Volume 10 Issue 1 Dec. - 2024

Yaantrika Newsletter

Department of Mechanical Engineering

Vision and Mission of the Institute

Vision

- To be one of the premier institutes of Engineering and Management Education in the country.

Mission

- To provide Engineering and Management Education that meets the needs of human resources in the country.
- To develop leadership qualities, team spirit and concern for environment in students.

Objectives

- To achieve educational goals as stated in the vision through mission statements which depicts the distinctive characteristics of the institution.
- To make teaching-learning process an enjoyable pursuit for the students and teachers.

Vision and Mission of the Department

Vision

- To be premier department for education in Mechanical Engineering in the state of Karnataka, moulding students into professional engineers.

Mission

- To provide teaching-learning process that prepares engineers to meet the needs of industry and higher learning.
- To provide environment for self-learning to meet the challenges of changing technology and inculcate team spirit and leadership qualities to succeed in professional career.
- To instil professional ethics and concern for environment for the benefit of society.

Program Educational Objectives (PEOs)

After 2/3 years of graduation, students will have the ability to:

- Apply principles of Mathematics, Science and Mechanical engineering to design mechanical systems and applications in industry.
- Apply knowledge of Mechanical Engineering to solve problems of social relevance with concern for environment.
- Work with professional ethics as individuals and as team members in multi disciplinary projects demonstrating creativity and leadership.
- Pursue higher education and research in advanced technology.

This issue of Yaantrika is dedicated to

Shri Vijay Kumar Chaturvedi

Shri Vijay Kumar Chaturvedi is an Indian Mechanical Engineer and a nuclear power expert. He is a former Chairman and Managing Director of the Nuclear Power Corporation of India Limited (NPCIL). He did his graduate studies in Mechanical Engineering at Vikram University- Samrat Ashok Technological Institute and secured a master's degree in Nuclear Engineering from Bhabha Atomic Research Centre Training School, Trombay. Shri Chaturvedi is a former member of the Atomic Energy Commission of India and has chaired the Tokyo Centre of the World Association of Nuclear Operators (WANO). He has also been a member of the Board of Governors of WANO for two years. The Government of India has awarded him with the Padma Shri award in 2001.

What's inside.....

Vidyayāmruthamashnuthe

B. N. M. Institute of Technology

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All eligible branches - CSE, ECE, EEE, ISE & Mech.Engg. are Accredited by NBA for academic years 2018-19 to 2021-22 & valid upto 30.06.2025

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Editor's Desk

Dear Readers,

Welcome to the Welcome to the December 2024 issue of 'Yaantrika'

The team of Yaantrika, wishes to give our readers an intellectually stimulating newsletter. Our endeavour is to reflect the values and quality of our esteemed institution.

The present edition of the Newsletter focuses on the activities and achievements of the Department over the past six months along with some interesting articles from our students. We appreciate all those students who have contributed their articles for this issue. It is their attribute of willingness, to put in efforts, share knowledge, concerns and special insights that have made this issue possible. Knowledge is a treasure that appreciates when we share and depreciates when stagnant. So, never stop sharing knowledge and helping others.

Wishing the readers, a happy perusal of the newsletter "Yaantrika".

Editorial Team

'The Department of Mechanical Engineering has been accredited by the National Board of Accreditation (NBA) for the Academic Years 2018 - 19 to 2021 - 22 and valid upto 30.06.2025'

ABOUT MECHANICAL ENGINEERING DEPARTMENT

The Department of Mechanical Engineering was started in the year 2011 with an intake of sixty students. All the laboratories have been established with state-of-the-art equipment. The Department has a team of dedicated and well qualified faculty members, with a blend of rich industrial and academic experience. The faculty members with Master's and Doctorate degree, having specialization in Machine Design, Thermal and Manufacturing Engineering are an asset to the institution and to the students. The Department has an R&D Centre recognized by Visvesvaraya Technological University, Belagavi.

The Department has Toyota Centre of Excellence and 3D Printing Center of Excellence. Toyota COE is a state-of-the-art Centre of Excellence established in association with Toyota Kirloskar Motor, with the distinction of being the first in the country to have such a Centre of Excellence by Toyota company. It has cut sections of Innova and Fortuner Car Engine Systems, wherein the running of the engine can be actually seen. The Center of Excellence also has facilities for students to experience hands-on assembly and dismantling of all the engine parts. 3D Printing COE has been established to provide students with hands-on experience and training in the rapidly evolving field of additive manufacturing. Equipped with advanced 3D printers and scanners, the Centre enables students to explore the diverse applications of 3D printing technology and develop innovative solutions across various industries.

The Department has MoU's with Toyota Kirloskar Motors Pvt. Ltd., Mahatma Gandhi Institute for Renewable Energy and Development (MIRED), Fenfe Metallurgicals, Spectrum Tool Engineers Pvt. Ltd., Maltown Electric Pvt. Ltd. and Kareer Banana Consultants LLP for sustained activities in the area of automobile engineering, renewable energy, metallurgical engineering, manufacturing and electrical engineering and career guidance respectively. The Department has initiated a dedicated Industry-Institute-Interaction Cell (IIIC) to encourage budding entrepreneurs with expert guidance and to provide internship opportunities for students.

The Department also offers Lathe Operator' course (Automotive Sector) under Pradhan Mantri Kaushal Vikas Yojana (PMKVY) an initiative by Automotive Skill Development Council, Ministry of Skill Development and Entrepreneurship, Government of India.

Technical Articles

Integration of AI in Robotics & Automation to Augment Productivity and Quality

Introduction: Automation has long been used in the manufacturing sector to increase output and efficiency. But with the development of artificial intelligence (AI), even greater advancements in these fields are now possible. In recent years, artificial intelligence has advanced significantly in the manufacturing sector. AI has shown itself to be a useful tool for enterprises seeking to boost productivity and cut expenses, from automating monotonous work to streamlining production procedures.

