high pendency levels across all levels. Our work had two goals. Firstly, we measured the efficiency of Indian high courts using Data Envelopment Analysis (DEA). Secondly, we studied the impact of including pending cases on judicial efficiency. The first DEA model took only judicial resources, namely, number of judges and staff members as inputs, and two outputs, viz., number of civil and criminal cases disposed. Since further data analysis revealed a role for using caseload as an input, two more DEA models were developed to incorporate these factors. The first included the number of civil and criminal cases instituted during the year as inputs, and the second incorporated the effect of both incoming and pending cases. Models 2 and 3 helped to distinguish between the courts that are efficient with respect to incoming cases, and those that are able to efficiently manage their total workload. Results identify the specific courts that are efficient in disposing cases, including the effect of their high volume. They point to policy imperatives and overall peer learning, as well as for specific aspects such as dealing with high pendency or fresh institution of cases. Finally, a comparison between these models can help the judicial officials of inefficient courts develop reforms with specific aims such as reducing backlog of cases, matching outflow and inflow of cases, or in some cases, both.
Few interesting analytical arguments in screening and treatment of infectious diseases

An agent-based simulation of hepatitis C virus (HCV) transmission was developed, and different regime-based treatment schemes were implemented at varying uptake rates. The uptake rates represent screening rates or adherence rates. In our model, we assume 100% adherence and hence the uptake rates represent screening rates. We observed that at lower uptake rates and higher values of disease prevalence, the number of people in the first disease state was always more than the number of people in the subsequent disease states. This was in contrast with what has been reported by doctors from different hospitals in India. As India lacks proper screening programmes for HCV infection and cases reported are mostly cases of symptomatic diagnosis, hence it is expected that many infections in earlier stages will be missed out given that symptoms begin to appear in later stages of the infection. We derived the conditions when it is expected to have more people moving into the first disease state than moving out of it for stages ahead and showed that the conditions are well suited for our model. We derived the prevalence value after which we can expect more people to move out of the first state than move into it for our case. We also derived a scheme using Bayes’ theorem to determine the likelihood of a person getting diagnosed with symptomatic diagnosis given that she or he is in a particular disease state. Finally, we proved that irrespective of the absolute number of infections treated and cured, we shall always find more residual infections at the end of the intervention period in cases of lower uptake rates than in cases of higher uptake rates. This implies that with lower uptake rates, there will be more transmissions in future than with higher uptake rates. Ignoring disease transmissions underestimates the benefits of screening and treatment programmes. Thus, these insights have the potential to motivate governments and health service providers to implement screening and treatment programmes to manage infectious diseases like HCV better.

Soham Das

Articles from M.Tech students

Food grain supply chain optimization

The Indian Institute of Technology Delhi and United Nations World Food Programme (WFP) India have agreed to combine forces to develop innovative solutions for enhancing the efficiency and effectiveness of the Government’s food safety nets through Operations Research. The project aims to support the Food Corporation of India (FCI) to maximize the utilization of its supply chain infrastructure and resources, which include owned and rented warehouse spaces, contracted transport and milling facilities by analyzing important operational data such as current stocks, projected harvest yields, and consumption figures. As an outcome, the end-to-end visibility on FCI’s supply chain will be improved, and forward-looking movement, storage and allocation supply chain plans will be generated, which will minimize operational costs for monthly cereal reallocations. By taking a more strategic and long-term approach to plan the monthly reallocation of cereals across states, supply chain issues can be anticipated, and optimization techniques can be leveraged
to evaluate different implementation scenarios that are cost-efficient solutions yet practical and implementable.

