BBDNIIT

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Babu Banarasi Das Northern India Institute of Technology

MECHDRISHTI

2025 - 26

MECHANICAL ENGINEERING DEPARTMENT

Babu Banarasi Das Northern India Institute of Technology

Sector-II,Dr.AkhileshDasNagar,Ayodhya Road,Lucknow(U.P.)-226028,India

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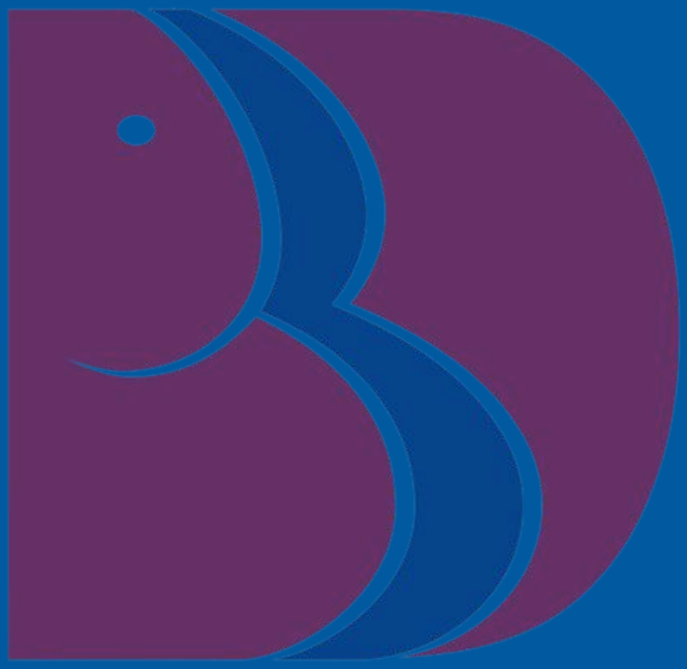

BBDNIIT

LORD GANESHA'S GRACE

The BBD Campus proudly houses a beautiful Ganesh temple, a spiritual haven that infuses the college with a profound sense of serenity and purpose. The temple's presence on campus is more than just a place of worship; it symbolizes a bridge between the academic and the divine, offering students a space to connect with their spirituality amid their educational journey.

Ganesh Ji, the revered remover of obstacles and the harbinger of wisdom and prosperity, holds a special place in Hindu tradition. His temple at BBD Campus stands as a testament to these values, providing students with a sanctuary where they can seek blessings, reflect, and find solace during their studies. The essence of the temple extends beyond its physical structure, permeating the entire campus with a spirit of peace and positivity.

For many students, college life is a time of immense growth, but it also comes with its share of challenges and uncertainties. The Ganesh temple offers a reassuring presence, reminding students that they are not alone in their journey. It encourages them to pause, pray, and draw strength from their faith, fostering a holistic approach to education that nurtures both the mind and the soul. The act of worshiping together also fosters a sense of community, as students from diverse backgrounds come together in shared reverence, strengthening their bonds and promoting a culture of mutual respect and support.

The choice of a Ganesh temple specifically holds deep significance. Lord Ganesh, revered as the deity of beginnings, is invoked at the start of new ventures to ensure success and remove obstacles. For students embarking on their academic journey, seeking Ganesh's blessings can be a source of immense comfort and confidence. His wisdom and benevolence inspire students to pursue their goals with determination and integrity, knowing they have divine support.

Moreover, the Ganesh Ji temple at BBD Campus serves as a reminder of the cultural and spiritual heritage that underpins our education system. It encourages students to value and preserve these traditions, recognizing that true education encompasses not just intellectual growth, but also moral and spiritual de
velopment.

BABU BANARASI DAS JI

Late Babu Banarasi Das Ji
(1912 – 1985)
Ex Chief Minister
Govt. of Uttar Pradesh

"To provide an open opportunity to the young generation for evolving their core competencies and to build their career as world class professionals with broad based foundation, in-depth knowledge & versatile personality to meet the challenges of Global Economy..." – Babu ji's Vision.

Babu Banarasi Das Ji, a born nationalist, in his early youth, joined hands with Mahatma Gandhi & Jawahar Lal Nehru in the movement to free India from the clutches of British rule.

During his long political career, he worked as a Minister, Speaker and Member of Parliament (both Lok Sabha and Rajya Sabha). He also held the position of the Chief Minister of Uttar Pradesh. His entire life was devoted to secure the dignity of individuals through selfless service to mankind. He was a humanitarian who enabled people to realize their goals. He never believed in surrendering to any forces. Even in the face of death, he would not give in. "Man doth not yield himself to angels, not even unto death, utterly, saved, by the weakness of his feeble will." Babuji always led and inspired people through his own example, leaving behind a legacy for future generations. We are privileged to inherit that legacy and perpetuate his memory.

AKHILESH DAS GUPTA JI

LATEDR. AKHILESH DAS GUPTA
MBA, LLB, Ph.D.
Ex-Memberof Parliament (Rajya Sabha)
Hon'bleFounder Chairman, BBD Group

"We not only make technocrats at BBD, we churn out citizens of the world, perfect in all respect in all respects, be it leadership, competence, confidence, communication, moral or knowledge..." - Akhilesh Das Gupta's Vision.

A distinguished political leader, philanthropist, educationist and social worker, Dr. Akhilesh Das is the pride of Lucknow city. He has established himself as a worthy son of his illustrious father Late Babu Banarasi Das Ji.

Public Life

He has obtained MBA, LLB & Ph.D.(Human Resource Management)degrees, Dr. Akhilesh Das decided to follow his father's footprints by choosing Social Service as his primary goal. In his distinguished public life spanning well over three decades, Dr. Das was first elected as the Mayor of Lucknow in year 1993 and became one of the youngest Mayors of the world. Subsequently, he was elected as a Member of Parliament (Rajya Sabha) in November 1996 and was re-elected for a second term in November 2002 till November 2008. Dr. Das has been elected again as a Member of Parliament (Rajya Sabha) for a third consecutive term in 2008 till 2014.

Dr. Das has been a member of many important parliamentary committees and National level apex advisory & statutory bodies including the AIMS. He has been a member of the Executive Committee of AICTE. He had been the Chairman Parliamentary Standing Committee for Industries. He also served with distinction as the Union Minister of State for Steel and made a place for himself as one of the foremost National leaders.

Contribution To Sports

Dr. Akhilesh Das is an enthusiastic sports person. He underwent an exhaustive training in England as a Junior Badminton player. Later, he represented and captained the U.P. State Badminton team for many years and won many National & International tournaments including the National Doubles Championship. His love for other sports is no less. He has been instrumental in organizing and facilitating many National level tournaments in various sports. Presently he is the president of the U.P. Olympic Association & Chairman of Badminton Association of India.

Contribution To The Cause Of Education

As a social thinker, Dr. Das realized the need of Quality Technical & Professional education for the overall growth and upliftment of the masses and development of the State of Uttar Pradesh. Accordingly, Babu Banarasi Das Educational Society (BBDES) was founded through which the torch for higher professional education was lit in Lucknow, the Capital of U.P. The first institution in the series, Babu Banarasi Das National Institute of Technology & Management (BBDNITM) was established in 1998.