Figure: Benefits of Generative AI in Robotics

The extensive use of smart sensors, robotic automation, and networked components, among other technologies, is making industries more intelligent. The manufacturing industry has been significantly impacted by the introduction of Industry 4.0. Industry 4.0, which is defined by a high level of automation and the exchange of enormous volumes of data across industrial technologies and machines, calls for autonomous and cognitive solutions to oversee the entire production process. This means changing the industrial landscape by utilizing AI-based, data-driven models for personalized manufacturing decisions, forecasts, and real-time optimization.

To increase production, several firms are spending more money on creating intelligent factories. In the industrial sector, artificial intelligence (AI) delivers personnel cost reductions, decreased unscheduled downtime, fewer product failures, and improved production speed and accuracy. AI deployment in industry will keep growing as Industry 4.0 becomes more well known. According to Microsoft, 31% of companies intend to deploy intelligent systems, while 15% of companies now utilize AI. Industry 4.0's major technological breakthrough has increased demand for artificial intelligence in the industrial sector. Let's examine the specifics.

Automation with AI: Robotic automation is one of the main applications of AI in industry. While AI-powered robots may adapt and learn on the go, traditional robots are pre-programmed to carry out specific duties. This enables them to carry out a wider variety of duties and deal with unforeseen circumstances more skilfully.

An AI-powered robot might be assigned to put a product together, for instance. It employs sensors and other data inputs to detect deviations from the desired result while completing the task. It can modify its movements and try a different strategy till it finishes the task if it notices that a part is not fitting properly. AI-powered robots can operate continuously without taking breaks, and they can also adapt and learn. This makes it possible to produce continuously, greatly boosting a manufacturer's output. 77% of manufacturers now employ robotics in their operations, and 17% more intend to do so in the near future, per a recent National Association of Manufacturers poll. This suggests that the use of AI-powered robots in manufacturing is on the rise.

Predictive Maintenance with AI: Predictive maintenance using AI in manufacturing is growing in popularity in the industrial sector. According to a survey by the Electrical and Electronics Engineers, 82% of manufacturers currently utilize AI for predictive maintenance or intend to do so. This suggests that the industry is strongly moving toward implementing this technology. Conventional maintenance methods depend on planned equipment downtime, which can be expensive and interfere with output. AI, however, enables manufacturers to identify possible equipment faults before they become serious ones. In order to find patterns and trends that point to a possible issue, AI systems can examine data from sensors and other sources. A machine may vibrate more than usual, for instance, which could be a sign of a problem with one of its components. Manufacturers can avoid expensive downtime and take preventative measures by identifying this early on.

Optimizing Production Processes: AI can optimize industrial processes in addition to automating chores and enhancing maintenance. Manufacturers can evaluate operational data and find ways to increase efficiency by using machine learning algorithms. AI, for instance, can assist in locating production line bottlenecks and making recommendations for adjustments to increase throughput. In order to guarantee on-time product delivery, it can also evaluate data from customer orders and offer suggestions for production scheduling. 70% of manufacturers now use or

Figure: Impact of AI in Manufacturing

intend to employ AI for process optimization, according to a recent McKinsey poll. This suggests that a large number of manufacturers are looking to integrate AI into their operations after seeing its benefits in this field.

Benefits of AI in Manufacturing: Numerous advantages could arise from the application of artificial intelligence (AI) in the manufacturing sector. The following are some of the main benefits of AI in manufacturing:

Lower labour expenses: AI systems can assist manufacturers in lowering labour costs by automating certain processes. A National Association of firm's poll found that 33% of firms said AI and other technology helped them cut labour costs.

Less unscheduled downtime: AI systems are able to track production processes in real time and spot possible issues before they arise. This can assist producers in preserving a steady level of output and avoiding expensive interruptions. AI-based predictive maintenance solutions can cut unscheduled downtime by as much as 50%, per a McKinsey & Company analysis.

Figure: Significance of AI in Manufacturing

Fewer product flaws: AI systems are able to examine data and spot trends and patterns that could point to a possible problem with a product. By doing this, producers can improve the overall quality of their products by taking corrective action before a damaged product reaches the client. AI-based quality control systems can cut product flaws by as much as 50%, according to research.

Enhanced production speed: AI systems can assist firms in cutting down on manufacturing time by automating some operations, enabling them to more swiftly and effectively satisfy consumer demand. According to a National Association of Manufacturers poll, 39% of manufacturers said AI and other technology had accelerated output.

Better decision-making: AI systems are able to examine manufacturing process data and offer suggestions and insights that people would find challenging or impossible to recognize. This can assist producers in streamlining their operations, cutting waste, and raising the general effectiveness of their manufacturing procedures. AI-based decision-support systems can increase industrial efficiency by up to 20%, according to an industrial Institute survey.

Conclusion: AI has the potential to have a big impact on the manufacturing sector by raising product quality, cutting costs, and enhancing efficiency. Even if there are still obstacles to overcome, such integrating AI technology into current systems and requiring specialist knowledge, the potential advantages of AI in manufacturing are substantial and will probably propel its further use in the years to come.

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- https://www.bigscal.com/blogs/ai-ml-blockchain/latest-trends-generative-ai-robotics/
- https://nextgeninvent.com/blogs/ai-in-manufacturing-industry-game-changer/

Sanjay Y
VII Semester

Topical Progress in Additive Manufacturing (3D Printing)

Introduction: Mechanical engineering has undergone a revolution because to additive manufacturing (AM), also referred to as 3D printing, which makes it possible to create intricate, highly precise parts with improved material efficiency and shorter production times. AM was first created as a tool for prototyping and has now spread to a number of sectors, including manufacturing, automotive, aerospace, and healthcare. Recent developments in AM, its uses, and its effects on the field of mechanical engineering are examined in this article.