The goal is to manage inventory levels at all warehouses in the country such that there is always enough storage space throughout the year at the lowest transportation cost possible. The initial model assumes each state to have one centralized granary where all grains are stored in Covered Storage and grains which exceed the covered capacity are stored in Cover and Plinth (CAP) type of storage (aggregated model). The model is formulated as a Linear Programming Problem (LPP) whose objective is to minimize the maximum fractional inventory of warehouses at all states throughout the year. Various constraints such as storage capacity limits, balancing inflow and outflow of grains in a given state on a given month, maintaining movement volumes sufficient to cater to demands in deficit states for at least the next two months, and maintaining buffer inventory levels according to current policies to even out grain storage are incorporated. This model is further extended to individual warehouses and railheads in the country along with all the existing constraints. Both models are solved using PuLP, a Python library used to solve Linear Programming and Mixed Integer Programming (MILP) problems using CPLEX and CBC solvers. The outputs from the models will provide a monthly grain movement plan that will meet practical constraints in the system at the lowest transportation cost possible.

Vivek Anand R
2nd year (Industrial Engineering)

COVID19 Alert-Improvising Perfect Supply Chains
Seeing is believing! Most of the supply chains are facing a hard time in this COVID-19 disruption phase which was never thought to happen. This article covers major issues being faced by today’s supply chains and possible solutions to those problems.

1. All forecasting models have gone in vain
Instead of using the Single Minute Exchange of Die Concept, Single Minute Exchange of Plans philosophy would be a better choice. No statistics or traditional software prepared earlier can be used to analyse this situation as the variables considered while modelling are nowhere near the variables to be considered today. To be able to reduce the effect of this issue, the best possible solution is to follow the approach of Demand-Driven Supply Chain (DDMRP Approach) with forecasting being done regularly, keeping in mind the variables such as lockdown extension possibilities, permissions and cross border challenges. It’s better to be as near as possible to the customer for efficient demand sensing as this is the best time to judge consumer behaviour. Prioritizing customers during this situation based on demand volume and past relations also becomes very important to smoothen production.

2. Labour is no Safer
Going out of their homes to produce items that are not essentials has become a cause of concern for their families. This mindset gave birth to another major issue, lack of labour availability. To tackle this issue, top management should come forward to personally address employees at all levels regarding the safety measures being taken to boost employee morale. Also, multi-skilled workers should be given preference over others and providing them with facilities near factories or office areas.

3. Vendor relations at stake
Vendors not prepared for this disruption are forcing companies to update relation norms which have become another cause of concern. It’s time to use Vendor Rankings as per past data and then moving ahead based on mutual understanding. Maintaining past relations with a continuous hunt for collaboration with fewer but bigger suppliers can be a winning solution. A proper balance should be maintained between
4. All Finished Goods turned to Dead Stock, Right Time to Innovate
The consumer has stopped buying products not considered essential which has led to many finished goods turning to dead stock. This is the best time to utilize Fisher’s work on Innovative Products. Attempts should be made to expand the product line of health care products to remain in the market. Winning the customers using new health care products in this phase can be fruitful for other existing products as well in the long run.
This is the time to find small faults and making the supply chain more flexible in terms of vendor relations, manufacturing lines, and distribution. Keeping all these points in mind, the focus should be more on responsiveness with a balance between community, safety, and business.
“Supply Chain can be improved even when there is nothing left to improve”

Akash Sachdeva
2nd year (Industrial Engineering)

