SOCIETY OF
MECHANICAL
ENGINEERING

"UTKARSHA"

ANNUAL MAGAZINE 2023

"Life is not to be lived for the sake of intelligence, science, culture, but the reverse; intelligence, science, culture, have no other reality than that which accrues to them as tools for life."

- José Ortega y Gasset

DEPARTMENT OF MECHANICAL ENGINEERING
C. V. RAMAN POLYTECHNIC, BHUBANESWAR

FROM THE

PRESIDENT'S DESK…..

I am immensely pleased to know that the department of mechanical engineering is going to launch their annual magazine UTKARSHA. I congratulate both the faculty and students for evincing keen interest in research. This magazine would definitely serve as a forum for the dissemination of scientific knowledge gained through rigorous research and experiments in the field of engineering. Further it will provide opportunity to the faculty and students to showcase their technical expertise in their respective field of study.

I appreciate the commitment of all towards making this magazine a huge success.

Er. Sanjib Kuma Rout
Chairman
C. V. Raman Polytechnic

FROM THE

PRINCIPAL'S DESK.....

It is with immense pride and joy that I welcome you to this edition of magazine “UTKARSHA”. As we continue our journey of academic excellence and holistic development, I am pleased to reflect on the remarkable strides we have made as a community.

This magazine stands as a testament to our collective efforts. It highlights the achievements, the stories of inspiration, and the values that define us as an institution. Each article, photo, and contribution encapsulates the spirit of collaboration that binds us all together.

I thank the editorial team for giving me the opportunity to send this greeting and wish the publication a grand success.

Dr. Manoj Kumar Parida

Principal

C. V. Raman Polytechnic

FROM

HoD's DESK.....

It is a matter of great joy and pleasure when I have been requested by the editor annual magazine "UTKARSHA" to give a short message which is going to be Published very shortly.

The magazine is a most powerful platform of the students where they can focus their talents as well as their creativity in their respective field which may be benefited to all.

Mr. Radhamohan Kabisatapathy
Head, Dept. of Mechanical Engineering
C. V. Raman Polytechnic

EDITORIAL BOARD

VISION OF THE DEPARTMENT

Mechanical department is committed to provide value based and quality education through highly qualified professionals with the cutting-edge technologies to meet industrial and social challenges.

MISSION OF THE DEPARTMENT

M1: To equip Mechanical Engineering students for competitive challenges by imparting knowledge on modern technology and industry-oriented programs.

M2: To encourage and empower students to enhance their skills by providing training through various Centers of Excellence.

M3: To foster a spirit of entrepreneurship through industrial visits, internships and seminars conducted by academic experts.

M4: To motivate students to pursue higher studies for betterment of society.

PROGRAM EDUCATIONAL OBJECTIVES

PEO1- Understand and analyze the industrial needs through knowledge gained in Mechanical Engineering fundamentals.

PEO2- Pursue entrepreneurial opportunities by acquiring special knowledge in training programs.

PEO3- Creating technical solutions that successfully address environmental and societal issues.

PEO4- Understanding technical concepts, engage in lifelong learning, exhibit leadership qualities with ethics in their professional career.

PROGRAM SPECIFIC OUTCOMES

PSO-1: Discipline knowledge: Demonstration and understanding of tools with advanced software for design specification and operation of Mechanical Engineering systems, components and processes.

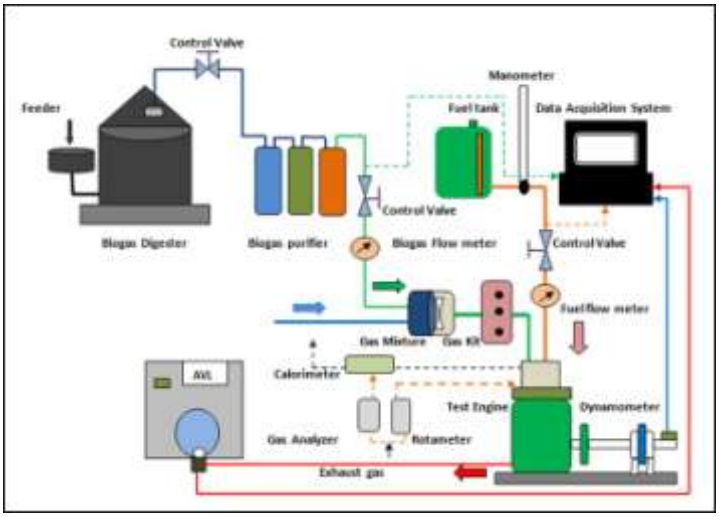
PSO-2: Professional Skills: Apply contextual knowledge to analyze social, environmental, health, safety, legal, and cultural issues with professional ethics as part of the lifelong learning process. To be equipped to lead a team or operate successfully alone as an individual managing tasks in trans-disciplinary areas.

CONTENTS

Multiple response optimization for performance and emission of a CI engine using waste plastic oil and biogas in dual fuel mode operation