Current Developments in Additive Manufacturing:

Better 3D Printing Materials: The capabilities of AM have been greatly expanded by the introduction of sophisticated materials. High-performance metals like Inconel, stainless steel, and titanium alloys may now be processed by modern 3D printers, making them appropriate for use in aerospace and medicine. Furthermore, composite materials that contain graphene and carbon fiber offer better strength-to-weight ratios, which increases the structural engineering applications of 3D-printed parts.in the field of additive manufacturing

Different types of polymer materials and their applications (A) high-impact polystyrene (HIPS)—stationery trays; (B) polyvinyl alcohol (PVA)—food wrap; (C) acrylonitrile styrene acrylate (ASA)—drain pipes and fittings; (D) polypropylene (PP)—food containers; (E) polycarbonate ABS alloy (PC-ABS)—glove box; (F) gears.

Hybrid Manufacturing : The combination of additive and subtractive manufacturing techniques is a significant advancement in AM. High-precision items with improved surface finish and material qualities can be produced using hybrid machines, which combine 3D printing and CNC machining. In the tooling and aerospace industries, where precise tolerances are necessary, this development is very advantageous.

Printing with many materials and colors: New advancements in multi-material printing enable the creation of intricate structures with different mechanical characteristics in a single print job. This is especially helpful in biomedical engineering, where implants and prosthetics can be made to resemble natural tissues with different levels of strength and flexibility.

Large-scale and fast printing: Developments in Selective Laser Melting (SLM) and Direct Energy Deposition (DED) have greatly accelerated metal 3D printing. Furthermore, the fabrication of full-scale automotive and aircraft comp

Additive Manufacturing Driven by AI: The science fiction shown in Mission: Impossible films is no longer applicable to additive manufacturing (AM), often known as 3D printing. It is now crucial for guaranteeing manufacturing's future and fortifying supply chains. The AM market is generating more excitement than ever before. AM has already exceeded $20 billion, and through 2030, it is expected to grow by 23.3 percent annually. This innovative technology, which builds things layer by layer based on the blueprints, has been swiftly embraced by the automotive, healthcare, defense, and aerospace industries. Manufacturing methods are changing as a result of the combination of additive manufacturing and artificial intelligence (AI). AI increases resource use and enhances design and performance analysis, leading to extremely productive and economical manufacturing.

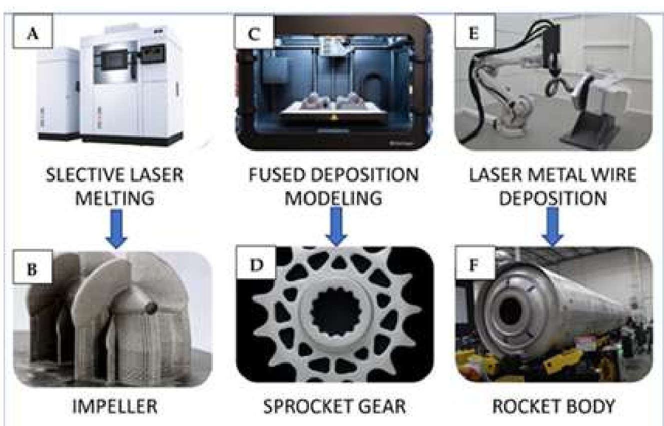

Figure: Metal 3D printing technologies and their applications

AI-powered additive manufacturing software can create a wide range of items, from large-scale manufacturing projects to prototypes. AM maximizes efficiency and improves accuracy when combined with AI. Additionally, it gives producers freedom over where their goods are constructed, which may result in lower tariffs. By streamlining processes and enabling exceptional design possibilities at reduced costs, this powerful combination of AI and AM promotes innovation. It marks the beginning of a new era of manufacturing in which efficiency and creativity are transformed by cutting-edge technology.

Challenges and Barriers to Adoption of AI Powered AM:

Material Restrictions: There is still a small selection of printable materials, especially for high-performance materials needed in specific applications. AM applications will grow as more research is done on novel material technologies including as composites, biopolymers, and high-performance metals.

Post-Processing Requirements: Extensive post-production processes, such as thermal treatment or refining, limit scalability, impede adoption, and add time and cost.

Quality Standardization: Establishing universal standards and ensuring consistent product quality are difficult tasks, especially in highly regulated industries like healthcare and aerospace.

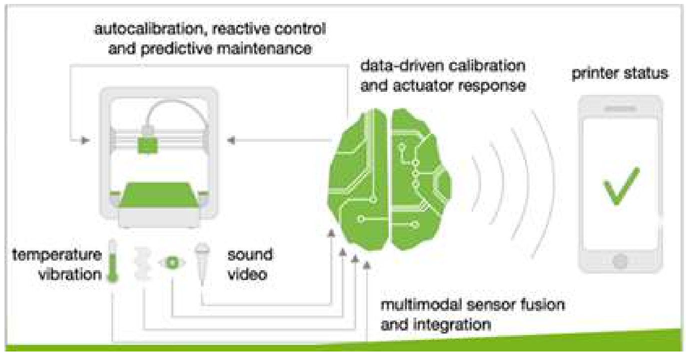

Figure: Illustration of integration of sensors and algorithms for improvement of 3D Printing

Measures to Overcome Obstacles for Accelerating AI Adoption:

Collaborative Partnerships: Standardized procedures that guarantee quality and dependability should be supported by manufacturing firms, academic institutions, and government agencies in order to facilitate mutual certification.

Advanced AI Integration: Accuracy, scalability, and efficiency will be improved by advancements in AI features such agentic AI.

Workforce Training: By supporting training programs for AI and AM technologies, industries will be able to fully utilize these technologies by equipping workers with the necessary skills to foster innovation and acceptance.onents is now possible thanks to large-scale AM systems, which lessens the need for conventional manufacturing techniques.

Applications of Additive Manufacturing :

Aerospace Industry: By making it possible to produce lightweight, very durable components, AM has revolutionized the aircraft industry. 3D printing is used by businesses like SpaceX and Boeing to create engine parts, which reduce weight without sacrificing structural integrity. Furthermore, AM speeds up design iterations by facilitating fast prototyping.