Travels And Experiences

He has travelled extensively to U.K., U.S.A., Japan, France, Switzerland, Spain, Portugal, Sau Pualo etc. on several occasions. Dr. Das has attended several World Seminars and Conferences including UNO sponsored Conference of Mayors (Japan) in 1993 and UNCTAD XI Conference (Brazil) in 2004. As the Mayor of Lucknow, he attended the International Children's Game held in Canada in 1994 and led the Indian Badminton Team as its Chief-de-Mission at the Athens Olympics in August 2004. Dr. Das also led a team of academicians to various European countries to study their education systems in the year 2002.

AKHILESH DAS GUPTA JI

ALKA DAS GUPTA JI

MRS. ALKA DAS
M.B.A., L.L.B.
Chairperson, BBD Group

A lady with spirit, determination and zeal, Mrs. Alka Das has been the driving force behind her husband Dr. Akhilesh Das. She is the daughter of Late Justice D. P. Gupta, who held high positions in the State of Rajasthan, as its Governor and Chief Justice. She was brought up on Gandhian ideals and philanthropic traditions.

Mrs. Das is a Management expert and a legal luminary who has a long involvement with issues of social justice and women empowerment in our country. She is a legal consultant to several reputed organizations and an active Social Worker. She is connected with many National Social & Educational Organizations. She is also a Life Member of the "Rajasthan High Court Bar Association". The establishment of Northern India Engineering College, Lucknow was an initiative taken by her to provide quality professional education to match the International Standards.

She has travelled extensively to countries like Denmark, Italy, Japan, France, Switzerland, UK and USA to study the pattern of education and facilities provided to the students there. As a Co-founder of Babu Banarasi Das Group of Educational Institutions, Mrs. Das has made a fertile attempt to nurture a generation of self-made and highly motivated students with an inbuilt commitment to do something constructive for the Country

VIRAJ SAGAR DAS JI

Mr. Viraj Sagar Das
B.A LL.B (Hons.),
Advocate
President, BBD Group

"Education is the most powerful weapon which you can use to change the world"
- Nelson Mandela

Babu Banarasi Das University has its roots lying deep in quality education practices that equip each student with broad outlooks to prepare them for this futuristic world. We are committed to providing the education that fulfils the needs of today's world. Today, education is not limited to textbook courses and their practical implementation. Education has been through a major transformation where apart from the syllabus, it has become imperative to inculcate some extra skills in the students so that they could truly succeed in their lives. We encourage our students to perform well in their academics and also to take active participation in all the co-curricular activities to develop interpersonal skills, take up challenges, be self-dependent and most importantly, have a good time while learning.

To quote Dr. A.P.J.Abdul Kalam, "Learning gives creativity, creativity leads to thinking, thinking provides knowledge, and knowledge makes you great".

DIRECTOR'S MESSAGE

Prof. (Dr.) V. K. Singh
Director (Engg.), BBDNIIT, Lucknow

Dear Readers,

"Education is the most powerful weapon which you can use to change the world."
- Nelson Mandela

It gives me immense pleasure to introduce our Mechanical Engineering Departmental college magazine at Babu Banarasi Das Northern India Institute of Technology (BBDNIIT), Lucknow. Since its inception, BBDNIIT has been committed to providing quality technical education and developing competent technocrats who are socially sensitive and committed to excellence on a global scale.

For over 17 years, BBDNIIT has stood as a beacon of academic excellence and innovation in the field of engineering. Our esteemed faculty, state-of-the-art infrastructure, and rigorous academic processes are all geared towards nurturing talent and fostering an environment of growth and learning.

In this magazine, you will find a vibrant showcase of the creativity, dedication, and hard work of our students and faculty. It reflects the dynamic and inclusive community we have cultivated, where every student is encouraged to pursue their passions and excel both academically and personally. Our systematic teaching-learning process prepares students for the challenges ahead, equipping them with the knowledge, skills, and ethical values necessary to make significant contributions to society.

The global technology landscape is evolving rapidly, and to remain competitive, our students must be prepared to face new challenges head-on. BBDNIIT is dedicated to training students to meet these challenges with confidence and competence. We continue to strive for excellence in professional education, aiming for new heights and fostering a thinking, professional order.

I encourage all students to make the most of their time with our dedicated faculty and staff, to develop their proficiency, and to grow both personally and professionally. The doors of our faculty members are always open for guidance and support.

With best wishes for your continued success and growth.

HOD'S MESSAGE

Prof.(Dr.) N. K. Mishra
Head of department

Dear Readers,

"Education is the most powerful weapon which you can use to change the world."
- Nelson Mandela

It is an honor to share my thoughts with you in this edition. The sustained growth and prominence of our college are reflections of our collective endeavor; every one of us has played an instrumental role in shaping the legacy of excellence we share today.

It is highly encouraging to observe the faculty's unwavering commitment to academic enrichment, as evidenced by their continuous organization of conferences, training programs, and workshops. Additionally, the strategic implementation of expert lectures across various departments plays a crucial role in maintaining our alignment with cutting-edge developments in science and technology.

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With best wishes for your continued success and growth.

Institute Vision

To establish a multi-disciplinary environment with excellence in technical education and research for developing competent professionals who meet the challenges of industrial and societal development with human values and ethics.

Institute Mission

- To provide an excellent environment with supporting infrastructure to prepare globally competent professionals acceptable to industry and society.
- To inculcate a spirit of research, innovation and entrepreneurship by exposing multi-disciplinary approach.
- To motivate aspiring graduates to solve real life problems with zeal of lifelong learning.
- To imbibe a healthy environment which helps to develop intellectual capabilities among graduates to transform them into professionals with human values and ethics.

Department's Vision

To be a leading center in Mechanical Engineering by providing value-based quality education that nurtures competent, versatile, and entrepreneurial professionals capable of excelling at the global level.

Department's Mission

M1: To deliver quality education using cutting edge infrastructure for producing competent professionals.
M2: To encourage students to pursue higher education and explore entrepreneurial skills through innovation to serve society at large.
M3: To Inculcate the values of leadership & integrity with sensitivity for societal issues.

PROGRAMME OUTCOMES

Program Outcomes (POs)

PO1: **ENGINEERING KNOWLEDGE:**

- Can Apply knowledge of mathematics, natural science, computing, engineering fundamentals and engineering specialization as specified in **WK1 to WK4** respectively to develop to the solution of complex engineering problems.

PO2: **PROBLEM ANALYSIS:**

- Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. **(WK1 to WK4)**

PO3: **DESIGN/DEVELOPMENT OF SOLUTIONS:**

- Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. **(WK5)**

PO4: **CONDUCT INVESTIGATIONS OF COMPLEX PROBLEMS:**

- Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis interpretation of data to provide valid conclusions. **(WK8).**

PO5: **ENGINEERING TOOL USAGE:**

- Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. **(WK2 and WK6)**

PO6: **THE ENGINEER AND THE WORLD:**

- Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment

(WK1, WK5, and WK7).