By: Mr. Radhamohan Kabisatapathy, HOD, Mechanical Engineering, CVRP

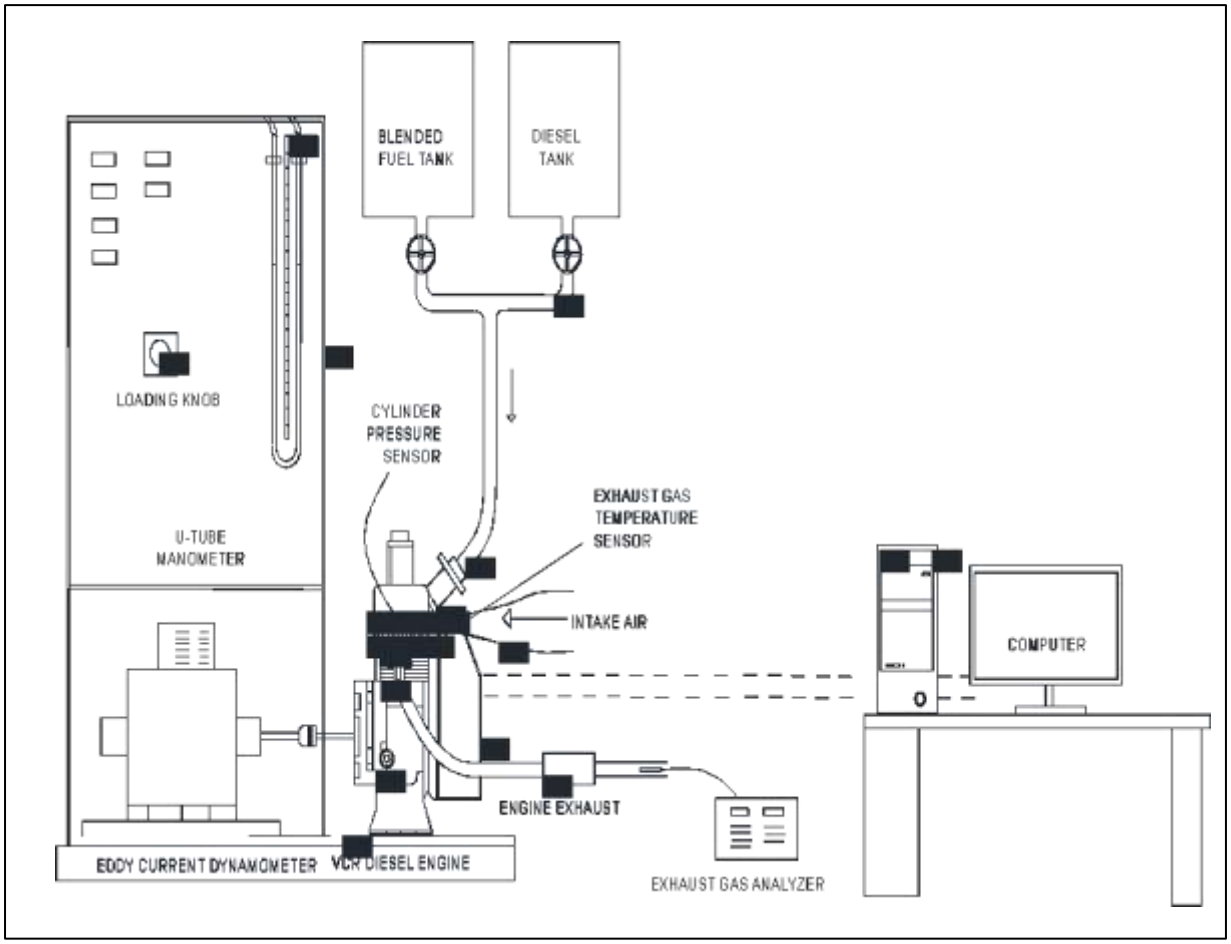
The availability of waste biomass and the advancement of waste-to-biogas technology has aided in the promotion of biogas as a viable alternative to fossil fuels. The objective of this research is to find the best proportion of biogas to use in a blend of waste plastic oil (WPO) and diesel in the dual fuel mode of engine induction for improved performance and emissions. In the CI engine, biogas (of 10%, 20%, 30%, and 40% by volume) is added as supplementary fuel alongside 20WPO-diesel blends. The optimal engine performance and emission are evaluated employing response surface methodology (RSM). The most desirable engine performance, i.e., higher energy and exergy efficiency, and lowest BSFC, HC, and NOx emissions, is determined by using the response surface technique with potential engine parameters such as different engine loads, compression ratios, and various proportions of biogas with test fuel. The energy efficiency, exergy efficiency, BSFC, and CO, HC, and NOx emissions, of 18.6%, 50.05%, 0.46kg/kWh, 0.16 ppm, 41.28 ppm, and 107.81 ppm respectively are found at optimum conditions of 57.12% engine load, 18 compression ratio, and 20% volume biogas with 20% WPO-diesel blend, with total desirability, D of 0.90029.



Determination of sustainability index along with energy-exergy-emission-economic analysis of a VCR diesel engine fuelled with diesel-bioethanol-Al2O3 nanoparticles

By: Dr. Brundan Sahoo, Assistant Professor, CVRP

One of the biofuels made from waste rice straw is mixed with diesel in different percentages [e-diesel (R10, R15, R20)] and diesel-bioethanol blends with 25 ppm Al_2O_3 nanoparticles [Nanofuel (NF0, NF10, NF15, NF20)] are tested in a VCR CI engine under varying the load intensities (0kg- no load, 10kg- full load) and at different compression ratio (CR: 14 and 18). Brake thermal efficiency in energy efficiency, exergy efficiency, brake specific fuel consumption (BSFC), heat release rate (HRR), peak cylinder pressure, and the emission of CO, HC, and NOx are the output parameters of the current investigation. The cost of e-diesel and Nanofuel was then predicted using economic analysis to compare them with regular diesel fuel. Except for BSFC, it has been seen that other parameters rise when the load changes from zero to full. Similar to this, all metrics, except BSFC, CO, and HC emissions, increase when the CR is increased from 14 to 18 and drop as the fuel type is changed from diesel to e-diesel and Nano-fuel. For the maximum load and CR condition, the NF0 exhibits maximum energy efficiency of 30.42%, maximum exergy efficiency of 63.5%, HRR of 61J/degree, peak cylinder pressure of 84 bar, the relative cost of -10.215%, and minimum BSFC of 0.463 kg/kW-hr, whereas the NF15 and F0 exhibit minimum emission of CO of 0.157%, HC of 43 ppm, as well as NOx of 422. NF0 attains a higher sustainability index of 1.817 compared to other fuels due to a lower depletion rate followed by NF10, F0, and NF15 of 1.803, 1.781, and 1.772 respectively. A higher waste energy ratio is observed for R20 of 0.751 followed by R15, NF20, and NF15 of 0.727, 0.704, and 0.651 respectively.