Articles from B.Tech students

Severe Plastic Deformation Processing of Metal Matrix Composites:
This study details about the potential of severe plastic deformation (SPD) techniques to produce ultrafine-grained (UFG) or nanostructured (NS) materials that offer exceptional properties. Although most of these efforts were limited to laboratory-scale investigations, the industrial application of SPD processing requires tremendous research efforts.
In this view, an attempt was made to detail about the fundamental understanding of different SPD techniques and their specific applicability towards the processing of metal matrix composites. Special emphasis is placed on the microstructural evolution during SPD processing and the factors affecting the end mechanical properties of SPD processed materials. Published studies demonstrate the feasibility of lab scale SPD methods such as ECAP, HPT, MAF etc. to produce ultrafine grained materials. While the downscaling of SPD processes provides an opportunity to produce UFG wires and fibres, the up scaling is not evident although interesting adaptations such as asymmetric rolling, corrugation and straightening, con shearing, continuous confined strip shearing, ECAP-conform etc. are being developed for the continuous production of fine-grained materials. Therefore, it is now reasonable to anticipate the extensive application of UFG metal matrix composites. UFG materials find significant potential for applications under extreme conditions in aircraft systems, oil and gas industry, energy, high performance sports, bio-medical, etc. SPD processing leads to a significant increase in dislocation density which results in a unique micro/nanostructured architecture. In this regard, stacking fault energy plays a critical role. While the grain refinement in high SFE materials occurs by dislocation activities, the complex interplay between the dislocation slips and the deformation twinning or twin boundaries is responsible for the grain refinement in low SFE materials. The unique microstructure resulting from SPD processing offers additional strain hardening capability and delays the localized plastic strain instability for moderate improvements in ductility. With adequate thermal stability, SPD processing also opens up the possibility for high strain rate and / or low temperature super-plasticity.

Ankita Mandal
B.Tech ,3rd year
Research internship at KAIST:
During my second year in summer 2019, I had decided to apply for foreign research internship. I was fortunate to secure an intern position at KAIST through the visiting student research program. I worked at the Neuro Rehabilitation Lab under Prof Hyung Soon Park and the project was based on designing a prosthetic thumb. We all know, thumb’s unique properties like the maximum degrees of freedom and predominant role in gripping objects made thumb the most important asset for hand. Generally, in the commercially available prosthetics having gaps in the thumb features, a fully functional prosthetic has a large size thumb which makes it uncomfortable and inconvenient for use.

Hence, my internship focused on designing a real life-sized prosthetic thumb with full functionality. My preliminary knowledge in SolidWorks and theory of linkages and mechanisms helps me during the project. The parts were 3D printed by using Cubic Creator. The most interesting part of the project was to develop an innovative mechanism that considerably reduced the thumb size without hindering the durability. I had worked on this project for 2 months and eventually produced 2 prototypes, the second one being in the considerable reduction in size. My overall experience in KAIST had been very insightful and enriching. I will always be grateful to my professor for providing me with this wonderful opportunity of being a VSR at KAIST and ensuring a safe stay. My lab colleagues were very interacting, and they had ensured me that I felt an enriching experience.

Rupsha Bhattacharyya
B.Tech 4th year

INTERACTION- An interaction series with PhD alumni members of IITs and IISc

The GPS team conceptualized a new series of webinars, named INTERACTION, wherein young doctoral alumni members will be invited to interact with the current students of IIT Delhi. The event had been started on the 16th December 2020 and was a remarkable success. The speakers shares their experiences and gave suggestions to scholars on life and career. The talks were followed by an interaction round between students and the speakers. Prof Pulak Mohan Pandey (Professor, MED IIT Delhi) had also interacted with the house and share his ideas and experiences. The second session was held on 10th March 2021.

Speakers on 16th December 2020:
1) Prof Prithviraj Mukhopadhyay (PhD: IIT Madras)- Assistant Professor at IIT Delhi
2) Dr Nivedita Basu (PhD: IISc Bangalore)- Yield Analysis Engineer at Intel Corporation
3) Prof Girish Chandra Verma (PhD: IIT Delhi)- Assistant Professor at IIT Indore
4) Prof Minakshi Kumari (PhD: IIT Delhi)- Assistant Professor at IIM Jammu

Speakers on the 10th March, 2021:
1) Prof Amrita Puri (PhD: IIT Delhi)- Assistant Professor at IIT Jodhpur
2) Prof Zafar Alam (PhD: IIT Delhi)- Assistant Professor at IIT Dhanbad (ISM)
Alumni article

Looking back towards my Ph.D. journey, there are many things I wish I’d known at the beginning. Here, I have mentioned below a few information which I have gained during my Ph.D. studies and post Ph.D. phase, this might help new students doing this program.