PROGRAMME OUTCOMES

Program Outcomes (POs)

PO7: **ETHICS:**

- Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. **(WK9)**

PO8: **INDIVIDUAL AND COLLABORATIVE TEAM WORK:**

- Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: **COMMUNICATION:**

- Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

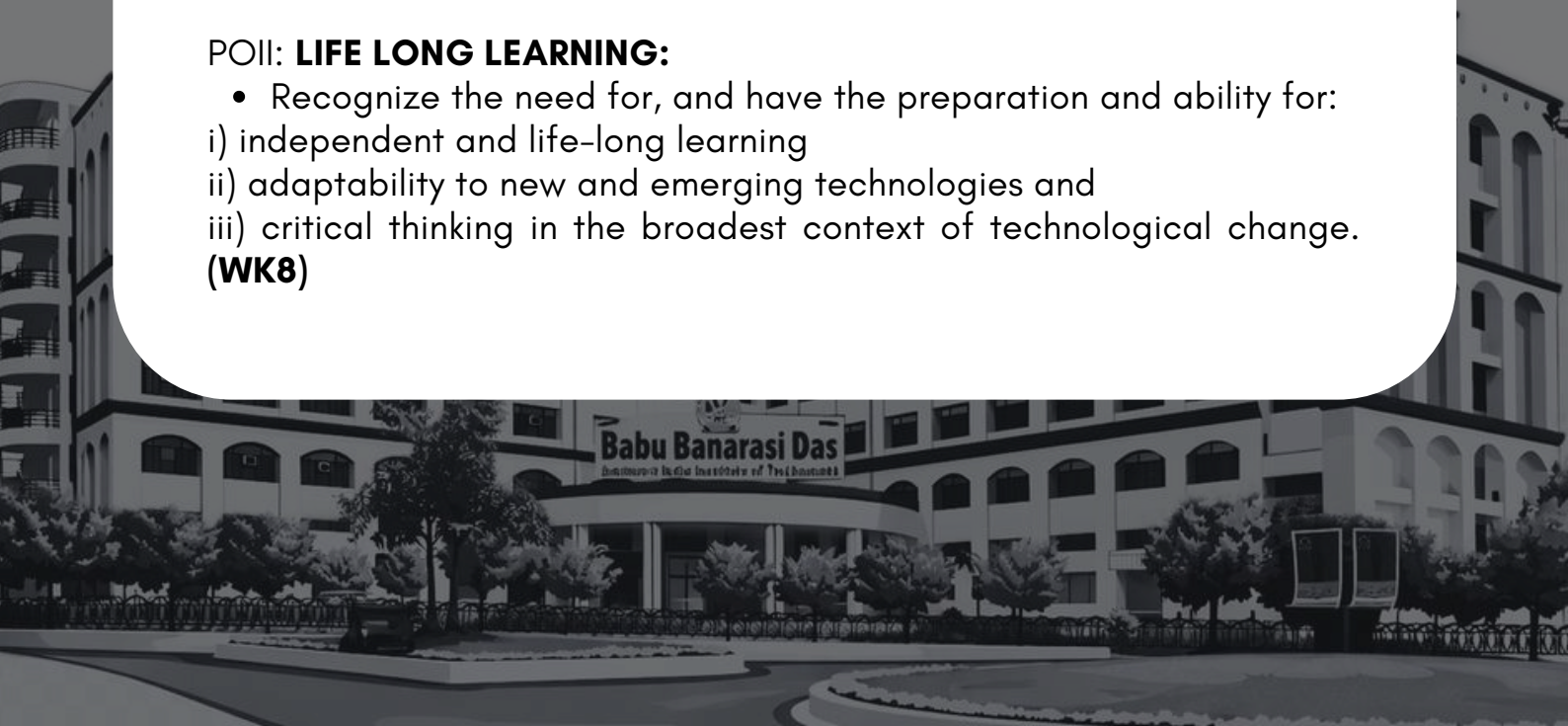
PO10: **PROJECT MANAGEMENT AND FINANCE:**

- Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

POII: **LIFE LONG LEARNING:**

- Recognize the need for, and have the preparation and ability for:

i) independent and life-long learning
ii) adaptability to new and emerging technologies and
iii) critical thinking in the broadest context of technological change. **(WK8)**



Programme Outcomes
Knowledge and Attitude Profile WK)

Programme Outcomes
Knowledge and Attitude Profile WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

PROGRAMME EDUCATIONAL OBJECTIVES

Program Educational Objectives (PEOs)

PEO 1: Graduates will be able to apply domain knowledge for employment, advanced studies, entrepreneurial activities and for facing challenges in professional life.

PEO 2: Graduates will exhibit professionalism through effective communication skills, ethical values, and social responsibility.

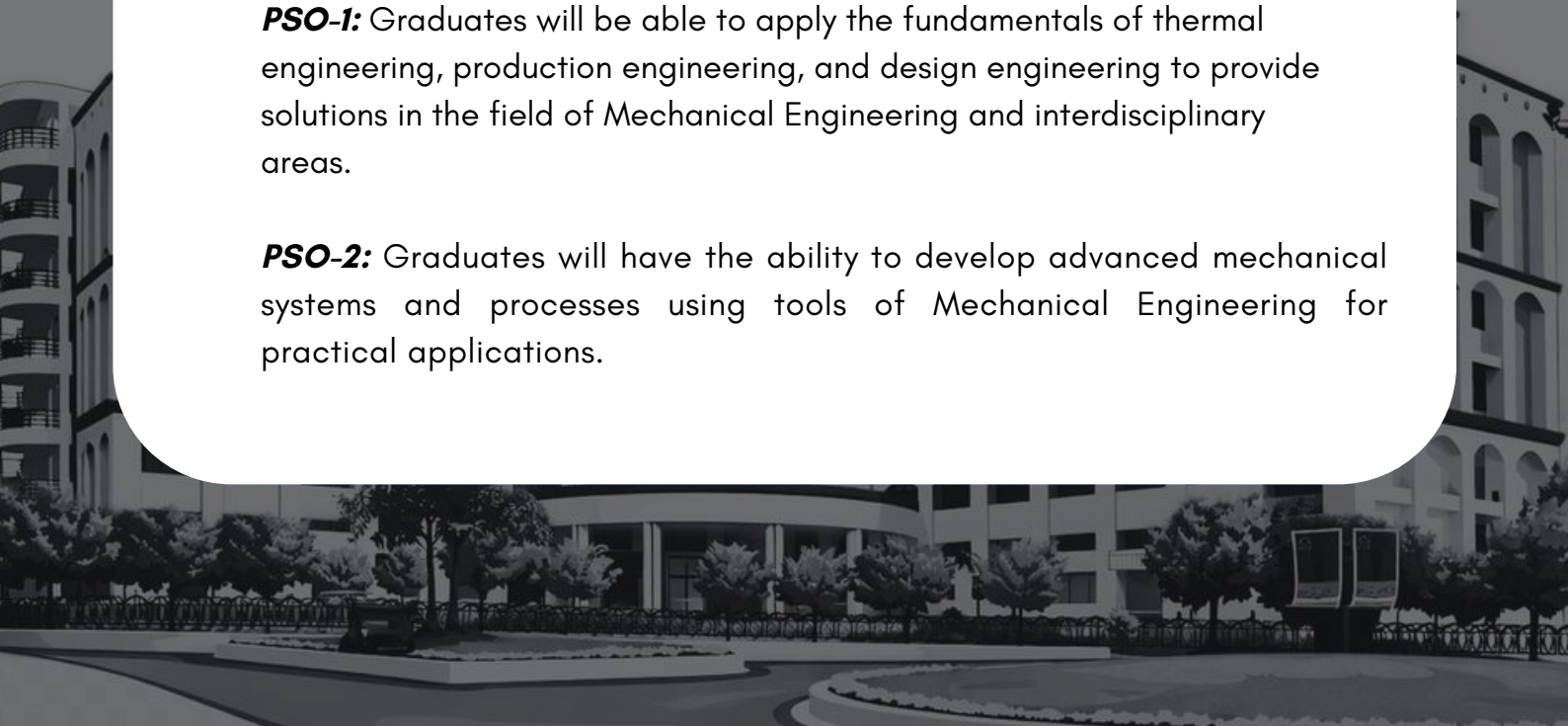
PEO 3: Graduates will demonstrate team spirit and leadership qualities and engage in lifelong learning to contribute to nation- building.