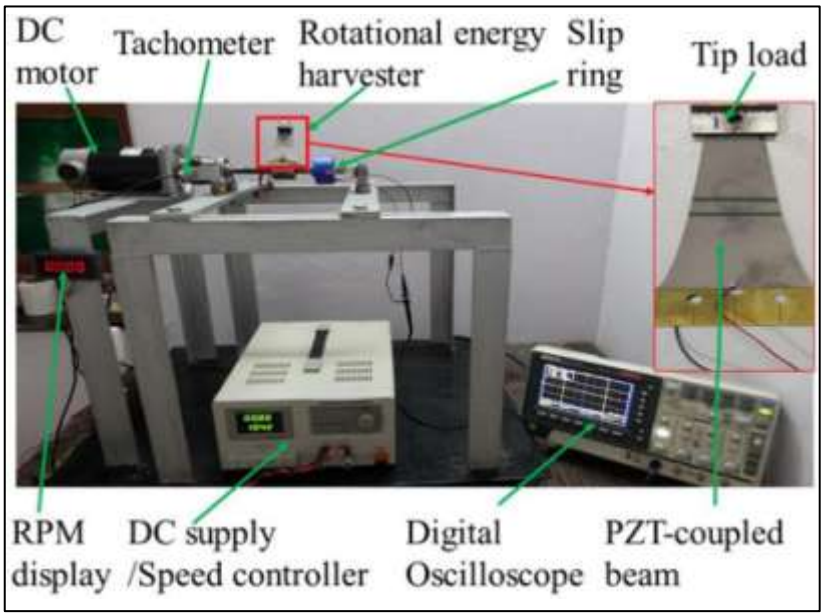

BLENDED FUEL TANK
DIESEL TANK
LOADING KNOB
CYLINDER PRESSURE SENSOR
EXHAUST GAS TEMPERATURE SENSOR
U-TUBE MANOMETER
INTAKE AIR
COMPUTER
ENGINE EXHAUST
EDDY CURRENT DYNAMOMETER
VCR DIESEL ENGINE
EXHAUST GAS ANALYZER

Design and experimental validation of an exponentially tapering width rotational piezoelectric vibration energy harvester

By:

Dr. Shubhashree Mohapatra
Assistant Professor, C. V. Raman polytechnic, Bhubaneswar

The efficiency of any rotational piezoelectric vibration energy harvester (RVEH) can be improved by redesigning its host beam and making provision for self-tuning the harvester's natural frequency with the rotational driving frequency. This article presents the design and analysis of an exponentially tapering width RVEH. The parameters for the proposed harvester's natural frequency characteristics are acknowledged, and their effects on the peak open-circuit (OC) voltage response are discussed. A mathematical model of the system is formulated using the Euler-Bernoulli beam theory and Hamilton's principle. Galerkin's technique is used to acquire the system's mass normalized mode shapes in matrix form. The proposed mathematical model is verified through ANSYS Mechanical APDL simulations and experimental methods. The harvester's responses are obtained through MATLAB code. The two types of parameters that modify the harvester's fundamental frequency are identified and analysed. The proposed harvester delivered an improved power density (PD) of 5.27 mWmm3 and a performance amplification factor (PAF) of 3.14, operating at 7.968 Hz.



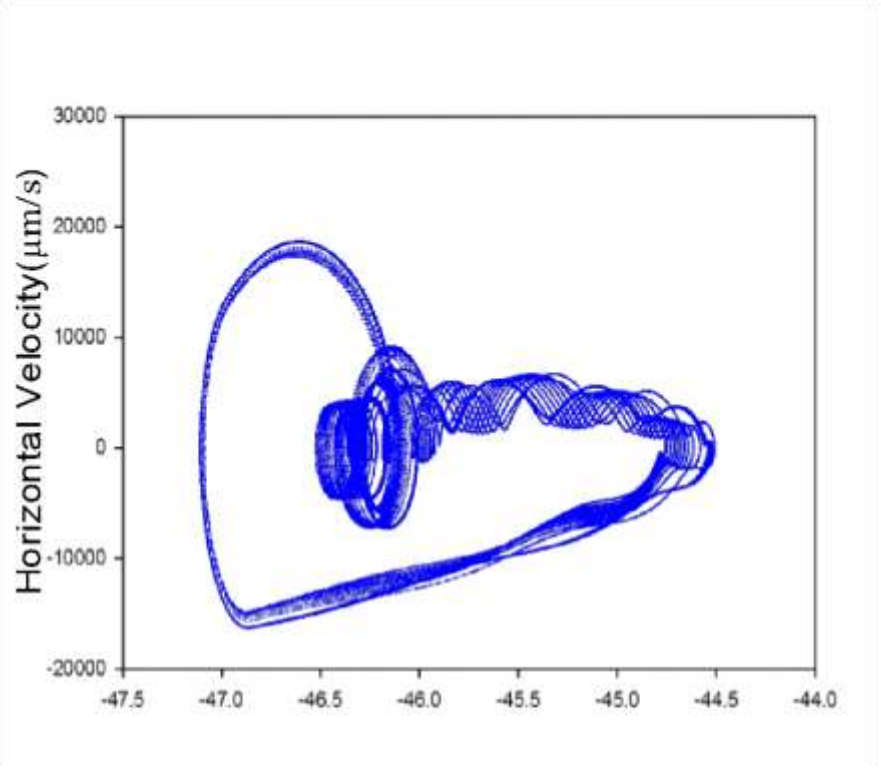
Nonlinear Response Analysis of Cylindrical Roller Bearings Due to Unbalance

By: *Ms. Sutapa Sakkar, Assistant Professor, C. V. Raman polytechnic, Bhubaneswar*