1. **Maintaining healthy lifestyle:** In my experience this is one of the most important aspect of Ph.D. journey. It is better to develop a good balance between your research work and your personal life. You must remember that you joined the program for a purpose, and you must work hard towards it, however, working intensively can sometimes exhaust you, so you must create a productive balance between both the aspects. I used to play football every day after coming from lab. As the Ph.D. program is a long journey, hence looking after both the aspects is key to success.

2. **Organize the work and workspace:** Organize your completed and planned work accordingly as it might help in completing the work faster. Also, discuss your research progress with your supervisor because it keeps a check on your progress and flow of research work. Organizing the completed work will also help you in writing the thesis and papers. It is better to show the progress through presentation as it helps in enhancing your presentation skills and knowledge domain. During my Ph.D. I never preferred to give presentations, but from my post PhD experience I can certainly say that your presentation skills are as important as your knowledge.

3. **Invest time in literature and deciding your objective:** The reviews of relative domain will help you both before and after data collection, in developing your research aims and conclusions. This will help you to conceive your objective and will also provide you an insight about the peripherals/instruments needed for completing the objective. As per my experience, significant amount of literature and structured objective helps in completing of proposed work on time.

4. **Building your knowledge base:** Try to learn as much as possible about the technicalities involved in the research. This will help you in getting a good job after the Ph.D. Try to learn about the equipment and the theories you have used in your research. In most of the interviews I have been asked about the technicalities involved in my research work.

5. **Be honest towards your research:** Once in a week try to analyse the work you have completed and if the progress is not significant, then try to identify the bottle neck. According to me this is the easiest way to maintain the pace of your research work.

6. **Enjoy your research:** There is a famous quote ‘**If you do not enjoy what you are doing, you will never be good at it**’, so just love your research work. This quote is the best advice I can give to the Ph.D. students.

Girish Chandra Verma  
Assistant Professor  
Department of Mechanical Engineering, IIT Indore
Tune your capabilities

When I was approached for an article contribution to the department newsletter, the first idea that came to my mind was to discuss a part of my research work. But then, I gave it a thought and asked myself, for whom am I writing this? This article is expected to catch attention of my juniors, some peers and may be the attention of some esteemed faculty members of our department too. And then I realized, out of all the expected audience/readers, I should try to write something for my juniors, who necessarily may not be from the same specialization as that of mine. I felt this urge because it is not been too long that I have changed the sides and have taken a role that seems to be another side for the students. I can very well recall the impulse that I used to have whenever I got a chance to interact with my seniors I so much wished them to share their experiences, throw some acumens that will help us shape our career paths. So, assuming that, you will also be thinking on similar lines, I thought of writing this small piece.

Some of you, who have very recently started your journey as research scholars, will feel lost occasionally. You do not know what breadths and depths of study, exploration and skill set is expected from you. There will be moments when you may not feel fully connected to the research problem you are attempting. To those juniors, my advice is, give yourself sometime. It is just the beginning and your acquaintance with the jargons, terminologies which are going to be a part of your professional as well as personal being for rest of your life, has just started. As you move ahead with your research work, you will realize that you had a very limited view of the horizon of your research problem. Your association with your research work will grow, and unnoticeably, it will become a part of your passive life too. Mind you, PhD is not just a degree, it is a journey that matures you in so many ways. Feel blessed to be at a place where every soul that you meet, understands and appreciates the relevance of what you are doing. Take full advantage of the ecosystem you are in and please do not restrict yourself to your research work, your lab and your lab mates. Interact with people from other labs, try to analyze their problems, understand various perspectives. This should not come at the cost of your research work, but you know how to manage your time judiciously by now.

To some of my juniors who are on the verge of completing their PhD, I want to share two of my thoughts. First, do not be overstressed for your future. Second, do not get stuck with your specialization. Your PhD has, by now, prepared you for professional excellence and has trained you on acquiring an approach. However, you should not restrict yourself to your domain. The world is changing fast and interdisciplinarily is the current trend. You may be good at something, but you cannot excel unless you have an awareness/ acquaintance with different fields. So, keep yourself fluid, ready to mold, ready to acquire. Your readiness to upgrade is going to be your success mantra.

