



**VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE**  
**MECHANICAL ENGINEERING DEPARTMENT**



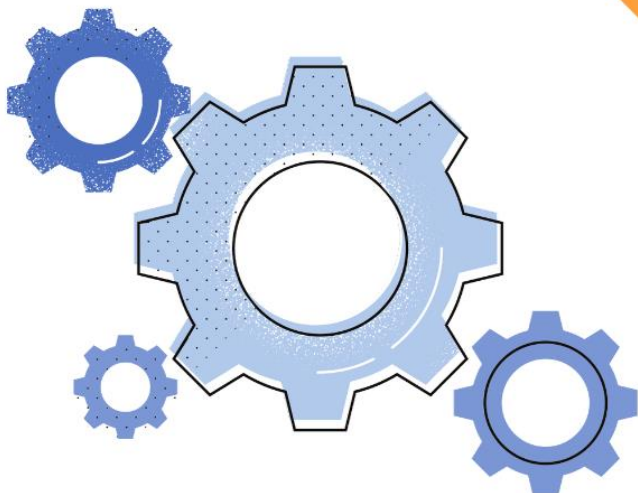
# Departmental Newsletter



**Volume 1 | Issue 1**



**Oct - Dec 2025**





Vol 1 | Issue 1

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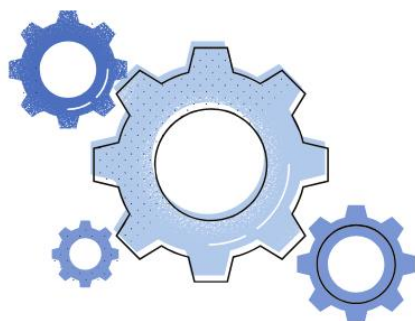
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## Editors

- ☐ Dr. Nishit Bedi
- ☐ Dr. Prasanna. P. Raut





It gives me great pleasure to present the first edition of our departmental newsletter. The bulletin captures the happenings carried out by our department in various spheres such as academic, technical, and outreach activities during the last quarter of 2025. This inaugural issue reflects the dedication, enthusiasm and commitment of our students and faculty in promoting excellence in learning, innovation, and professional development.

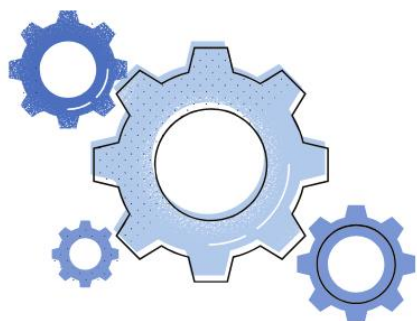


I am happy to share that many enriching experiences such as key academic milestones i.e. upgrading laboratories to state-of-the-art facility through industry-supported initiatives, initiatives for outreach activities, our research capability, industrial visits for practical exposure etc can be observed in this issue.

Newsletter serves not only as a record of accomplishments but also as a testament to the collaborative spirit and commitment to excellence. I extend my sincere appreciation to everyone who contributed to this edition and look forward to many more successful milestones in the journey ahead.

Enjoy reading !!

**Dr. Sachin S. Naik**



### **HVAC Plant Performance Simulation Test Rig**

A brand new test rig to study the performance of HVAC Plant was introduced in the measurements lab in December 2025. The facility was inaugurated by Mr. Vaibhav Pitale, Managing Director, Belimo Automation India Pvt Ltd. Established under CSR initiative by Belimo automation India, the test rig is dedicated to innovate and pursue research in the field of HVAC systems and energy performance. Inturn the facility will help students, staff and faculty to understand the related concepts in deep and better manner.

Interested members can contact Dr. H P Khairnar for more details about the facility.

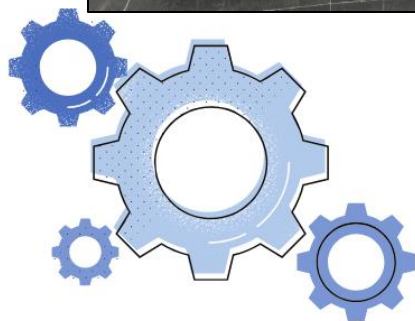


### **Scanning Electron Microscope (SEM)**

A scanning electron microscope (SEM) was added to the Advanced Material Characterization Laboratory in November 2025. The SEM facility with minimum resolution of 3nm at 30 kV along with magnification range of 10X to 300,000X is so precise that actual images related to any field can be observed. The services offered by the institute using SEM, obviously on paid basis, includes

- (a) Analysing metals, ceramics and polymer
- (b) Visualize cells, tissues and micro organisms
- (c) Inspection of circuits and microchips
- (d) Examine trace evidence with unparalleled detail
- (e) Failure and elemental analysis
- (f) Quality control inspection
- (g) Customized reports and consultations
- (h) Surface morphology imaging

Interested members can contact Dr. W S Rathod for more details about the facility.