PROGRAMME SPECIFIC OUTCOME

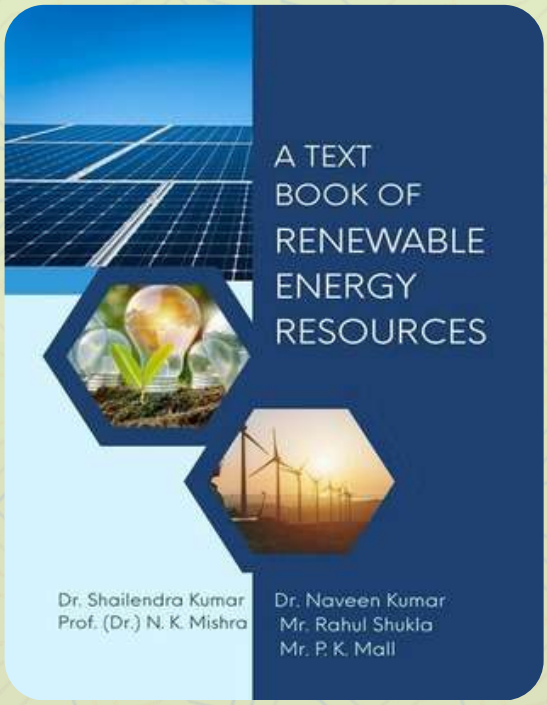
Program Specific Outcomes (PSO)

PSO-1: Graduates will be able to apply the fundamentals of thermal engineering, production engineering, and design engineering to provide solutions in the field of Mechanical Engineering and interdisciplinary areas.

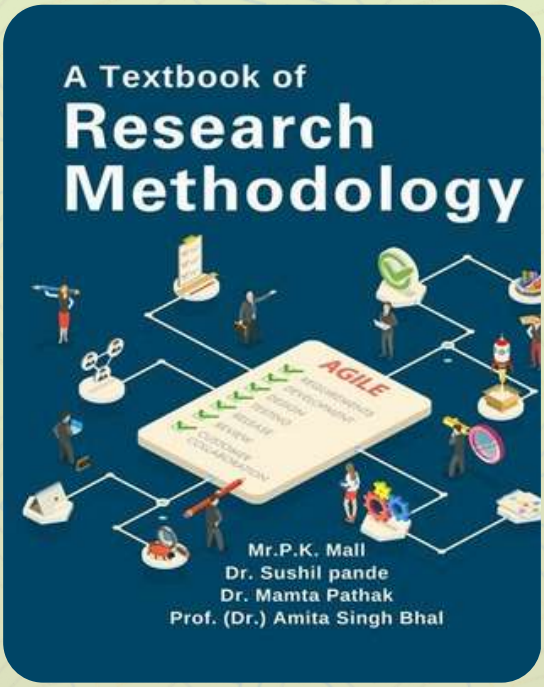
PSO-2: Graduates will have the ability to develop advanced mechanical systems and processes using tools of Mechanical Engineering for practical applications.



Our Published Books



Author: Dr.N.K.Mishra & Dr. P.K.Mall
ISBN: 9789359119762 & 9359119768



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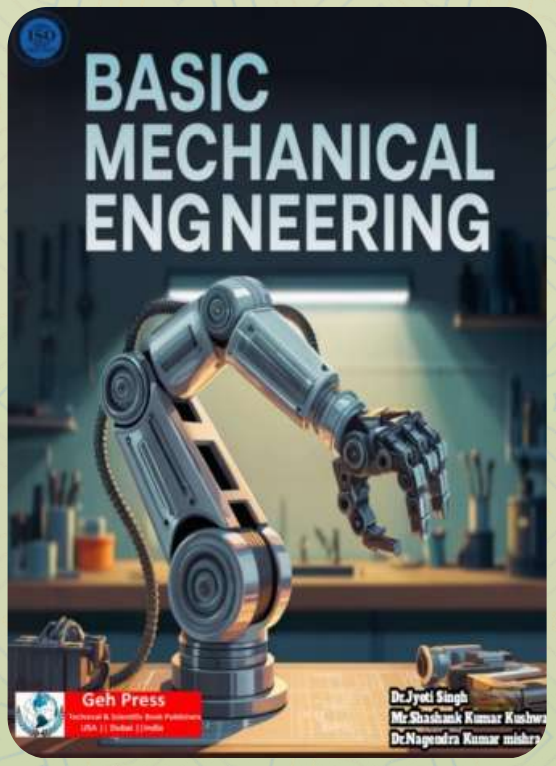
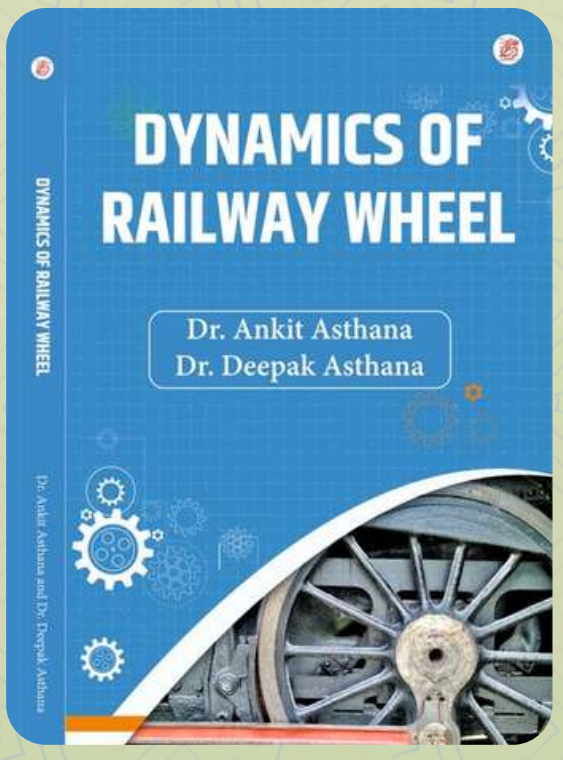


Author: & Dr. Jyoti Singh, Dr.N.K.Mishra & Mr.Shashank Kumar Kushwaha
ISBN: 978-1-971938-05-9



Author: Dr. Ankit Asthana
ISBN: 9789359929651

Departmental Events & Seminars

International Yoga Day

- BBD University celebrated the 2025 International Yoga Day with the theme "Yoga for One Earth, One Health.
- Students and faculty gathered at Dr. Akhilesh Das Gupta Stadium for a collective session of mindfulness and physical wellness.

Robotics Workshop

- Organised by the Technical committee to enhance students's interest in IoT and robotics.
- The program provided students with hardwares so that they can learn and perform task.

Internal Hackathon for SIH 2025

- BBDNIIT conducted an internal hackathon to select top talent for the Smart India Hackathon (SIH) 2025.
- The event encouraged students to develop creative solutions for real-world problems under the MoE's Innovation Cell initiative.

Profile Building for Placement & Higher Education

- Krati Yadav, Co-founder of AOO SEEKHE and International Author, shared expert strategies for high-value career growth
- The session on September 29, 2025, focused on optimizing profiles for Fortune 500 recruitment and global higher education.

Artificial Intelligence: Driving the Next Revolution in Mechanical Engineering

Artificial Intelligence (AI) is redefining the future of Mechanical Engineering by transforming the way engineers design, manufacture, and maintain mechanical systems. What was once considered a discipline centered on machines and manufacturing has now evolved into a data-driven field where intelligent technologies enhance productivity, precision, and innovation.