Dr. Minakshi Kumari
Assistant Professor
Operations and supply Chain Area,
IIM Jammu

Welcoming two new staff members:


2. Amresh Kumar, (27654), SLA . Joined in Turbo Machine Lab of ME on 05/06/2020
GUESTS TALK

1. **Title:** A combined simulation and machine learning approach for real-time delay prediction for waitlisted neurosurgery candidates  
   **Speaker:** Prof. Varun Ramamohan (Department of Mechanical Engineering, IIT Delhi)

2. **Title:** Finding simplicity in complex fluid flows  
   **Speaker:** Prof. Clancy Rowley (Department of Mechanical and Aerospace Engineering Department, Princeton University)

3. **Title:** Computational prediction of hemodynamical and biomechanical alterations induced by aneurysm dilatation and endovascular repair in aorta.  
   **Speaker:** Dr. Jayendiran Raja (Computational Fluid Dynamics specialist in Stryker, R&D Trauma)

4. **Title:** Composition and Trends of Particulate Matter in the Eastern United States in Winter  
   **Speaker:** Dr. Viral Shah (Harvard John A Paulson School of Engineering and Applied Sciences)

5. **Title:** Journey from a Ph.D. student to a faculty  
   **Speaker:** Prof Kusum Meena (Department of Mechanical Engineering, IIT Delhi)

6. **Title:** Electric field assisted levitation of liquid droplets in air: Pattern formation, surface oscillation and breakup  
   **Speaker:** Prof. Rochish Thakkar (IIT Bombay)

7. **Title:** Introduction of Our Research on Passive Vibration Methods for Rotors  
   **Speaker:** Prof. Yukio Ishida (Nagoya University, Japan)

8. **Title:** Computing on Largest open science supercomputers in the world  
   **Speaker:** Prof. Anshu Dubey (University of Chicago)

9. **Title:** Journey from a Ph.D. student to a faculty and his research work  
   **Speaker:** Prof. Shaurya Shriyam (Department of Mechanical Engineering, IIT Delhi)

10. **Title:** Education - a gateway to Social Innovation  
    **Speaker:** Mr. Raju Goteti (TCS’ Vice President and Head of Co-Innovation Network)

11. **Title:** Connecting Crop Productivity, Residue Fires, and Air Quality over Northern India  
    **Speaker:** Dr. Hiren T Jethva (Research Scientist, NASA)

12. **Title:** Bubbles and Drops: Natural Phenomena to Industrial Applications  
    **Speaker:** Prof. Kirti Sahu (Department of Chemical Engineering, IIT Hyderabad)

13. **Title:** Anisotropy in additive manufacturing  
    **Speaker:** Prof. Muvvala Gopinath (Department of Mechanical and Aerospace Engineering, IIT Hyderabad)

14. **Title:** Aerosol and trace gases in Indian perspective: Role in air pollution and ecosystem health  
    **Speaker:** Prof. Sachin S. Gunthe (Department of Civil Engineering, IIT Madras)

Some important links related to the Department of Mechanical Engineering at IIT Delhi:
1. GPS link: [https://web.iitd.ac.in/~bray/gps.html](https://web.iitd.ac.in/~bray/gps.html)
2. Mechanical engineering Laboratory link: [https://mech.iitd.ac.in/laboratories](https://mech.iitd.ac.in/laboratories)
3. Mechanical engineering library link: [http://mechlib.iitd.ac.in/](http://mechlib.iitd.ac.in/)
4. Mechanical engineering submitted thesis link: [http://eprint.iitd.ac.in/handle/2074/7880](http://eprint.iitd.ac.in/handle/2074/7880)
**Few Publications:**