Automotive Industry: AM helps the automotive sector by producing prototypes, specialized parts, and lightweight structures quickly. AM is used by high-performance automakers like Bugatti and Porsche to produce intricate metal components that enhance vehicle performance and efficiency.

Medical and Biomedical Engineering: The development of patient-specific implants, prosthetics, and even bioprinted tissues is one of the most significant uses of additive manufacturing in the medical industry. By guaranteeing a precise fit, custom orthopedic implant composed of titanium and biocompatible polymers enhance patient results.

Manufacturing and Tooling : AM enables the on-demand fabrication of spare components and minimizes material waste in conventional manufacturing. Just-in-time manufacturing is made possible and inventory expenses are reduced. Additionally, the die-casting and injection molding industries' production cycles are accelerated by AM's quick tooling.

Energy and Sustainability: By reducing waste and maximizing energy use, AM is essential to sustainable manufacturing. Compared to traditional subtractive manufacturing techniques, 3D printing has a smaller environmental impact because it uses only the necessary amount of material. Furthermore, AM makes it possible to repair and refurbish important parts, prolonging their lifespan and cutting down on industrial waste.

Development of Additive Manufacturing in India:

Government Initiatives : Under the "Make in India" and "Atma Nirbhar Bharat" efforts, the Indian government has started a number of schemes to increase manufacturing capacity, including AM. By promoting domestic manufacturing and lowering reliance on imports, the National Strategy on Additive Manufacturing seeks to establish India as a global center for 3D printing technologies.

Automotive and Aerospace Sectors: AM is being used by businesses like Hindustan Aeronautics Limited (HAL), Mahindra, and Tata Motors for quick component manufacture and prototyping. To cut weight and increase efficiency, ISRO has been using AM in the aerospace industry for propulsion systems and satellite components.

Figure: Major applications of 3D printing

Healthcare and Medical Devices: AM is being used by Indian research institutes and medical companies to create patient-specific, reasonably priced implants and prosthetics. Research is being done on biofabrication and 3D-printed organs for potential future uses at universities like IITs and AIIMS.

Startups and Innovation Hubs: With the rise of companies like Intech Additive Solutions, Objectify Technologies, and Ethereal Machines—pioneers in metal 3D printing and customized manufacturing solutions—the AM ecosystem in India is expanding.

Educational and Research Contributions: IITs and NITs, two of the top engineering schools, are providing specific courses and research programs in AM. Industry innovation and skill development are being stimulated by academic-industry collaborations.

Conclusion: By providing creative answers to challenging manufacturing problems, additive manufacturing has profoundly changed mechanical engineering. Efficiency, sustainability, and personalization will all be boosted by the technology's growing influence across a range of industries. AM is expected to be crucial to mechanical engineering and beyond in the future due to ongoing improvements in materials, machine capabilities, and software integration. A bright future is suggested by India's proactive adoption of AM through government regulations, business involvement, and research projects. India is positioned to become a pioneer in 3D printing technology as AM is more widely used in production, opening the door for both technological independence and economic progress.

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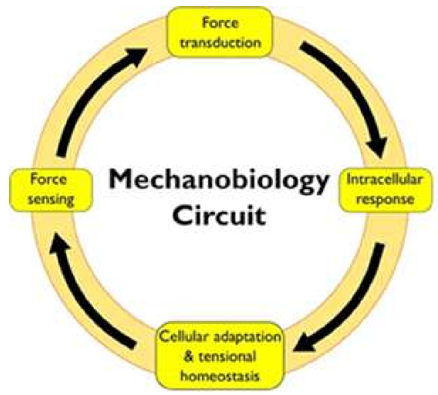
Vishruth
V Semester

Mechanomics

Introduction: Mechanomics explains how biology is shaped by mechanical factors. With the intention of codifying the influence of the mechanical environment on biology, it captures the organic development of knowledge at the nexus of mechanics and biology, starting with an understanding of biomechanics and mechanobiology. When the terms "mechanics" and "genetics" are substituted, Mechanomics could be thought of as the mechanical counterpart of genomics, which deals with the influence of genetics on biological structure and function. Many biological processes at the organ, tissue, cell, and molecular levels depend on mechanical stimulation. The most common in vivo mechanical stimuli are shear flow, tensile stretch, and mechanical compression. These stimuli can work alone or in concert with other mechanical and even biological elements.

Mechanobiology and Transcriptomics/Proteomics: Over the past 20 years, the interdisciplinary area of mechanobiology—which sits at the intersection of biology and mechanics—has grown. Its main goal is to clarify the ways in which changes in the mechanical environment of cells or tissues or outside forces affect an organism's physiology, development, and illness. Clarifying the molecular mechanisms of mechanotransduction—the process by which cells detect, react to, and transform biomechanical inputs into biochemical signals—is a significant problem in this subject.

Single Type of Mechanical Stimuli: Shear Flow: Much research has been done on how cells react to shear flow that simulates physiological blood or interstitial flow. When live cells are exposed to shear flow, their shape, adherence, and spreading undergo notable alterations. Endothelial cells (ECs), for instance, exhibit adaptive remodeling in response to shear stress, where shear stress is detected by surface mechanosensors comprising integrins, Flk-1, ion channels,