One of the most significant contributions of AI is in ***product design and simulation***. Modern AI-powered Computer-Aided Design (CAD) tools employ generative design algorithms that can produce thousands of optimized design alternatives within minutes. By considering constraints such as weight, strength, material, and manufacturing cost, AI enables engineers to develop lightweight, durable, and cost-effective products while significantly reducing design cycles. This technology is already being adopted in the aerospace and automotive sectors to create high-performance components with improved efficiency.

In the era of ***Industry 4.0***, AI has become the driving force behind smart manufacturing. Integrated with Computer Numerical Control (CNC) machines, robotics, and Internet of Things (IoT) sensors, AI enables manufacturing systems to monitor production in real time, optimize machining parameters, reduce material waste, and improve energy efficiency. Intelligent production systems can detect anomalies, self- correct process variations, and enhance overall productivity, making factories more responsive and sustainable.

Another transformative application is ***predictive maintenance***. Instead of relying on periodic inspections or waiting for equipment failure, AI analyzes sensor data such as vibration, temperature, and acoustic signals to predict potential faults before they occur. This proactive approach minimizes unexpected downtime, reduces maintenance costs, and extends the operational life of industrial equipment such as pumps, compressors, turbines, and motors.

AI is also revolutionizing ***quality assurance*** through machine vision and deep learning techniques. Automated inspection systems can identify surface defects, dimensional inaccuracies, and manufacturing inconsistencies with exceptional speed and accuracy, often outperforming conventional manual inspection methods. The result is improved product quality, reduced rejection rates, and enhanced customer satisfaction.

The impact of AI extends beyond manufacturing into ***thermal and fluid engineering***, where intelligent algorithms optimize the performance of heat exchangers, refrigeration systems, HVAC installations, and combustion processes. By predicting optimal operating conditions, AI helps reduce energy consumption, operating costs, and environmental emissions, contributing to more sustainable engineering solutions.

The growing adoption of ***intelligent robotics*** has further expanded the capabilities of modern manufacturing. AI-enabled robots can adapt to dynamic environments, collaborate safely with human operators, and perform repetitive or hazardous tasks with minimal supervision. These collaborative robots are becoming indispensable across automotive assembly, material handling, precision machining, and industrial automation.

As AI continues to reshape engineering practice, the role of the mechanical engineer is evolving. Future engineers will require not only strong foundations in mechanics, thermodynamics, manufacturing, and materials science but also proficiency in programming, data analytics, machine learning, and digital technologies. The integration of these interdisciplinary skills will empower engineers to solve increasingly complex industrial challenges and lead technological innovation.

Artificial Intelligence is not replacing mechanical engineers—it is enhancing their capabilities. By combining engineering fundamentals with intelligent technologies, AI is enabling faster innovation, smarter decision-making, and more sustainable industrial practices. The future of Mechanical Engineering belongs to professionals who can seamlessly integrate human creativity with the analytical power of artificial intelligence.

"The future of Mechanical Engineering lies at the intersection of engineering excellence and artificial intelligence—where innovation is driven not only by machines but by the intelligence behind them."

Author: Dr. Nagendra Kumar Mishra
Professor and Head of Dept.
Mechanical Engineering

Digital Twin Technology: Revolutionizing the Future of Mechanical Engineering

The rapid advancement of digital technologies is transforming the landscape of mechanical engineering, with Digital Twin Technology emerging as one of the most influential innovations in modern industry.

A digital twin is a virtual representation of a physical asset, process, or system that continuously receives real-time operational data from sensors and connected devices. By integrating simulation, data analytics, and the Internet of Things (IoT), digital twins enable engineers to monitor performance, predict failures, and optimize operations throughout an asset's lifecycle. As industries move toward intelligent manufacturing and Industry 4.0, digital twin technology is becoming an indispensable tool for improving efficiency, reliability, and sustainability.

How It Works

The fundamental principle of a digital twin lies in establishing a dynamic connection between a physical system and its virtual counterpart. Sensors installed on machines collect parameters such as temperature, vibration, pressure, rotational speed, and power consumption. This data is transmitted through industrial communication networks to cloud or edge computing platforms, where computational models and simulation software continuously update the virtual model. Unlike conventional CAD models, a digital twin reflects the real-time operating condition of the equipment, enabling engineers to evaluate system performance under varying operating conditions and predict future behavior with high accuracy.

Key Applications

1. Predictive Maintenance: Traditional maintenance relies on fixed intervals or corrective action after failure. Digital twins use real-time data and machine learning to spot early signs of degradation, so maintenance happens only when needed.

2. Automotive: Virtual replicas of engines, transmissions, and production lines help improve product development and manufacturing efficiency.

3. Aerospace: Aircraft engines are monitored throughout their operational life to plan maintenance and extend service life.

4. Smart Manufacturing: Twins analyze workflow efficiency, identify bottlenecks, and optimize production without disrupting operations.

5. Emerging Uses in 2026: Renewable energy farms use twins to predict wind turbine failures, healthcare uses them to personalize medical devices, and smart cities use them to simulate traffic and energy grids.

Challenges

Despite the advantages, digital twins require high-quality sensors, reliable communication infrastructure, accurate simulation models, and strong cybersecurity. Integration with legacy equipment and the need for multidisciplinary expertise remain significant challenges.

The Road Ahead With advances in AI, cloud computing, edge computing, and industrial IoT, digital twins are becoming increasingly intelligent and autonomous. We're shifting from “monitor and alert” to “monitor, predict, and self-optimize.” For mechanical engineering, this means moving from reactive repairs to proactive design. As the push for sustainable, efficient industry grows, digital twins will remain a cornerstone of reliable and resource-efficient operations.

Author: Yash Sharma
4th year

The Invisible Furnace: Why Decarbonizing Heavy Industry Is the Ultimate Engineering Challenge

Everyone loves talking about electric cars and rooftop solar panels. They are clean, quiet, and fit nicely on a slide deck. But they are only scratching the surface. The real elephant in the global energy room—the massive, carbon-belching monster nobody likes to talk about—is heavy industry.

If you want to build modern civilization, you need steel, cement, glass, and chemicals. And to make those materials, you need brute-force, ultra-high-temperature thermal energy, often exceeding 1,500 degrees Celsius. Historically, humanity has solved this problem the same way for centuries: by setting fossil fuels on fire.
Natural gas and coal burners provide the intense, continuous heat required to melt iron ore and calcine limestone. Replacing that thermal output isn't just a policy problem; it is a brutal, unforgiving challenge of physics and materials science.

The High-Temperature Wall
When you push thermal systems past 1,000 or 1,500 degrees Celsius, standard engineering assumptions go out the window. Metals lose their structural integrity, conventional electronics fry, and conventional insulation fails. If you try to electrify these processes using resistance heating or plasma-arc furnaces, you immediately run into the thermal wall: *how do you design systems that can deliver continuous, mega- watt scale heat without melting themselves from the inside out?*
This is where the next generation of mechanical and materials engineers must step up. We cannot simply rely on incremental tweaks. We need a fundamental redesign of industrial architecture.

First-Principles Engineering: Thermal Batteries and Beyond
Solving this requires first-principles thinking. If intermittent renewable electricity is going to power heavy industry, we need a way to capture that energy when the sun shines and the wind blows, store it safely, and discharge it as blistering, continuous heat.