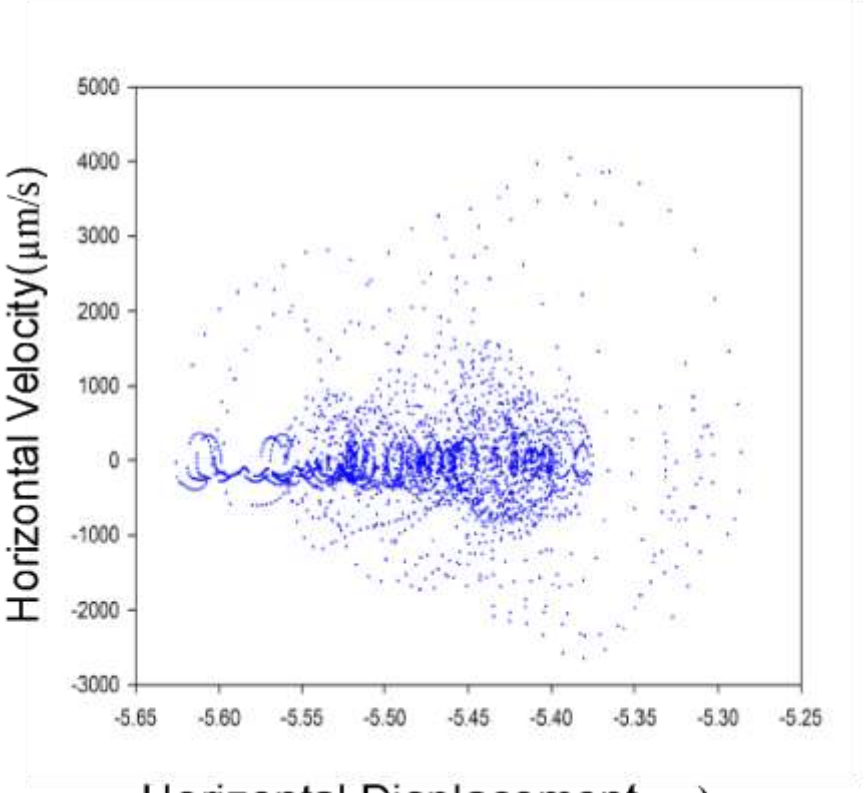
Dynamic study of the roller bearings requires understanding the physics behind the nonlinear contacts and sources of vibration which are important to monitor the present health condition. In the present world, roller bearings are used in highly sophisticated and high-speed machinery where the unwanted vibration in the radial direction caused a severe effect on the performance of the roller bearings. The reasons behind vibration occurred even in a healthy bearing are first, the eccentricity present in the bearing axis and the rotor axis and second, variable compliance effect of the bearings because of the cage rotation.

The unbalance effect adds the rotating frequency (X) effect on the variable compliance effect (VC), which makes the system behaviour more unpredictable even for healthy bearings. Variable compliance vibration, which is the change of dynamic stiffness of the bearing as the rolling element complement undergoes its orbital motion. So, it is also speed-dependent as a function of cage speed (relative to a stationary outer race) multiplied by the number of rolling elements.

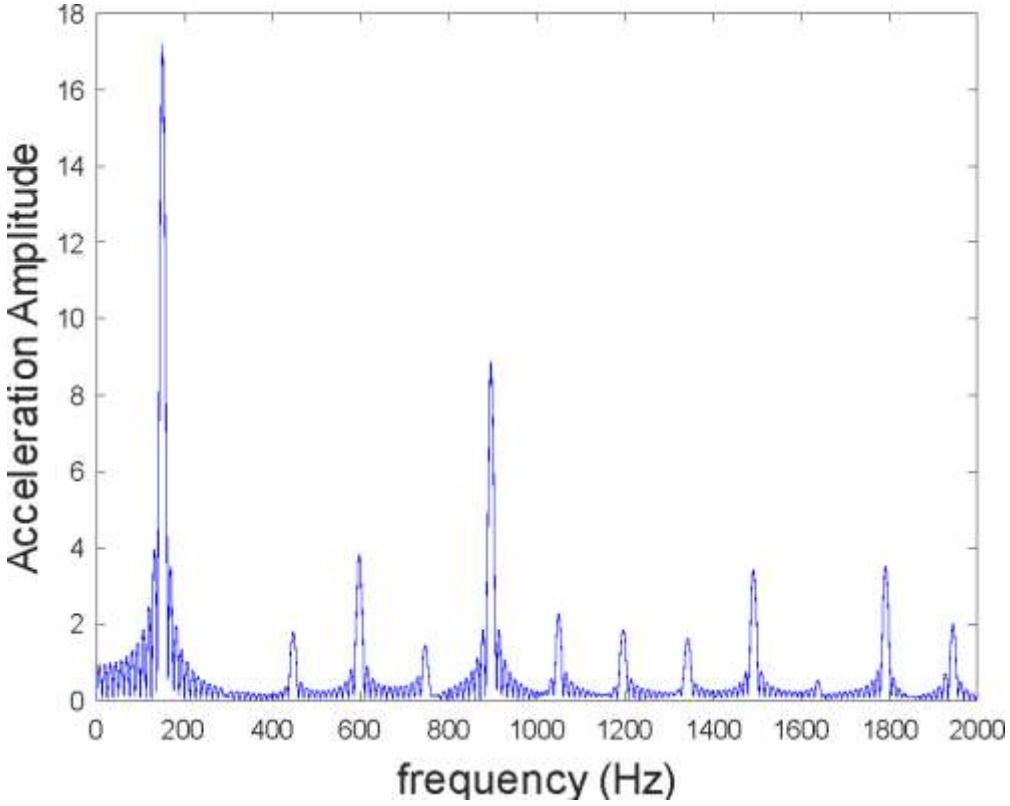
The article contains a brief analysis of dynamic behaviour of cylindrical roller bearings for unbalanced rotor conditions due to speed variations and internal clearances. The system behaves nonlinearly due to various reasons such as stiffness and damping at the contact points (due to Hertzian contact force between rollers and races), radial internal clearance, and speed associated with unbalanced rotor force. The tools like orbit plots, phase portraits, Poincaré maps, and FFT plots are helpful for analysing various motion behaviour. The obtained response showed the sensitive behaviour of the system from periodic to quasiperiodic and chaotic with speed and clearance variations for unbalanced rotor conditions. The analysis is an attempt to show an interaction between existing frequencies due to change in speed and clearance variations, which will be helpful for analysing the current condition of a healthy cylindrical roller bearing.