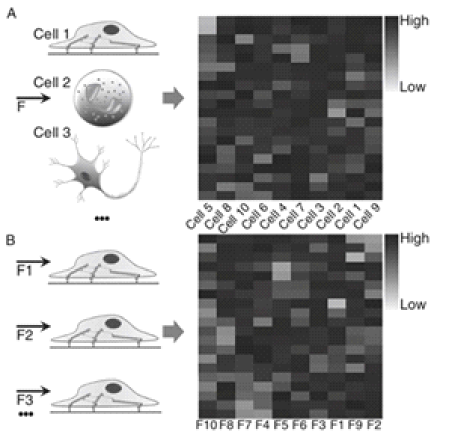


Schematic of a mechanobiology circuit

GPCRs, and PE CAM-1. In a stress-dependent pattern, steady flow compels myeloma cells to develop protrusions that are actin-rich but lack microtubules. When it comes to blocking osteoclast development and resorption through NO-dependent pathways, osteocytes exposed to pulsating flow seem to be more responsive than osteoblasts or periosteal fibroblast osteocytes. Organ-specific metastasis under blood flow requires shear-induced transport of circulating tumour cells to the target site, and interstitial fluid typically promotes tumour cell invasion by altering their interactions with stromal cells. Over the past few decades, transcriptomic analysis has become more popular in studies of cell mechanobiology under fluid movement. Several genes are expressed in different biological processes in response to a particular shear flow pattern or parameter setting. For example, the gene expression profile of ECs exposed to laminar or constant flow suggests that genes implicated in angiogenesis, ECM/cytoskeleton remodelling, cell proliferation, inflammatory cytokines, stress response proteins, and signalling molecules are significantly modulated. In order to determine the destiny of mesenchymal stem cells (MSCs), oscillatory flow increases the expression of transcription factors and promotes osteogenic differentiation through RhoA and its effector protein ROCK II. Since various gene profiles and resulting EC characteristics are seen between low-shear disturbed flow and high-shear laminar flow to find >100 novel genes, different shear flow patterns or parameter settings encourage the distinct transcriptome alternations. Additionally, under blood flow, the physiological circumstances or biochemical microenvironments in which cells reside should be considered. For instance, under laminar f low, ECs monoculture increases ICAM-1 expression, whereas ECs and SMC co-culture decreases ICAM-1 expression. TNF-α-induced gene expression differs from disturbed flow-induced gene expression, suggesting that the signalling mechanisms that activate NF-κB are not the same as those that mediate the downstream effect of disrupted flow. Although transcriptome analysis under shear flow has made significant strides, proteomic profiling of cells under shear stress has also seen some effort. Annexin A2 and GAPDH are significantly elevated in hMSCs under steady flow, while 10 and 3 proteins are identified to be up- and down-regulated, respectively. Furthermore, as demonstrated by the 43 distinct proteins identified from the low shear-induced rat thoracic aorta, where two secretary molecules of PDGF-BB and TGF-β1 are essential for vascular remodelling, cells are also capable of sensing shear stress and converting it into secretary signals. Once more, the combination of biochemical factors and biomechanical stress is crucial because, while laminar shear and high glucose together increase HSPs and protein ubiquitination of bovine ECs, high glucose alone significantly modulates shear-induced mechanosensing complexes and endothelium protein phosphorylation pathways.

Tensile stretch: At the molecular and cellular levels, mechanical stretch typically causes notable alterations in tissue remodeling and cellular responses. In a wound-repairing model, keratinocytes cocultured with fibroblasts migrate asymmetrically when subjected to static stretch. Tendon fibroblasts produce proteins (Col-I, TGF-β1, COX, PGE2, and LTB4) in response to cyclic strain seen in dose- and time-dependent patterns. Anterior cruciate ligament fibroblasts produce more pro-MMP-2 and its active form than do medial collateral ligament fibroblasts, but there is no difference in post-translational modification between the two groups. Fetal bovine bladder smooth muscle cells (SMCs) exposed to cyclic biaxial strain exhibit a transient rise in cysteine-rich protein 61 (Cyr61) mRNA, which is associated with intracellular signaling (PKC, PI3K, and Rho kinase). Furthermore, because cyclic stretch can activate gadolinium-sensitive stretch-activated ion channels, causing a rapid Ca2+ influx, ion channels may be used as potential mechanosensors. These channels are then essential for the mechanotransduction of fetal rat lung cells with specific structural changes and gating dynamics. Numerous genes from plants and mammals that respond to mechanical stretch have been found, and gene expression is globally mapped under physiologically-mimicking strain. For the metabolism of chondrosarcoma cells subjected to continuous cyclic stretch or for the biochemically driven osteogenesis and bone nodule formation of human ESCs exposed to intermittent cyclic stretch, distinct mechanosensitive genes have been identified. The programming of genes functionally involved in paracrine signaling of angiogenesis for bladder SMCs subjected to cyclic stretch is revealed by integrative knowledge of proteins encoded by mechanosensitive genes and of their interactions with putative partners, in addition to obtaining a candidate list of the differential genes. These days, it can also compare the genes of interest under mechanical strain and characterize plant transcriptomes. The Populus tremula × P. tremuloides tension wood cDNA library is used to create the first expression sequence tags of tension wood. Four distinct cDNA libraries are then created from the opposite and tensile wood of bent poplars in order to identify the highly expressed genes based on the analysis of the tags in the libraries. Additionally, profiles of different proteins under mechanical stretch are created, particularly for events that transcriptome analysis cannot identify. Cyclic biaxial stretch promotes 194 and 177 differential proteins linked to ECM production, intracellular signalling, remodelling, and inflammatory response from tenocytes cultured on polyglycolic acid long fibres, respectively, and starts several phosphorylations linked to the recently discovered mechanosensitive proteins in chondrosarcoma cells.

The significance of MAPK and TGF-β signalling pathways in mechanotransduction is recapitulated by cyclic equiaxial stretch, which reveals a few major proteins (TGF-β1, TNF, CASP3, and p53) that consistently occupy the centre of the interacting network with the recently profiled proteins of interest (BAG5, NO66, and eIF-5A) in activated lamina cribrosa cells. Stretch-induced proteins also exhibit a coupling of biomechanical and biochemical regulations. For example, the synergistic up-regulation of the calponin 1 gene for human MSCs differs from the TGF-β1-activated up-regulation of α3β1 integrin and the uniaxial stretch-induced increase of calponin 3 protein. The tensile wood of Eucalyptus gunnii linked to growth strain and the differentiating tissue of tension-induced wood in Eucalyptus camaldulensis both include five and twelve proteins, respectively. The mechanotransducive extents in plant sciences are expanded by mechanically induced proteome analysis, despite the fact that there is a lot less data accessible for plants than for mammals.