Enter advanced high-temperature thermal energy storage—essentially massive, industrial-grade thermal batteries utilizing abundant, low-cost earth materials like silica sand or specialized ceramics capable of operating safely past 1,000 degrees Celsius. Pair these storage matrices with advanced resistance-heated refractory systems, and you begin to decouple heavy manufacturing from fossil combustion entirely.

The Call to Action

Building a net-zero future is not won by corporate pledges or carbon offsets. It is won on the factory floor, in the metallurgy lab, and through the rigorous application of thermodynamics at scale.

If you are studying engineering today, do not waste your talent on trivial optimizations. Look at the heavy industries powering our world. Redesign the furnaces, invent the next-generation thermal media, and master the art of moving extreme heat efficiently. The energy transition will stall out unless our generation solves the industrial heat problem. Physics demands a solution. It is time to build it.

Let's talk about execution speed and scale. ***Innovation without production is just a hobby.*** If a breakthrough stays trapped in a university lab or a PowerPoint slide, it hasn't changed reality. We need young engineers who are obsessed with manufacturing velocity—people who treat the factory floor as the ultimate product.

Think about the sheer economic leverage here. Decarbonizing steel and cement isn't just an environmental checkbox; it is the single largest commercial opportunity of our lifetime. ***The first team that cracks zero-emission heavy manufacturing at commercial scale won't just save ecosystems—they will capture trillions of dollars in value while redefining global infrastructure.***

This is your moment. Stop optimizing comfortable, legacy problems. Run toward the fire —literally. Master advanced thermodynamics, push refractory material science to its absolute threshold, and build the physical backbone of tomorrow.

The old world was forged in coal and smoke. The new world will be built on physics, grit, and relentless execution. The furnace of civilization is waiting for its next architect. Go ignite it.

Author: Mohd Junaid Ahmad Khan
3rd year

DEPARTMENT TOPPERS

4th Year

TUSHAR SRIVASTAVA

3rd Year

DEVANSH YADAV

2nd Year

JUNAID AHMAD KHAN

THERMODYNAMIC INVESTIGATION ON THE USE OF TRANSCRITICAL CARBON DIOXIDE IN A REHEAT GAS TURBINE-BASED COMBINED COOLING AND POWER CYCLE

Research Paper

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Abbreviations: *TCTCTC: Transcritical- Transcritical- Transcritical carbon dioxide, HRVG: Heat recovery vapor generator, C: Compressor, CC:Combustion chamber, HTb: High-pressure turbine, RCC:Re-heat the combustion chamber, LTb: Low-pressure turbine, tCO_2/ TCO_2 :Transcritical carbon dioxide, HPD: High-pressure steam drum, MPD:Medium-pressure steam drum, LPD: Low-pressure drum, RHe: Heat exchanger, FHe: Feed Heater, P: Pump, Sp: Seperator, Cd: Condenser, G: Generator,M: Mixture, f_g :Flue gases, h_i, h_j : Initial pressure, Intermediate pressure, C_p :Specific heat at constant pressure(KJ/kgK).*

ABSTRACT

Currently, increasing the efficiency of power generation cycles is not the only goal for engineers; the focus is also on how it is achieved, whether through conventional or non-conventional energy sources. In conventional systems, changing the working fluid in the bottoming cycle has attracted engineers' interest to boost cycle efficiency. Among various working fluids, carbon dioxide and ammonia water mixtures show promising thermodynamic properties that enhance both first and second law efficiencies. This research explores the use of transcritical carbon dioxide as the working fluid in the bottoming cycle of a combined cycle power plant with reheat cycles. The results indicate that, under operating conditions such as a topping cycle pressure ratio of 20, an ambient temperature of 303 K, and a turbine inlet temperature of 2000 K, the system performs better, with first law and second law efficiencies reaching 44.8% and 56.83%, respectively. Additionally, the maximum cooling water mass flow rate, observed at a condenser pressure of 0.9 bar, is 1.67 kg/s.

ANALYTICAL MODELING AND PERFORMANCE ANALYSIS OF FUZZY AND PID CONTROLLER FOR FULL ACTIVE SUSPENSION SYSTEM USING 7 DEGREES OF FREEDOM

Research Paper

Authors: Shailendra Kumar, Rahul Shukla, PK Mall, Amit Medhavi, Ambuj Kumar and Rahul Shukla

Publishing Journal: International Journal of Acoustics and Vibration.

DOI: https:DOI:10.20855/ijav.2026.31.12167

Acronyms: ANFIS: Adaptive Neuro-Fuzzy Inference System, CG: Center of Gravity, DOF: Degree Of Freedom, FLC: Fuzzy Logic Controller, HIL: Hardware In the Loop, LQR: Linear Quadratic Regulator, MF: Membership Function, MIMO: Multi-Input Multi-Output, PID: Proportional-Integral-Derivative, RB: Rule Base, RMS: Root Mean Square, SFSC: Self-organizing Fuzzy Sliding mode Controller,
SISO: Single-Input Single-Output

ABSTRACT

Modern vehicle suspension systems play a crucial role in ensuring ride comfort, road handling, and overall vehicle stability. Active suspension systems, unlike passive ones, utilize control strategies to dynamically adjust suspension forces, improving vehicle performance under varying road conditions in real time. This research paper focuses on the analytical modeling and performance analysis of a Fuzzy Logic Controller (FLC) and a Proportional-Integral-Derivative (PID) controller for a full-car active suspension system using a 7-degree of freedom (DOF) model. The developed model considers the vertical motion of the vehicle body, pitch, and roll dynamics, along with the suspension dynamics of all four wheels. A hydraulic actuator is incorporated at each suspension to provide active control forces. The control strategies are designed to minimize vehicle body displacement and acceleration, thereby improving ride comfort and stability. The FLC is developed using fuzzy inference rules and triangular membership functions, while the PID controller follows conventional control logic. Simulation results indicate that the FLC significantly reduces suspension travel, body displacement, and acceleration when compared to both the passive and PID-controlled suspensions. The FLC achieves superior performance by mitigating pitch and roll motions, which are crucial for overall ride quality. Root mean square (RMS) values of suspension parameters confirm that the proposed fuzzy controller enhances vehicle dynamics, providing better vibration isolation and improved ride comfort. The study demonstrates the effectiveness of the FLC in handling nonlinearities in active suspension systems, making it a promising approach for real-time automotive applications.

INTEGRATED EFFECTS OF AERODYNAMIC CONTROL AND ACTIVE SUSPENSION SYSTEMS ON VEHICLE STABILITY AND HANDLING DYNAMICS DURING HIGH-SPEED MANEUVERS

Research Paper

Authors: Shailendra Kumar, Rahul Shukla, PK Mall, Amit Medhavi, Ambuj Kumar and Shashank Kumar

Publishing Journal: International Journal of Acoustics and Vibration.

DOI: https://doi.org/10.20855/ijav.2025.30.42203

ABSTRACT

The effect of aerodynamic control and active suspension systems on vehicle handling and stability during dynamic maneuvers is examined in this study. The paper shows how vehicle behavior changes from oversteer to understeer under different load conditions by analyzing the understeer coefficient in response to both longitudinal and lateral load transfers. The importance of suspension tuning is highlighted by the examination of the impact of roll stiffness distribution on handling characteristics. To increase stability, a control method based on departures from ideal yaw behavior is implemented, modifying the normal forces on each axle. The advantages of active systems in dampening oscillations, decreasing overshoot, and achieving faster stabilization is demonstrated by the comparison of passive and active systems across several performance parameters, including yaw rate, sideslip angle, and lateral acceleration. Actuator force and power profiles further confirm the control system's responsiveness and effectiveness. The improved trajectory tracking and decreased deviation made possible by active control are validated by high-speed maneuver data collected on both dry and wet roads. With a focus on the trade-offs between drag and downforce, the research also investigates aerodynamic force changes depending on spoiler features and dynamic indications. Overall, the results confirm that combining aerodynamic controls and active suspension greatly improves vehicle safety, cornering stability, and responsiveness.