### **Centre for Excellence in Automotive Engineering and EV Technology**

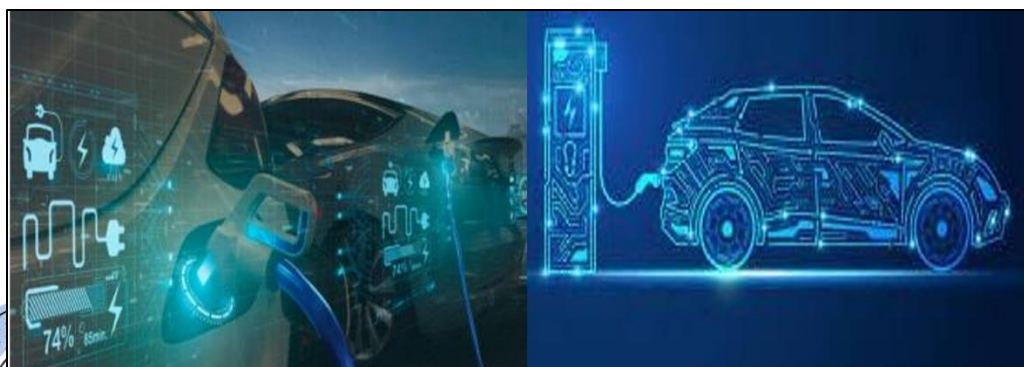
A brand new Centre of Excellence in Auto/EV technology was inaugurated by Mr. Virendra Bansal, Managing Director & CEO of SBI Caps in the month of June 2025. Established with a generous CSR contribution of nearly ₹1 crore, Dr. Gulhane and Dr. Wankhede played key role in the initiative. The CoE consists of various battery related equipment such as battery cell analyzers, assembly stations, BMS, test rig for performance and safety, Li-ion battery pack charge and discharge tester. On the other hand, testing and diagnostic tools such as dynamometer for vehicle simulation, software integrated work stations can also be observed. The facility also covers EV/Hybrid training system, computers with simulation software and safety gear like high voltage insulators. The facility can be used by many B.Tech. and M.Tech students interested in automotive technology programs, focusing on hands-on repair and maintenance of EVs.



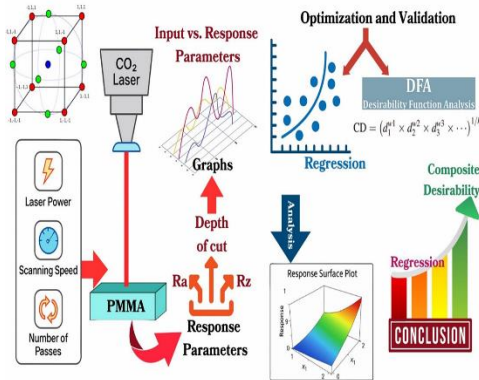
### **Upcoming FDP on EVT**

It is our pleasure to share that Mechanical Engineering Department is going to organize One-Week Faculty Development Programme (FDP) on “Emerging Trends in Electric Vehicle Technology”. The event is spanned from 12th to 16th January 2026. The programme is being conducted in association with MathWorks, Spark Technology, Rudved EV, and Sciencetech Technology.

The FDP aims to disseminate foundational and advanced knowledge about EV architecture, powertrains, battery technologies, and charging infrastructure. Hands-on exposure to modern EV design, simulation, testing, and performance analysis using industry-standard tools will be emphasized during the program. On the other hand, research and collaboration in areas such as battery management and thermal systems will also be promoted. The programme will cover EV fundamentals, electric drives and powertrain systems, MATLAB/Simulink simulations, battery technologies and management systems.



## Journal Articles Published

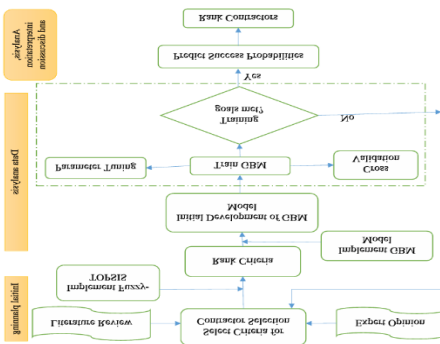


### Optimization of CO<sub>2</sub> laser machining parameters for PMMA using RSM and desirability analysis

[10.1007/s12008-025-02421-4](https://doi.org/10.1007/s12008-025-02421-4)

Faculty Name: Dr. Arif Varsi

Optimization of CO<sub>2</sub> laser machining parameters such as depth of cut and surface roughness when conducted on Polymethylmethacrylate (PMMA) was studied. Response Surface Method (RSM) and Desirability Function Analysis (DFA) technique was used. Achieving trade-off between high depth of cut and maintaining surface quality was highlighted.