Schematic of cellular responses to mechanical stimuli in one-to-more (A) or more-to-one pattern (B).

Mechanical compression : Internal or external compression can be sensed and responded to by cells. The primary target of compression-induced mechanotransduction is articular cartilage, a hydrated soft tissue used to support diarthrodial joints. In primary and immortalized chondrocytes, constant hydrostatic pressure triggers stress-associated transcription factors, most likely as a result of HSP70 mRNA stability but not synthesis. The metabolic activity of articular chondrocytes is regulated by both dynamic compression and insulin-like growth factor I (IGF-I) through different activating pathways. Dynamic compression speeds up the biosynthesis response to IGF-I and increases IGF-I transport into the articular cartilage matrix. Another common target is a tumour, mostly because of its unchecked growth in a small area. Although tibial compression prevents the growth and osteolysis of secondary breast tumours, tumour cells frequently undergo mechanical compressive stress that promotes adherence and migration by a subset of "leader cells." These investigations offer clues regarding the possible signalling routes that these mechanosensitive effectors may use in reaction to mechanical compression. One of the main problems with chondrocyte mechanotransduction is differential gene expression during mechanical compression. Under various compression regimens and settings, chondrosarcoma cells are more likely to be sensitive to continuous pressure with multiple triggered genes than to cyclic and static pressure with few gene modifications. Since immediate-early genes including c-jun, jun-B, and c-myc become up-regulated but destabilized under pressure treatment, hydrostatic pressure not only controls gene expression but also affects the mRNA stability of chondrosarcoma cells. To comprehend how various proteins are coordinated to react, proteomic analyses of mechanical compression are used. An interaction subnetwork for differentially expressed proteins (mostly for Raf1 and PDCD8) is produced by 42 difference proteins encoded by 21 genes, according to proteomic study of the ulna between normal and fatigue axial compressive pressures. When osteoblasts and osteocytes are co-cultured and subjected to cyclic compression, the protein release of MMP-3 and-13 is induced, Col-II and aggrecan mRNA expression is inhibited, and 14-3-3ε is promoted as a new soluble mediator between subchondral bone and cartilage in osteoarthritis, suggesting interactive communications between various bone cell types. Furthermore, for mesenchymal progenitor cells originating from bone marrow, cyclic compression also causes unequal production of characteristic proteins.

Conclusions : An emerging field for understanding how genes are expressed and proteins are produced in response to various mechanical stimuli is the combination of mechanobiology and transcriptomics/proteomics. It appears that Mechanomics is still in its infancy. One anticipates that the state-of-the-art methods in biomechanics and high-throughput analysis in transcriptomics and proteomics will help define the necessary mechanical variables and offer an integrated profile of signaling events from the perspective of the mechanome at the molecular and cellular levels.

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Hamsini H S
III Semester

FACULTY ACHIEVEMENTS

- **Dr. B S Anil Kumar,** completed an NPTEL course on 'Artificial Intelligence and Machine Learning in Materials Engineering', in October 2024
- **Dr. Raghavendra N**., participated in an online Faculty Development Program on 'Next Generation Automation: Bridging Electronics And Mechanical Systems In Industry 4.0' organized at REVA University, Bengaluru, from 22nd to 26tth July 2024.
- **Dr. D Shivalingappa**, completed an NPTEL course on Robotics, in October 2024.
- **Dr. B S Anil Kumar**, participated in Faculty Development Program on 'Gen-AI and Prompt Engineering Using Microsoft Co-Pilot', organized at BNMIT, from 16th to 20th September, 2024
- **Dr. Mahendra Kumar C.**, participated in an industrial training program on 'Powertrain Solutions' organised by Bosch Global Software Technology, Bengaluru, on 19th and 20th November 2024.
- **Dr. Mahendra Kumar C**., participated in an online Faculty Development Program on 'Data Science(ML&AI)', organized by IIT Kanpur, from 21st to 26th October 2024.
- **Mrs. Shwethashree B.**, participated in an online Faculty Development Program on 'Green Hydrogen Generation Opportunities and Challenges in India', at Shri Mata Vaishno Devi University, from 9th to 14th December 2024.
- **Mrs. Madhushree K J.**, participated in an online Faculty Development Program on 'Research Structuring and Publication Process' organized by NFED Coimbatore, from 23rd to 27th July 2024.
- **Dr. Raghavendra N.**, participated in an online Faculty Development Program on 'Transformative Examination Practices & OBA' organized by Indus Institute of Information and Communication Technology, Indus University, Ahmedabad, India, from 16th to 20th December 2024
- **Dr. B S Anil Kumar**, Dr. D Shivalingappa and Mr. Vishwanath B R., participated in an industrial training program conducted by Ashok Leyland, Hosur Plant, India, from 16th to 20th December 2024.

STUDENT ACHIEVEMENTS

- **Litheesh Gowda,** a student of 7th semester won a bronze medal in 4th National Open Water Championship, held at Padubidri Beach, Udupi district, Karnataka, on 23rd November 2024.
- **Dimpana P Jadhav and Dhanvi Reddy M**, students of 3rd semester participated in a national seminar on the occasion of 57th Engineer's Day, organized at IEI(India) Karnataka state center, Bengaluru, on 15th September 2024 and secured second place.
- **Thanush M Bharadwaj, Litheesh Gowda** and **Rithik R**, students of 7th semester have completed NPTEL course on 'Artificial Intelligence and Machine Learning in Materials Engineering', in October 2024.
- **Hamsini H S., Samanaa R and Kushal R.**, students of 3rd semester, participated in a national seminar on the occasion of 57th Engineer's Day, organized at IEI(India) Karnataka state center, Bengaluru, on 15th September 2024

Litheesh Gowda, receiving bronze medal at 4th National Open Water Championship held at Padubidri Beach, Udupi, Karnataka in November 2024

Dimpana P Jhadav (third from right) and Dhanvi Reddy M(second from right) secured second place in national seminar organized at IEI(India), Karnataka state center, Bengaluru in September 2024

DEPARTMENTAL ACTIVITIES

Workshop on Introduction to Supply Chain, Procurement, Corporate Communications, and Employee Behaviour

On July 18th, 2024, a comprehensive workshop on "Introduction to Supply Chain, Procurement, Corporate Communication, and Employee Behaviour" was organized for the fourth-semester Mechanical Engineering students. This insightful and engaging session was conducted by the esteemed resource person, Mr. Srinidhi Maduger, expert in supply chain management and procurement. The workshop commenced with a warm welcome and introduction of the resource person. Mr. Srinidhi, known for his expertise in supply chain management and corporate communication, set the tone for the session by emphasizing the importance of these domains in the modern engineering landscape. Overall, the workshop was a resounding success, providing our students with crucial knowledge and skills that are essential in today's competitive engineering field.