45microns



5microns


Acceleration Amplitude
frequency (Hz)
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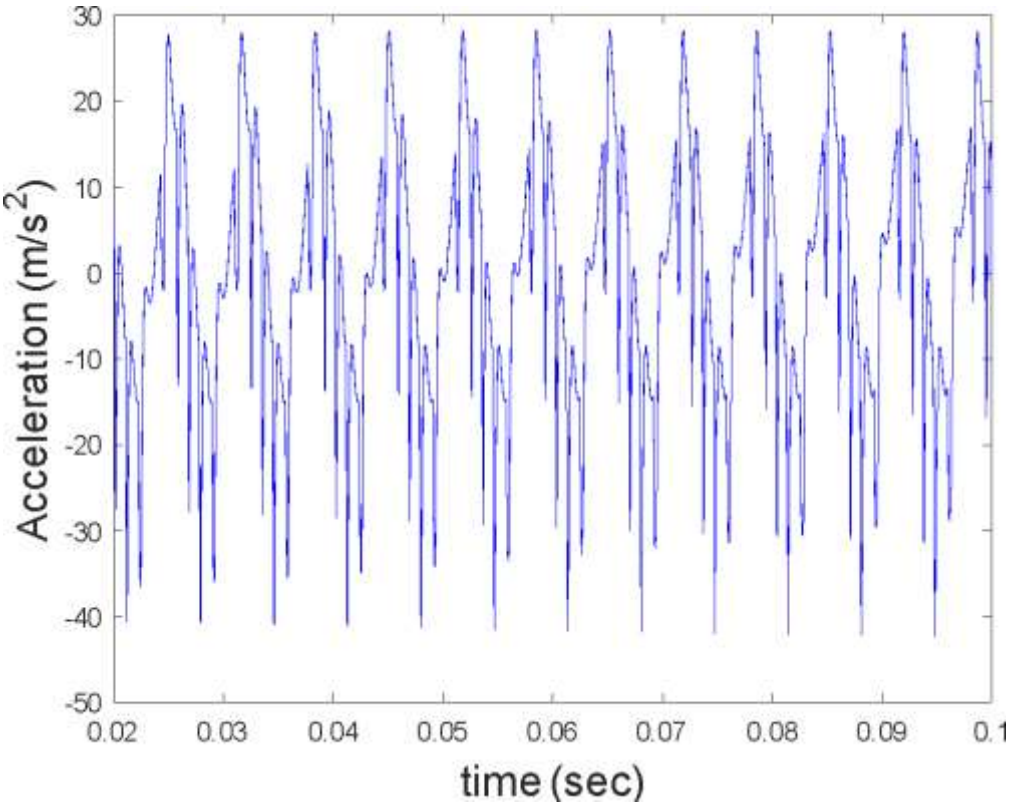
Acceleration (m/s^2)
time (sec)
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0.04
0.05
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0.09
0.1

India’s Ambitious Vision for Space Exploration: A Journey Beyond the Stars

By: Dibyajyoti Dalai, Student, Mechanical Engineering

In recent years, India has emerged as a formidable player in the realm of space exploration, propelled by the ambitious vision of the Indian Space Research Organisation (ISRO). From launching missions to Mars and the Moon to embarking on human spaceflight endeavors, India's space program is charting new frontiers and inspiring a generation of scientists and engineers.

At the heart of India's space exploration vision lies a commitment to scientific discovery, technological innovation, and international collaboration. With a series of successful missions under its belt, including the Mars Orbiter Mission (Mangalyaan) and the Chandrayaan missions to the Moon, India has demonstrated its capability to undertake complex interplanetary journeys.

One of the most exciting projects on India's horizon is the Gaganyaan mission, India's first human spaceflight program. Set to send Indian astronauts into space, Gaganyaan represents a significant leap forward for the country's space program and is poised to make India the fourth nation in the world to achieve human spaceflight capability. With preparations underway and

rigorous training programs in place for the astronauts, ISRO is inching closer to realizing this historic milestone.

Beyond the confines of Earth's orbit, India has set its sights on deeper space exploration. ISRO has outlined plans for missions to study asteroids, comets, and other celestial bodies, aiming to unravel the mysteries of the universe and expand humanity's understanding of the cosmos. These missions hold the potential to yield groundbreaking discoveries and contribute to scientific advancements on a global scale.

Moreover, India's space program emphasizes the importance of harnessing space technology for socio-economic development. Satellite technology plays a crucial role in areas such as communication, navigation, weather forecasting, disaster management, and agricultural monitoring, offering tangible benefits to society. ISRO's efforts to democratize access to space through initiatives like the Indian National Space Promotion and Authorization Centre (IN-SPACe) aim to foster innovation and entrepreneurship in the space sector, driving economic growth and technological advancement.

In pursuit of its space exploration goals, India recognizes the value of international cooperation and collaboration. ISRO actively engages with other space agencies, participating in joint missions, sharing expertise, and pooling resources to tackle common challenges. Collaborative endeavours such as the Mars Orbiter Mission, which involved cooperation with NASA, underscore the importance of global partnerships in advancing space exploration.

As India looks to the future, its space exploration vision remains bold and ambitious. With plans for missions to explore Venus, the Sun, and beyond, India is poised to continue pushing the boundaries of space exploration and cementing its status as a spacefaring nation. Through a combination of scientific excellence, technological prowess, and international cooperation, India is charting a course for a future where humanity's reach extends far beyond the confines of Earth.

In conclusion, India's space exploration vision represents a testament to the country's scientific and technological capabilities, its commitment to innovation and progress, and its aspirations to unlock the mysteries of the universe. With each mission launched and each milestone achieved, India takes another step closer to realizing its dream of exploring the cosmos and shaping the future of space exploration.

Mumbai–Ahmedabad high-speed rail corridor

By: *Subashis Dash, Student, Mechanical Engineering*

The Mumbai–Ahmedabad high-speed rail corridor, also known as the MAHSR corridor, is a significant infrastructure project in India aimed at revolutionizing rail transportation in the country. This corridor is planned to connect Mumbai, the financial capital of India, with Ahmedabad, the largest city in the state of Gujarat, through a high-speed rail network.