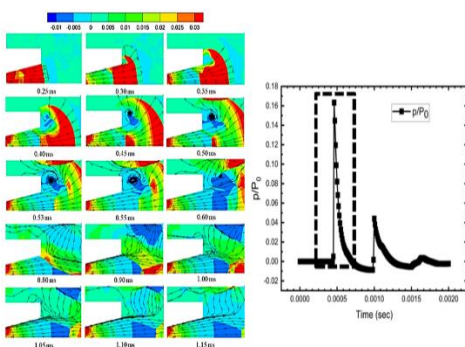


### Integrated Framework for Contractor Selection using Fuzzy TOPSIS & GBM in Construction Industry

[10.1007/s42107-025-01611-5](https://doi.org/10.1007/s42107-025-01611-5)

Faculty Name: Dr. Arif Varsi

Selecting the suitable contractors in construction industry remains a challenge. The study discusses advanced decision strategies and forecasting methods, using fuzzy TOPSIS and GBM to enhance selection of contractors

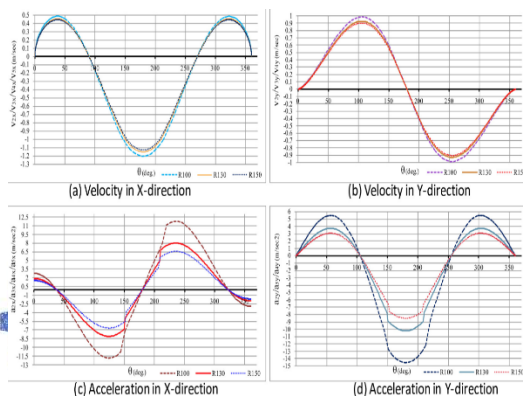


### Unveiling Pressure Spikes and Shock Structures in a Concentric Vertical Launch Rocket System

[10.2514/1.A36458](https://doi.org/10.2514/1.A36458)

Faculty Name: Dr. P A Rajiwade

This paper delves into the transient dynamics of missile ignition within hot launching systems, specifically focusing on the flow field characteristics within a Vertically Canisterized Launch System. Employing computational fluid dynamics, the study thoroughly analyzes the internal dynamics of the canister tube during missile initiation over a firing phase of two milliseconds, crucial for understanding the critical phase of ignition.



### Kinematic Analysis and Parametric Study of 5-Bar Double Crank Rotary Shear Mechanism

[10.1007/s40032-025-01287-5](https://doi.org/10.1007/s40032-025-01287-5)

Faculty Name: Prof Sachin Barve

kinematic modeling and sensitivity analysis of 5-bar double crank mechanism was conducted. Analytical and dynamic simulation method was used to evaluate position, velocity and acceleration profiles of various linkages. The influence of critical parameters such as crank angular velocity, link lengths, and phase angles on the overall system behavior was presented.



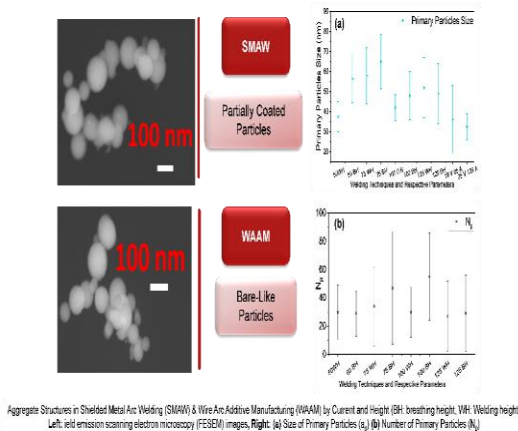
## International Conferences

### Morphological and Health Impact Evaluation of Particulate Emissions from Different Welding Techniques

Asian Aerosol Conference (AAC) December 01 – 04, 2025, Mumbai, Maharashtra India

Faculty Name: Dr. Sachin Kore, Dr. Akshat Jain

The study systematically characterizes particulates morphology in SMAW and WAAM under varying operational parameters, including welding current, voltage, and sampling height. Aggregates collected directly from the welding height (WH) and breathing height (BH) were imaged using FE-SEM and analysed to reconstruct their three-dimensional (3D) structures using established mathematical models and methodologies.