Faculty members and 5th semester students of ME dept., with resource person Mr. Srinidhi Maduger(second line, third from left) during the session

Industrial Visit

Industrial visit to M/s M ACER Automotive Systems Pvt Ltd., Bengaluru, was organized for 6th and 3rd semester students on 22nd July and 9th December 2024 respectively. The visit aimed to provide practical exposure to the design and manufacturing processes of various industrial products, complementing the theoretical knowledge gained in classrooms. Students had the opportunity to interact with engineers and technicians of the industry. They discussed various aspects of manufacturing, challenges faced in the industry, and the importance of continuous learning and adaptation.

Mr. Bapu Gowda C M with 6^{th} semester students and employees of M/s M ACER Automotive Systems Pvt Ltd., Bengaluru

Faculty members of ME dept. with 3^{rd} semester students and employees of M/s M ACER Automotive Systems Pvt Ltd., Bengaluru

Technical Session on Animation Careers and Skills

Mr. Irfan Shariff, addressing 3^{rd} semester students during the technical session

On September 28, 2024, a technical session on "Animation Careers and Skills" at 11:30 a.m. was conducted. The session was delivered by esteemed guest speaker, Mr. Irfan Shariff, a renowned person for his expertise and innovative contributions to animation and multimedia. The event was attended by students from both the third and fifth semesters, who actively participated in the session. The primary objective of the session was to provide students with an understanding of the vast opportunities available in animation and the essential skills required to pursue a successful career in the field. The talk also aimed to broaden the horizons of Mechanical Engineering students, showcasing how animation can be applied in various engineering sectors, particularly in design, simulation, and manufacturing processes.

Seminar on Masterclass on Higher Education

On July 10, 2024, the Mechanical Engineering Department of BNM Institute of Technology had the privilege of hosting an insightful talk on “Masterclass on Higher Education (Abroad Studies)” by Sri Tiru Mothukuri, a renowned expert in higher education counseling. The event aimed to provide Mechanical Engineering students with comprehensive information on pursuing higher studies in foreign countries, the pathways available, and the benefits of scholarships provided by international universities.

Faculty members and students of ME department with resource person, Sri Tiru Mothukuri (fifth from left), during the seminar

Alumni Talk

The alumni talk was conducted on 11th November, 2024, for the third and fifth semester students of Mechanical Engineering. It focused on the opportunities for Mechanical Engineers for pursuing higher studies. Mr. Raghav Y, a proud alumni of Mechanical Engineering department (2018-22 batch) currently pursuing M.Tech. program at IIT D&M, Chennai, addressed our young minds and educated them with his informative talk. His domain of specialization is design & manufacturing and he mainly focuses on the projects related to calibration of modern machining equipment and their procedure. During the talk, he conveyed the importance of higher education in the fields of science and technology. He also addressed about the preparations needed to get into premier institutions like IIT and NIT. He also deliberated on the current job opportunities after pursing the masters in the core as well as IT domain.

Mr. Raghava, PG Student IITDM, Kancheepuram, Chennai

Industrial Training Program for Faculty

Faculty members of ME dept. with employees of Ashok Leyland, Hosur Plant during the Training Program

A five-day industrial training program, from 16th to 20th December 2024, was conducted at Ashok Leyland, Hosur Plant. Dr B S Anil Kumar, Dr. D Shivlaingappa and Mr. Vishwanath B R attended this program. The training program provided a comprehensive understanding of cutting-edge advancements in engine research and development. It provided valuable exposure to real-world practices in engine calibration, emission measurement, and assembly line operations. Each session of the training program included practical insights and future trends that can be integrated with academic research and teaching practices.

Workshop on Industrial Applications of IoT

Prof. Rohini and Prof. Sarala, dept of ECE with faculty members, technical staff and students of ME dept. during the workshop on 06.11.2024

A workshop on " Industrial Applications of IoT " was organized for fifth-semester Mechanical Engineering students on November 6, 2024, from 8:15 AM to 1:15 PM at BNMIT. Professors Sarala and Rohini from the Electronics and Communication Department graciously led the session, to deliver this knowledge-rich and practical workshop. Over the course of four hours, participants gained insights into core IoT concepts, platforms, and real-world applications, fostering a hands-on learning environment.

Talk on Mechanics to Mechanobiology: Exploring Cell Under Shear Stress

On 25.10.2024, the Department of Mechanical Engineering at BNM Institute of Technology, in association with the Institution of Engineers (IEI) Students Chapter, hosted a technical talk titled "From Mechanics to Mechanobiology: Exploring Cell Under Shear Stress." The event featured Dr. Neha Paddillaya, a distinguished Postdoctoral Researcher from the Department of Mechanical Engineering at the Indian Institute of Science (IISc), Bangalore. The talk aimed to introduce students to the emerging field of mechanobiology, focusing on the role of mechanical forces, particularly shear stre

Students and Faculty members of ME dept. during the session

understanding of how mechanics intersects with biology, paving the way for novel research and applications in bioengineering and medical fields.