E5 Series Shinkansen set in Japan, which will be the rolling stock of the Mumbai–Ahmedabad high-speed rail corridor

Here are some key points about the project:

1. **Speed and Technology**: The corridor will feature high-speed trains capable of traveling at speeds up to 320 km/h (200 mph). The technology employed will likely be similar to Japan's Shinkansen bullet trains, known for their safety, efficiency, and punctuality.
2. **Distance and Travel Time**: The corridor spans approximately 508 kilometers (316 miles) and is expected to reduce travel time between Mumbai and Ahmedabad to around 2 hours, compared to the current journey time of about 7 hours by conventional train.
3. **Economic Impact**: The high-speed rail corridor is expected to have significant economic benefits, boosting regional connectivity, facilitating faster movement of people and goods, and stimulating economic growth along the corridor.

4. **Cost and Financing**: The project is estimated to cost around ₹1.1 trillion (approximately $15 billion USD). The funding for the project involves a mix of loans from Japan International Cooperation Agency (JICA) and the Indian government.
5. **Environmental Benefits**: By providing a fast and efficient alternative to road and air travel, the high-speed rail corridor is expected to contribute to reducing carbon emissions and easing congestion on existing transportation infrastructure.
6. **Challenges**: The project faces various challenges, including land acquisition, environmental clearances, and ensuring the financial viability of the venture. However, the Indian government has been actively pursuing the project, aiming to overcome these hurdles.
7. **International Collaboration**: The MAHSR project is a symbol of Indo-Japanese collaboration, with Japan providing technical expertise, funding, and assistance in project implementation.

Overall, the Mumbai–Ahmedabad high-speed rail corridor represents a major leap forward in India's transportation infrastructure, promising to revolutionize intercity travel and stimulate economic development along its route.

Map of Mumbai-Ahmedabad high-speed rail corridor.

The National Education Policy (NEP) 2020: Framework and Implementation

By: Smrutisweta Das, Student, Mechanical Engineering

The National Education Policy (NEP) 2020 in India is a comprehensive framework aimed at transforming the education sector. Here are some key highlights:

Holistic Education: NEP 2020 emphasizes a holistic approach to education, focusing on cognitive, social, emotional, and physical development.

Early Childhood Care and Education: The policy emphasizes the importance of early childhood care and education, aiming to provide universal access to quality early childhood education for children up to 6 years old by 2025.

School Education: The NEP advocates for the restructuring of school curricula and pedagogy to promote critical thinking, creativity, and experiential learning. It proposes a new curricular framework for 5+3+3+4 system, covering ages 3-18 years.

Multidisciplinary Education: The policy promotes a multidisciplinary approach, allowing students to choose subjects across different streams such as arts, humanities, sciences, and vocational subjects.

Vocational Education: NEP 2020 aims to integrate vocational education into mainstream education from the secondary level onwards, providing students with practical skills and knowledge.

Teacher Training and Professional Development: The policy stresses the importance of continuous professional development for teachers, including regular training, mentorship programs, and opportunities for career advancement.

Higher Education: NEP 2020 proposes several reforms in higher education, including the establishment of a single regulatory body for higher education called the Higher Education Commission of India (HECI), promotion of multidisciplinary education, and flexible undergraduate courses.

Language Policy: The policy advocates for a flexible language policy, promoting multilingualism and encouraging the use of local languages as the medium of instruction in schools.

Technology in Education: NEP 2020 recognizes the importance of technology in education and proposes the integration of technology in teaching, learning, assessment, and administration.

Equity and Inclusion: The policy aims to ensure equitable access to education for all, including marginalized and disadvantaged groups, by providing scholarships, infrastructure, and other support mechanisms.

Overall, the National Education Policy 2020 seeks to address the evolving needs of the Indian education system and prepare students for the challenges of the 21st century.

The NEP 2020 being discussed with educational institutions across the country. Visible are BITS Pilani, Jamia Millia Islamia, Panjab University, Tezpur University Assam and Central University of Kerala.

Implementation

In early August 2021, Karnataka became the first state to issue an order with regard to implementing NEP.

On 26 August 2021, Madhya Pradesh implemented NEP 2020.

Uttar Pradesh Chief Minister Yogi Adityanath said the National Education Policy-2020 will be implemented in phases by 2022.

The Telangana State government has decided to implement the newly announced National Education Policy 2020 (NEP 2020) in the State.

Maharashtra CM Uddhav Thackeray directs to appoint experts' committee for implementation of new education policy.

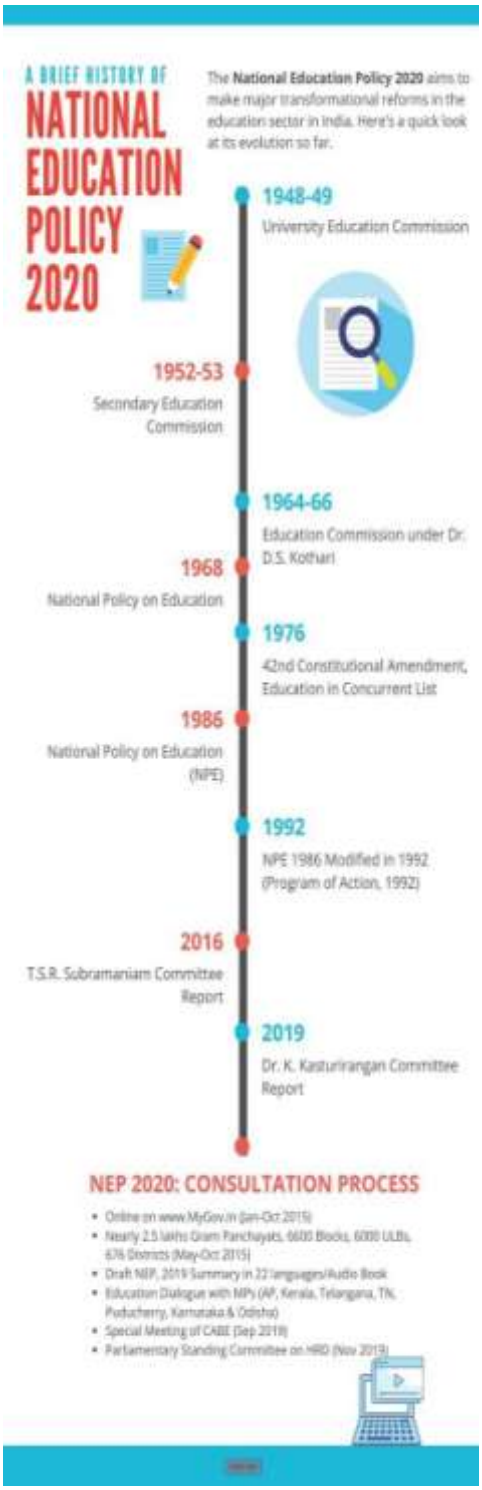
Andhra Chief Minister Y.S. Jagan Mohan Reddy has directed officials of the Education Department to implement the National Education Policy 2020 in letter and spirit across the State.