EFFECT OF LIQUID DENSITY, ULTRASONIC VELOCITY, AND GAS FLOW RATE ON THE FORMATION OF AIR BUBBLES IN AQUEOUS METHANOL AT TEMPERATURE 293.15, 303.15, AND 313.15 K

Research Paper

Authors: P. K. Mall, H. K. Paliwal, Amit Medhavi and Shafiq Ahmad.

Publishing Journal: International Journal of Air - Conditioning and Refrigeration.

DOI: https://doi.org/10.1063/5.0251734

Keywords: Surface tension, Viscosity, Gas velocity, Bubble column, Bubble diameter, Flow rate.

ABSTRACT

This study examines the relationship between bubble diameter and influencing factors, such as surface tension, mole fraction, liquid density, and ultrasonic velocity across different gas flow rates (0.00005, 0.00005833, and 0.00006666 m3/s) and temperatures (293.15, 303.15, and 313.15 K). As surface tension increases, the bubble diameter decreases due to the greater force required to expand the gas-liquid interface. Higher mole fractions also result in smaller bubbles, influenced by fluid properties, such as viscosity and density. The image captured using aq high-resolution camera was analyzed using the Bubble Analyzer software. The bubble diameters extracted from the processed images were then compared with those obtained through a mathematical model. The strong agreement between both sets of results validates the accuracy and reliability of the bubble diameter measurements derived from the mathematical model. Bubble size decreases nonlinearly with increasing liquid density as buoyant and inertial forces restrict growth. Enhanced cavitation and acoustic pressure from increasing ultrasonic velocity further reduce bubble size, with its effect becoming more pronounced at higher velocities. Temperature has a minimal impact, with slightly larger bubbles forming at higher temperatures due to reduced viscosity and surface tension. These findings are essential for optimizing gas-liquid systems, foaming, aeration, emulsification, and sonochemical reactions by improving efficiency and stability.

CYCLIC OXIDATION OF 304L AND 316L STAINLESS STEEL COATED AND UNCOATED WITH CR3C2–NICR AT ELEVATED TEMPERATURES

Research Paper

Authors: Nagendra Kumar Mishra, Naveen Kumar, Md Sarfaraz Alam, Sujeet Kumar, Jayant Giri, Ayman A. Aly, Gaurav Kumar Gupta

Publishing Journal: International Journal of Acoustics and Vibration.

DOI: https:DOI:10.20855/ijav.2026.31.12167

Keywords: Detonation gun, Oxidation, Cr3C2-NiCr , SS , Coating.

ABSTRACT

Failure of the boiler, gas turbine, incinerator, and other power-producing machines is mainly caused by the metals' oxidation and alloys at high temperature service environment. It is a common practice to apply thermal barrier coating to increase the resistance to oxidation of metal alloys when subjected to high temperatures. In the current research, an effort has been madetoapplyacoating ofCr3C2-NiCrusing the detonation gun (D-gun) technique on stainless steel (SS) 304L and SS 316L. The characteristics of coatings have been studied at 750 and 850°C. A cyclic oxidation process was carried out in a mufflefurnace for 50 cycles. For each cycle, 304L and 316L SS, both bare and coated, are heated for 1h in a muffle furnace and cooled for 20min in ambient air. Under the investigated conditions, the Cr3C2-NiCr coating sprayed with a D-gun exhibited outstanding adhesion to the substrate alloy. A weight change/area versus the number of cycles plot has been drawntounderstand thekinetics of oxidation. SS 304L coating has shown approximately 26.54 and 21.93% improvement in oxidation resistance at 850 and 750°C, respectively. For SS, 316L coating has shown approximately 27.67 and 25.92% improvement in the oxidation resistance, respectively, at 850 and 750°C. The oxide-scale-generated Cr2O3 phase demonstrated notable resistance to oxidation throughout the 50 cycles of cyclic oxidation at 750 and 850°C. The weight change/ area shows that 316L has much better oxidation resistance than 304L at both temperatures of 750 and 850°C. The application of such coatings at high temperatures may reduce the formation of oxide scale which attacks and corrodes exhaust valves, turbocharger nozzles, and blade.

ANALYSIS OF MICROSTRUCTURE AND MICROHARDNESS OF ALUMINUM ALLOY MELT FOR GRAIN REFINEMENT BY TWIN-ROLL CASTING

Research Paper

Authors: Naveen Kumar, P. K. Mall, C. Durga Prasad, Amit Medhavi, Monica Mehrotra, Shailendra Kumar, Md Sarfaraz Alam, Gurbhej Singh, Suresh Singh, Ranjith Balu & Adem Abdirkadir Aden.

Publishing Journal: Journal of Materials Science: Materials in Engineering.

DOI: https://doi.org/10.1186/s40712-025-00211-0

Acronyms: TRC, MCTRC, Grain refinement, Casting, Microhardness, Microstructure

ABSTRACT

This study examines sheets produced using twin-roll casting (TRC) and melt conditioned twin-roll casting (MCTRC) to evaluate the effect of melt conditioning on segregation pattern and grain refinement. To produce sheets through the MTCRC technique, melt conditioning using high shear technology (high-speed rotor) was applied to Al-5 Mg alloys, before subjecting the melt to TRC. A low shear slope was used to prepare a commercially pure aluminum ingot. The mean grain size obtained for slope processed samples with vibration at a pouring temperature of 780°C is 69.4 µm, decreasing to 62.5 µm with a 20°C decrease in pouring temperature. Samples prepared without vibration at temperatures of 780°C and 760°C exhibit grain sizes of 85.172 and 77.8 µm, respectively. Additionally, the average grain size of Al-5 Mg alloy sheets produced using TRC is around 270 µm, which decreases to 230 µm for sheets produced using MCTRC. The grain size data comparison of the samples prepared using high shear technology and those with a low shear slope indicate successful results of grain refinement in both cases. However, it is advantageous to produce sheets using the low shear slope method as compared to the high shear technology, because of the low setup costs.

IMPACT OF SURFACE TENSION, VISCOSITY AND FLOWRATE ON AIR BUBBLE FORMATION IN AQUEOUS METHANOL AT TEMPERATURES 293.15, 303.15 AND313.15K

Research Paper

Authors: Naveen Kumar, P. K. Mall, C. Durga Prasad, Amit Medhavi, Monica Mehrotra, Shailendra Kumar, Md Sarfaraz Alam, Gurbhej Singh, Suresh Singh, Ranjith, Balu and Adem Abdirkadir Aden

Publishing Journal: Russian Physics Journal.

DOI: https://doi.org/10.1007/s11182-025-03508-x

Keywords: Surface tension, Viscosity, Gas velocity, Bubble column, Bubble diameter, Flow rate.

ABSTRACT

TThis study investigates the effects of temperature, surface tension, and viscosity on air bubble production in an aqueous methanol solution. Experiments are conducted at three temperatures (293.15, 303.15 and 313.15K) and varying flow rates. It is shown that lower temperatures and higher surface tension and viscosity lead to smaller bubbles, while increased temperatures promote larger and more frequent bubble formation. Flow rate variations significantly influence the bubble dynamics, with higher flow rates generating more bubbles. Research findings have implications for optimizing gas-liquid interactions in industrial processes.