Innovative Project Lab (IPL) Exhibition

3rd semester students of ME dept., demonstrating their project to 1st semester students

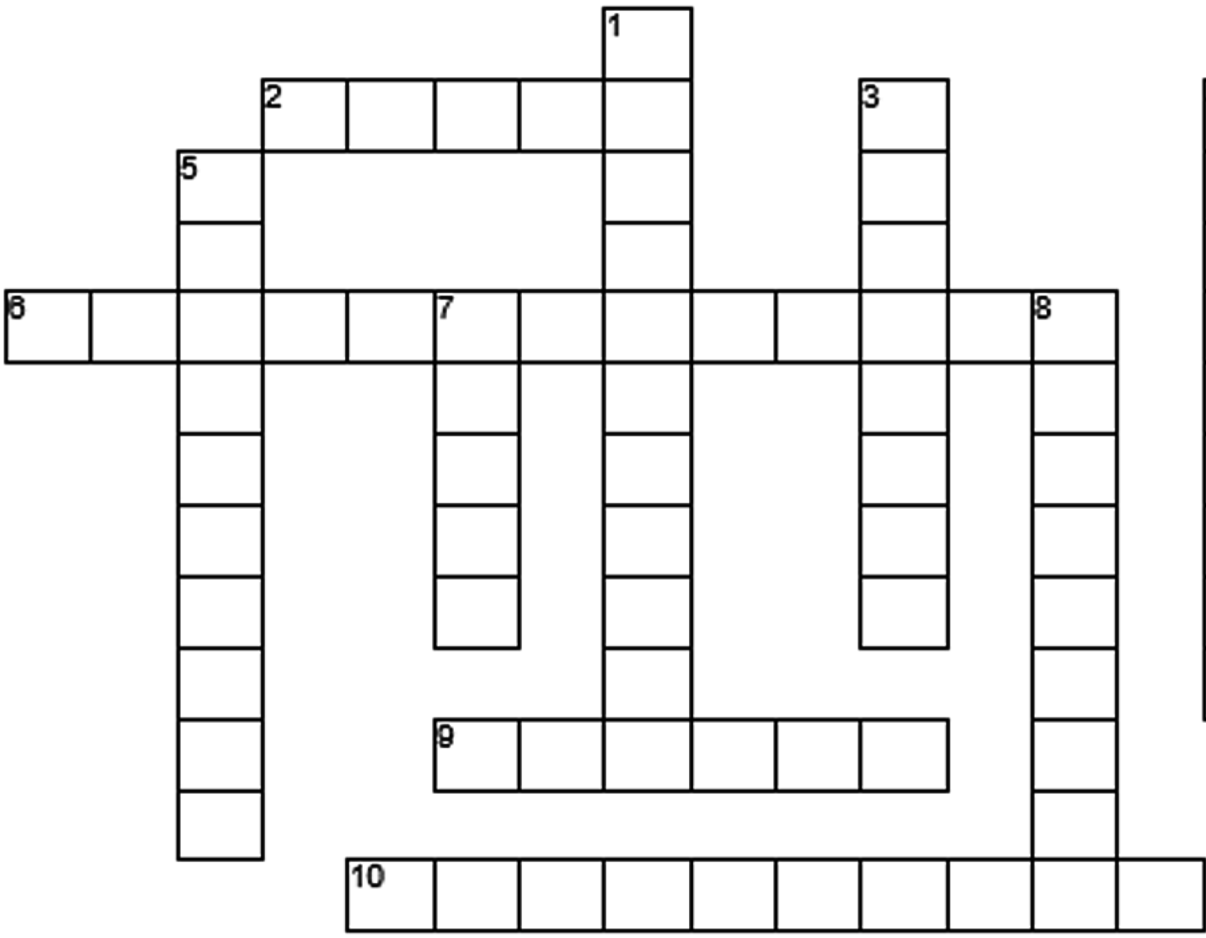
The Innovative Project Lab (IPL) Exhibition, organized by the Department of Mechanical Engineering at BNMIT, on 14th December 2024, provided a platform for third-semester students to showcase their innovative project-based learning outcomes. This event was designed to inspire creativity, foster collaboration, and promote practical applications of engineering principles among students. The primary aim of the IPL Exhibition was to enhance interdisciplinary learning by allowing students to develop, implement, and present solutions that address real-world challenges. The projects demonstrated the integration of Mechanical Engineering concepts with contemporary technologies like IoT, automation, and smart devices. These projects emphasized critical thinking, problem-solving, and technical design, showcasing the students' ability to integrate theoretical knowledge into practical applications.

3rd semester students of ME dept., demonstrating their project to 1st semester students

Faculty members, technical staff and 3rd semester students of ME dept. with their IPL Project Models

Cross Word

Automotive Parts



Across

2. A flat metal disc that serves as the friction surface for the front brake assemblies.
6. Technique used to remove air from the brake hydraulic system.
9. A unit or device used to reduce or eliminate vibrations,oscillation,of a moving part,fluid,ect.
10. The conventional hydraulic and friction brake part minus the ABS unit.

Down

1. A collection of components that work together to stop the vehicle.
3. the housing in which a hydraulic piston operates.
4. A flexible rubber sheet that divides two sides of a chamber.
5. A special fluid used in hydraulic brake system
7. The process of removing air or fluid from a closed system, such as the brakes
8. To coat a metal with a molten alloy mixture of lead and tin.

HINTS:

brake bleeding	cylinder	Galvanize	Rotor
Brake system	Dampen	Bleed	
Brake fluid	Diaphragm	Base brakes	

EDITORIAL TEAM

Faculty

Smt. Shwethashree B.,
Assistant Professor
Dept. of Mechanical Engineering

Dr. Payal Mukherjee.,
Assistant Professor
Dept. of Humanities

Students

Hamsini H S	**III Semester**
Archisman Deb	**V Semester**
Tejas V	**VII Semester**
Chandan V Gopal	**VII semester**

For any queries and suggestions, please mail to: shwethashree.b@bnmit.in/hodme@bnmit.in