Rajasthan Governor Kalraj Mishra said that NEP 2020 will be implemented in phased manner.

The Chief Minister of Assam, Himanta Biswa Sarma said that NEP 2020 will be implemented from 1 April 2022.

In April 2022, the UGC (University Grants Commission) approved simultaneous dual degrees, both in physical and online modes

In October 2022, Ministry of Education released New Curriculum Framework for 3–8 years children and National Credit Framework inline of NEP 2020.



Technology and Privacy: Navigating the Digital Age

By: ***Chinmayee Majhi, student, Mechanical Engineering***

In the digital era, technology has become intertwined with daily life, offering unprecedented convenience and connectivity. However, this comes with a trade-off: privacy. As we embrace smart devices, social media, and online services, we generate vast amounts of data, often without considering the privacy implications.

The Privacy Paradox

While we enjoy the benefits of technology, we also expect our personal information to remain private. This paradox is at the heart of modern privacy concerns. Every online search, purchase, or interaction leaves a digital footprint that companies can use to tailor services or advertisements, raising questions about the extent of data collection and usage.

The Role of Legislation

To address these concerns, laws like the General Data Protection Regulation (GDPR) in the EU have been enacted, granting individuals more control over their personal data. Such regulations compel organizations to be transparent about data practices and offer users the right to access, correct, or delete their information.

Personal Responsibility

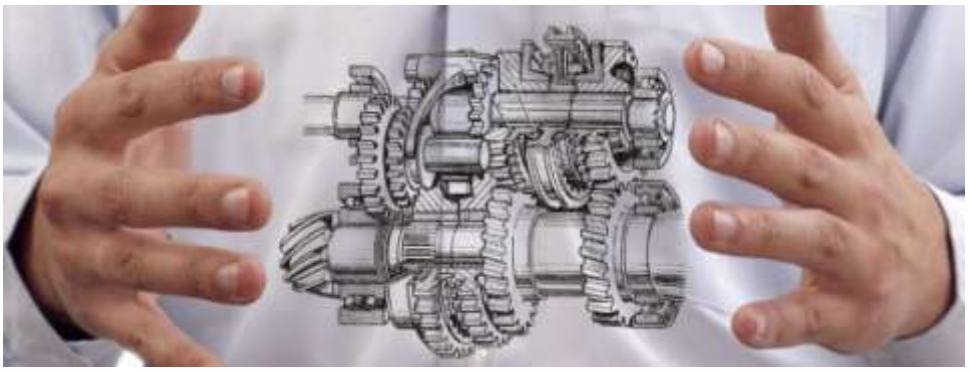
As users, we must also be proactive in protecting our privacy. This includes using strong, unique passwords, being mindful of the information we share online, and understanding the privacy settings of the platforms we use.

The declining interest in Mechanical Engineering branch among B.Tech. aspirants

By: ***Puja Swain, Student, Mechanical Engineering***

The field of mechanical engineering has long been regarded as the backbone of engineering disciplines, encompassing a wide array of applications from manufacturing and transportation to energy and robotics. However, in recent years, there has been a noticeable decline in interest and investment in this once-thriving branch of engineering. Several factors contribute to this decline, ranging from shifts in technology and industry demands to changes in educational priorities and global economic trends.

One significant factor in the decline of mechanical engineering is the rapid advancement of technology, particularly in the fields of automation and digitalization. As industries embrace automation and robotics, there is a growing emphasis on disciplines such as electrical and computer engineering, which play pivotal roles in developing and implementing these technologies. This shift has led to a perception among students and professionals that mechanical engineering may be becoming obsolete in comparison to more cutting-edge fields.



Moreover, the traditional image of mechanical engineering as a hands-on, physically demanding profession may no longer resonate with younger generations who are increasingly drawn to careers in software development, data science, and other high-tech fields. The allure of working with state-of-the-art technologies and the promise of lucrative salaries in these emerging sectors have contributed to a decline in enrolment in mechanical engineering programs at universities worldwide.

Additionally, globalization and outsourcing have had a profound impact on the job market for mechanical engineers. Many manufacturing jobs that were once the domain of mechanical engineers have been outsourced to countries with lower labour costs, leading to a decrease in demand for mechanical engineering expertise in some regions. This trend has further dampened enthusiasm for pursuing a career in mechanical engineering, as students may perceive limited job prospects and opportunities for advancement in the field.

Furthermore, the emphasis on sustainability and environmental consciousness in modern society has prompted a shift towards green technologies and renewable energy sources. While mechanical engineering plays a crucial role in these areas, the focus on sustainability may not always align with the traditional image of the field, which has historically been associated with heavy industry and fossil fuel extraction. As a result, some students may be drawn to disciplines like environmental engineering or renewable energy systems, which offer a more direct path to addressing pressing global challenges.