Few awards received by students of the department:
1. Ashish Kumar Sahu, Harish Kumar, Hardik Arvind Bhai Patel, Jitin Malhotra, Society for research and Initiatives for sustainable technologies and institutions, SRISTI GYTI appreciation 2020.
3. Sarvesh Mishra. Award: Heidenhain Scholarship
   Conference: 20th International conference and exhibition (ICE2020), CERN, Geneva, Switzerland
   Awarding agency/institute: The European Society of Precision Engineering and Nanotechnology (EUSPEN, UK) and Dr. Johannes Heidenhain GmbH (Germany).
4. Jasvinder Singh, Development of customized shape patient specific tubular stent by 3D printing technology, Gandhian Young Technological Innovation Award (GYTI-2020).

PhD thesis Submitted in 2020:
1. Dayanidhi Krishana Pathak, Pulak Mohan Pandey, Development of Zinc based biodegradable material with improved mechanical and degradation properties.
4. Punit Singh, Prabal Talukdar, Characterization and property determination of food materials subjected to convective drying: experimental studies and model development.
7. Dewangan, Mainendra Kumar, Datta, Subhra, Microscale flows over patterned topographies.
8. Mishra, Sarvesh Kumar, Ghosh, Sudarsan; Aravindan, Sivanandam, Investigations into the machining of Ti6Al4V alloy using structured tools.
9. Bhadauria, Neha, Pandey, Sunil; Pandey, Pulak Mohan, In-situ surface modification for erosive wear of aircraft wings through alumina reinforcement.
10. Kansal, Sachin, Mukherjee, Sudipto, Design and development of vision based catching system.
12. Digpal Kumar, Premachandran, B, Heat transfer studies on solar air heaters for performance improvement.
13. Singh, Ravinder Pal, Pandey, Pulak Mohan, Development of rotary ultrasonic bone drilling machine and experimental investigations on human cadaver bone
15. Soni, Tukesh, Dutt, Jayanta Kumar; Das, Anindya Sundar, Active vibration control of rotors subject to base excitation using novel control laws
17. Singh, Jagtar, Pandey, Pulak Mohan, Development and experimental investigations into electric discharge machining using rapidly manufactured complex shape electrode with cooling channel.
18. Patel, Ashwinkumar Virambhai, Bhatnagar, Naresh, Experimental and numerical study of porous surface generation on titanium-based cement less femoral stems for improved osseo integration.
19. Sihag, Asha Ram, Vrat, Prem, Industrial engineering: inventory control for a small-scale unit
20. Tamang, Siddharth, Aravindan, S., Joining of dissimilar materials through microwave hybrid heating.
21. Yadav, Anil, Bhatnagar, Naresh, Studies on design and development of light weight composites for ballistic protection.
22. Madarkar, Rajeshkumar D, Ghosh, Sudarsan; Rao, P Venkateswara, Ultrasonic vibration assisted grinding of Ti-6Al-4V alloy and modeling of surface roughness.
23. Ved Prakash, D Ravi Kumar, Numerical and experimental investigations on deep drawing of an Al-Mg alloy at ambient and elevated temperatures.
27. Popatlal, Changela Kandarp, K Hariharan; Ravi Kumar, Mechanical behavior and deformation kinetics of ultrafine-grained aluminum alloys developed by cryorolling and constrained groove pressing.
29. Anil Kumar, Sudarsan Ghosh, S Aravindan, Fabrication of Si3N4 ceramic and improvement in its grinding
31. Gurminder Singh, Pulak Mohan Pandey, Experimental investigations into ultrasonic assisted pressure-less sintering for rapid manufacturing of copper components

**Welcoming new faculty members**

Prof Kusum Meena joined as Assistant Professor in Mechanical Engineering Department, IIT Delhi in June 2020. She was born and brought up in Kota, Rajasthan. She did her graduation from University College of Engineering, Kota, M.Tech from IIT Kharagpur, and PhD from Auckland University of Technology, New Zealand. She works in the area of auxetic materials, additive manufacturing, and laser processing of materials.
Er Bhupinder Godara joined the Department of Mechanical Engineering Department on Feb 13, 2020. He happens to be the first Professor of Practice in the Department.