STEPPED SINGLE-SLOPE SOLAR STILL USING MWCNT NANOFLUID AND NANO-ENHANCED PCM

Research Paper

Authors: V. Kumar·, D. Singh, S. P. Singh, P.K. Mall, S. Kumar, K. Sadhana.

Publishing Journal: Has been accepted for publication in « Russian Physics Journal ». Awaiting For Publication Russian Physics Journal.

DOI: https:DOI:10.20855/ijav.2026.31.12167

Keywords: Solar desalination, Phase change material (PCM), Multi-walled carbon nanotube (MWCNT) nanofluid, Nano-enhanced PCM (NEP), Energy and exergy efficiencies, Yield, Cost analysis.

ABSTRACT

Thermal and productivity analysis of a stepped single-slope solar still (SSSSS) employing MWCNT nanofluid (0.05wt.%) and MWCNT(0.05wt.%)basednano-enhancedPCM(NEP)inarectangulararrangementin summer shows a comparison. Energy efficiency was highest for NEP at 64.48%, followed by MWCNT nanofluid at 59.36%, and exergy efficiency was 4.73% and 4.46%, respectively. Maximum daily freshwater productivity was achieved as 3.20kg/m2 for NEP and 3.00kg/m2 for MWCNT nanofluid. Economic investigation showed that MWCNT NEP improves thermal performance and freshwater yield at a cost per liter of $0.0195 and $0.020 using nanofluid only, with payback periods of 7.02 and 7.20 months, respectively. Potable water is scarce in arid and semi-arid locations, making freshwater scarcity a global issue [1, 2]. Solar desalination uses abundant solar energy without fossil fuels to produce freshwater sustainably, cheaply, and ecofriendly. Traditional solar stills have low thermal efficiency and daily productivity, limiting their general use [3-5]. The use of PCM and an external solar heat exchanger increased solar still production to 4300mL/day·m2, with 40% of water generated after sunset. Lower basin water levels and hot water circulation boosted productivity. The exergy study showed substantial absorber losses during daylight, highlighting the need to reduce exergy destruction for efficiency

THERMALANDPRODUCTIVITYANALYSIS OFASTEPPEDSLOPESOLARSTILL USING SILVER NANOFLUID AND NANO-ENHANCED PCM

Research Paper

Authors: V. Kumar·, D. Singh, S. P. Singh, P.K. Mall, S. Kumar, K. Sadhana.

Publishing Journal: Has been accepted for publication in «Russian Physics Journal». Awaiting For Publication, Russian Physics Journal.

DOI: https://doi.org/10.1186/s40712-025-00211-0

Keywords: Solar desalination, Phase change material (PCM), Silver nanofluid, Nano-enhanced phase change material (NEPCM).

ABSTRACT

Modified stepped slope solar stills (MSSSS) have been augmented with silver (Ag) nanofluids, Ag nanofluids with phase change material (PCM), and Ag nano-enhanced phase change material (NEPCM). Due to increased heat storage, the NEPCM improves energy and exergy efficiencies, especially at night. The NEPCM has the highest energy efficiency at 60.75%, followed by Ag (0.07%) with PCM at 57.45%, and Ag (0.07%) at 49.55%. The NEPCM has an average exergy efficiency of 4.65%, followed by 4.33% and 3.33%, respectively. The daily yield at 3.392kg/m2·day is the highest one for the NEPCM, surpassing 2.955 and 2.64kg/m2·day. Thus, the stepped geometry with Ag-based NEPCM improves sustainable solar desalination output and efficiencies. In recent years, a significant amount of research has been directed toward enhancement of solar desalination systems through optimization of their design, development of new materials, and hybrid integration strategies. An exhaustive evaluation of desalination methods that are driven by renewable energy sources was carried out in works [1, 2]. It is essential to combine solar stills with thermal storage systems to overcome the limitation of intermittent solar radiation and guarantee continuous operation of the system [3]. In a similar conducted research on various solar still designs, it is found that elements such as the depth of the basin water, insulation, and glazing aspect all have a significant impact on the productivity and efficiency of the system [1]. The fluid properties, such as temperature, surface tension, and viscosity, affect the formation of bubbles. The authors discovered that higher temperatures and flow rates lead to an increase in the generation of bubbles, which in turn leads to an improvement in the efficiency of the gas-liquid process [4].

DESIGNING AND OPTIMIZATION OF HYBRID SOLAR POWER GENERATIONIN JHANSI, INDIA: UTILIZING HOMER FOR ENHANCING EFFICIENCY

Research Paper

Authors: Garima Singh, Bharat Raj Singh.

Publishing Journal: Procedia Environmental Science, Engineering and Management.

DOI: https://10.21844/16202118107.

Keywords: HOMER optimization; hybrid solar power generation; India; renewable energy; sustainability.

ABSTRACT

Thisstudy explores the design and optimization of a hybrid solar power generation system tailored to Jhansi, India, a region confronting critical energy challenges. Focusing on enhancing energy efficiency, the integration of solar energy with complementary renewable sources emerges as a key strategy. Utilizing the advanced optimization capabilities of HOMER software, the research evaluates various system configurations to identify the most efficient setup for Jhansi's specific requirements. The findings provide actionable insights for policymakers, researchers, and industry stakeholders, offering guidance in the transition to sustainable energy solutions at both local and global levels.

The study underscores the transformative potential of hybrid systems, such as PV-Biomass and Solar-Wind combinations, in addressing the multifaceted challenges of energy transition. These systems demonstrate the capacity to stabilize energy grids, mitigate climate change impacts, and promote economic prosperity, while significantly improving energy generation and utilization. By leveraging renewable energy's inherent benefits, this research highlights the role of advanced hybrid systems in driving sustainable development in Jhansi and similar regions worldwide. The results exemplify how innovative optimization tools like HOMER can reveal pathways towards achieving resilient and efficient energy systems, contributing to the broader objectives of global sustainability.

From the Editors Pen.....

Esteemed Readers,

Welcome to the genesis of Mechdrishti—the inaugural volume of the Department of Mechanical Engineering's official magazine at BBDNIIT. This debut edition is not merely a collection of pages; it is a blueprint of our kinetic energy, forged by the ingenuity, precision, and relentless drive that define our discipline.

Our editorial board has engineered this publication with exactitude, capturing the mechanical heartbeat of our department. From the calculated brilliance of the drafting rooms to the roaring innovation on the workshop floor, Mechdrishti reflects a community dedicated to turning raw potential into tangible reality. We celebrate the makers, the designers, and the builders who continuously challenge the limits of modern engineering.

Within these pages lies the record of our collective momentum:

- ***Academic & Research Excellence:*** Chronicling the breakthroughs in material science, thermodynamics, and structural analysis that reinforce our foundational knowledge.
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Mechdrishti stands as a testament to our shared vision and unyielding spirit. As you turn these pages, we invite you to engage with the ideas that propel us forward and to witness the machinery of human intellect at work.

Thank you for joining us at the starting line. Here is to breaking inertia, engineering the future, and the boundless trajectory of the Mechanical Engineering department!

With Unyielding Gratitude,
The Editorial Team
Student : Yash Sharma, 4th year, Mechanical Engineering
Guided By: Prof. (Dr.) N.K. Mishra (HOD, ME)

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Babu Banarasi Das Northern India Institute of Technology

"The more I read, the more I acquire, the more certain I am that I know nothing."

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