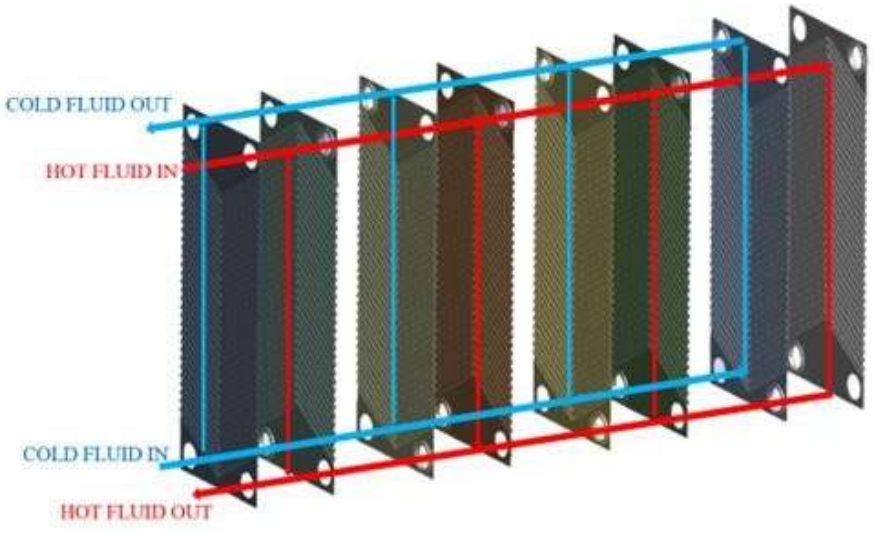
Despite these challenges, it is essential to recognize that mechanical engineering remains a vital and multifaceted discipline with enduring relevance in numerous industries. From designing more energy-efficient systems to advancing the frontiers of aerospace and automotive engineering, mechanical engineers continue to innovate and drive progress in diverse fields. Moreover, the interdisciplinary nature of modern engineering demands collaboration between different specialties, highlighting the importance of cultivating a broad skill set that includes mechanical engineering principles.

In conclusion, while the field of mechanical engineering may be facing challenges in terms of declining enrolment and shifting industry dynamics, its fundamental principles and applications continue to play a crucial role in shaping the world around us. By adapting to changing technologies and embracing new opportunities, mechanical engineers can continue to make invaluable contributions to society and remain at the forefront of innovation in the years to come.

Numerical simulation of a brazed plate heat exchanger using Al_2O_3-water nanofluid with periodic boundary conditions

By: Dr. S.Basak, Assistant Professor, Mechanical Engineering

Brazed plate heat exchangers are used as evaporators, condensers, and single-phase heat exchangers in the industry. This complex piece of engineering has the effectiveness and compactness to give it an edge over many conventional heat exchangers. Solar power plants and organic Rankine cycle systems do use these heat exchangers as a part of heat recovery systems. The complex channels formed by the angled sinusoidal plates allow the fluid to be in a turbulent zone at a low Reynolds number, thus promoting better heat transfer characteristics. The challenge of simulating these heat exchangers is the large computational requirements. This can be solved by using periodic boundary conditions where a single repeating element is simulated to analyse the heat transfer characteristics of the entire channel. Varying concentrations of Al2O3 Nanofluid were considered as the working fluid for this study. The variation in the concentration did not affect the Nusselt number showing that the heat transfer coefficient was completely dependent on the hydraulic diameter and the thermal conductivity of the fluid. The friction factor also did not change with varying concentrations but the pressure drops increased as the chevron angle, pitch, and concentration increased.

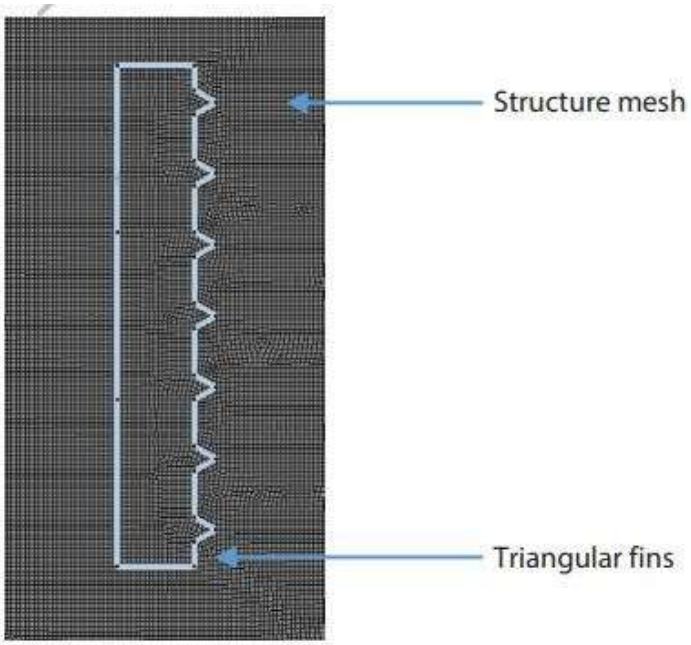


Schematic of the plate arrangement and flow pattern

Study of Natural Convection from a Vertical Wall with Extended Surfaces

By: Mr. Chandan Sourav Sahoo, Lecturer, Mechanical Engineering

Fins are often added to surfaces to enhance heat transmission through convection between the surface and the surrounding fluid. For a system to remain in a steady state, the heat passing through must be dispersed continuously to the environment, including solids, walls, or limits. In many engineering applications, there is a need to dissipate a large amount of heat from a small region. Fins expand a surface's usable area, which enhances convectional heat transmission. Straight fins come in two different shapes: rectangles and triangles. Among the two, triangular fins require less space but offer equal heat transmission compared to their rectangular counterparts, making them more desirable. Fins are useful because they provide maximum heat flow per unit mass while being easy to fabricate. For an air-cooled engine cylinder, rectangular and triangular fins are installed on the periphery to improve heat transfer. Heat transfer analysis is performed on the cylinder's surface temperature with varying temperatures ranging from 300°C to 350°C. The analysis involves comparing rectangular fins with other types of fins using density, thermal conductivity, heat transfer coefficient, and fin thickness as input parameters.



Mesh geometry of the triangular fins attached to the heated surface in the domain

EVENTS AND ACHIEVEMENTS