Prior to this role, he has worked extensively in Product Development, Laboratory setup and introduction of new technology in the field of Refrigeration and Air conditioning. He has an accumulated experience of 30 years working at senior positions at Carrier, Danfoss, ACME, Onida and Fedders Lloyd. He core strength is product development from concept to market.

He has a special interest in environmentally sustainable energy efficient air-conditioning technology and has been a contributor to National Standards and Labelling Program.

His hobbies and interests beyond work include travel, photography, and meditation.

He is an alumnus of IIT Delhi having done his B.Tech in Mechanical Engineering in 1987 followed by his M. Tech. in Thermal Engineering in 1989. While at IIT Delhi as a student he was Secretary Mechanical Crafts Society and Secretary Yoga Club. His B. Tech Project won the Thermax Award in 1987.

Prof Prithviraj Mukhopadhyay obtained his Ph.D. from the Department of Mechanical Engineering, IIT Madras. Before joining at IIT Delhi, he worked as an Assistant Professor in Birla Institute of Technology and Science (BITS) Pilani. His ongoing research interests take part in alternative tool development strategies capable of enhancing cutting tool life, appreciating tool-work material compatibility, exploring advanced techniques of joining ceramic/diamond/cBN to metal, investigate the effect of filler composition on wetting characteristics and interpreting with the state-of-the-art of surface coating technology. At present, Dr. Mukhopadhyay has published nine research articles, out of which five of them are published in International Journals of repute and four in international and national conferences. He has been the coordinator for courses, such as, Precision Engineering (Metrology) at BITS Pilani; Machining Processes and Analysis, Manufacturing Processes-I at IIT Delhi and possesses a teaching experience of one and a half years. While pursuing Ph.D., Dr. Mukhopadhyay has filed four Patents (Three Indian and One International). In 2020, his Ph.D. work was appreciated with Prof. R Krishnamurthy Endowment Award at IIT Madras. In 2019, he and his team were awarded with a cash prize of rupees one lakh for developing a high-speed low noise ring orienting system for SKF India Ltd. at SIH 2019 (Hardware Edition) CSIR, India (AICTE, New Delhi, MHRD’s Innovation Cell Smart India Hackathon 2019).

Prof Shaurya Shriyam joined as Assistant Professor in Mechanical Engineering Department, IIT Delhi in February 2020. He finished his undergraduate studies at the Department of Mechanical Engineering, Indian Institute of Technology Kanpur, and obtained his Ph.D. degree at the Department of Aerospace and Mechanical Engineering, University of Southern California. His current research interests include simulation modeling, heuristic optimization, multi-agent planning, and reinforcement learning. He is interested in the application areas of robotics, logistics, healthcare, urban transport, and public resource distribution systems.
Post Doctoral Fellows (PDFs) of Mechanical Engineering

Dr Krishna Kishore Mugada joined as PDF in Mechanical Engineering Department, IIT Delhi in 20th Aug 2019. His current research interests included Friction stir welding, wire arc additive manufacturing, resistance spot welding, hybrid joining, and composites. The research accomplishments includes published book chapter in wire arc additive manufacturing, and experiments are conducted in collaboration with IIT Madras for which two SCI articles are in progress. He had completed his PhD form National Institute of Technology Warangal.

Dr Ganesh Bapu Shirsat joined as PDF in Mechanical Engineering Department, IIT Delhi in 3rd July 2019. His current research interests included Solar drying, Solar Still, Membrane distillation, textured surface, Renewable energy, IC engines, Alternative fuels, Photo-thermal materials. The research accomplishments includes designed and development of multipurpose 5 in 1 domestic and portable indirect type of solar dryer and Domestic and portable direct type of solar dryer cum chair. He had completed his PhD form Indian Institute of Technology Kanpur (2012-2018).

Dr Chandan Kumar joined as PDF in Mechanical Engineering Department, IIT Delhi in 16th March 2020. His current research interests included Laser welding, Laser Cladding, solid state welding. The research accomplishments includes publishing one research paper in SCI Journal materials engineering and performance One SCI article is submitted and one SCI article is in progress, also his experimental works are in progress in collaboration with RRCAT Indore, MP, India. He had completed his PhD form Indian Institute of Technology Guwahati.

Dr Deepak Kumar Prajapati joined as PDF in Mechanical Engineering Department, IIT Delhi in 10 Dec 2020. His current research interests included Tribology, Rolling, Contact fatigue, mixed-EHL. The research accomplishments includes writing a successful project proposal for funding. He had completed his PhD form Indian Institute of Technology Patna (2019).

Dr SS Mani Prabu joined as PDF in Mechanical Engineering Department, IIT Delhi in 4 Jan 2021. His current research interests included Shape memory alloys, welding, laser material processing, additive manufacturing. The research accomplishments includes, potential interlayers for joining of shape memory alloys and publishing a review paper on welding of shape memory alloys under progress. He had completed his PhD form Indian Institute of Technology Indore (Dec 2019).
### References of Images

These links lead us to pages from where we took pictures to add visual value to the articles, and don’t have relations from an academic viewpoint. Most of these articles did not involve pictures related to their research. Thus, we added pictures ourselves just to add visual value to the newsletter. The pictures with articles other than the above sixteen articles are related to the articles with which they are attached.

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<td>1</td>
<td>Analysis of citizen’s perception towards segregation and composting</td>
<td><a href="https://nenow.in/north-east-news/assam-hygiene-sanitation-gone-toss-jorhat.html">https://nenow.in/north-east-news/assam-hygiene-sanitation-gone-toss-jorhat.html</a></td>
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<td>3</td>
<td>Molecular Dynamics investigations of nanoscale adhesion and friction at articular cartilage interface</td>
<td><a href="https://www.arthritis-health.com/types/joint-anatomy/knee-anatomy">https://www.arthritis-health.com/types/joint-anatomy/knee-anatomy</a></td>
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<td>5</td>
<td>Development of customized shape patient specific tubular stent by 3D printing technology</td>
<td><a href="http://altru.adam.com/content.aspx?productid=117&amp;pid=1&amp;gid=007473">http://altru.adam.com/content.aspx?productid=117&amp;pid=1&amp;gid=007473</a></td>
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<td>9</td>
<td>Food Grain Supply Chain Optimization</td>
<td><a href="https://www.bakingbusiness.com/articles/50836-the-threat-looming-over-global-grain-supply-chain">https://www.bakingbusiness.com/articles/50836-the-threat-looming-over-global-grain-supply-chain</a></td>
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<td>13</td>
<td>Design and performance analysis of Horizontal Axis Hydrokinetic Turbine (HAHkT) with aerodynamic stall model:</td>
<td><a href="https://www.smart-hydro.de/submerging-turbine-proves-successful-thus-far/">https://www.smart-hydro.de/submerging-turbine-proves-successful-thus-far/</a></td>
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Obituaries from the department:
Shri Pratap Singh Negi, 45, passed away on the 4th of May, 2021. He was an employee of the office in the department of Mechanical Engineering at IIT Delhi. He was a sportsperson. His untimely demise comes as a big shock for all not only his staff members, but also students and faculty members of the department.

Prof. Dinesh Mohan, 75, passed away on the 21st of May, 2021. He was an honorary professor in the department of Mechanical Engineering and the founder of TRIPP. He played a pivotal role in Delhi becoming a city safer for pedestrians and light vehicle commuters. He was a great public intellectual and thinker as well.

Hari Prasath R, 20, passed away on the early hours of 1st June, 2021. He was a third year undergraduate student in the department of Mechanical Engineering. He was a deep thinking individual and his friends remember him as one of the best human beings they have ever seen, and whose innocence was remarkable.