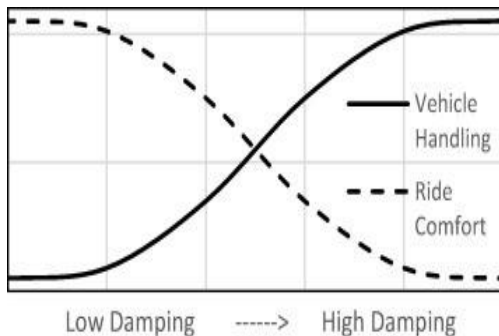
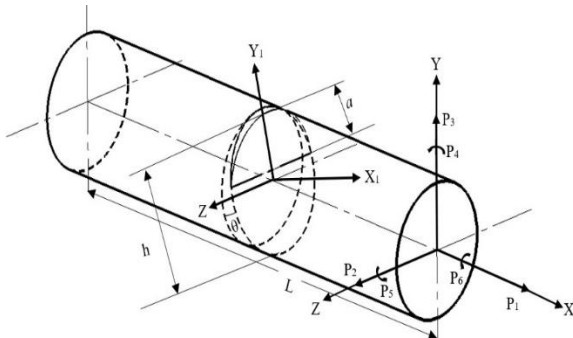
### Flexibility of Circular Shaft with Open Inclined Edge Crack: Application to Frequency Determination

ISTAM, Dec 10-12, 2025, VIT University Bhopal, M.P, India

Faculty Name: Dr. Sachin Naik

Student Name: A.A. Darekar

Flexibility of shaft having an edge crack inclined at an angle to its axis was estimated. Inturn, natural frequencies of the shaft were calculated. Strain Energy Release Rate for general loading was calculated and equation of compliance coefficients was achieved. Complete stiffness matrix for general loading was discussed.



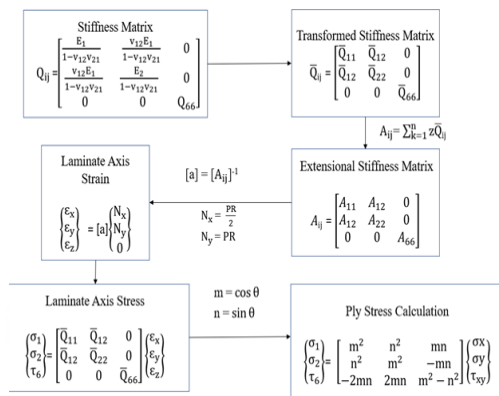
### Evaluation of Vehicle Stability for Passenger Comfort

VETOMAC, Dec 18 - 20, 2025, IIT Guwahati, Assam, India

Faculty Name: Prof. Sachin Barve

Student Name: Neil James

Key aspects of vehicle stability, primarily ‘lateral dynamics’ were explored. A 2D model of bicycle was simulated in MATLAB. Vehicle reaction during cornering was studied under four different steering inputs.



### Design of Cooling System for Heat Reduction in Liquid Hydrogen Storage

ICERTSD 2025, Sept 11-12, 2025, IIST Shibpur, West Bengal, India

Faculty Name: Dr. MV Tendolkar, Dr. GU Tembhare

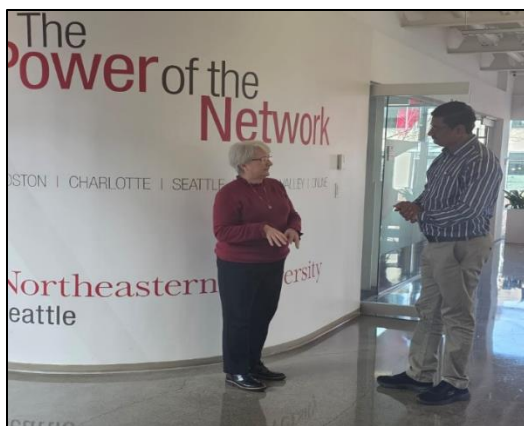
Student Name: Ms. Jagruti Dalvi

Structural and thermal analysis of Type III and Type IV Pressure Vessel designed as per ASME standards was presented in this paper. Total heat ingress, thermal stresses developed, and boil-off gas generation rate was observed under thermal analysis. Under structural analysis, Ply stress was calculated to determine the strength of composite layer using Classical Laminite Theory.



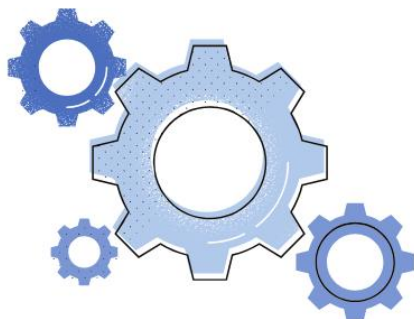


Dr. N. Gulhane, visited American University of Sharjah UAE during last week of November 2025 as a Visiting Professor. A lecture on the topic “Experimental Investigation on Radiation and Convection Losses using Cascade Cavity Receiver” was delivered. He also discussed with Dr. Mohammad Hamdan, Professor at American University of Sharjah, about various other ways for research collaboration



Similarly, Professor Gulhane also visited Northeastern University, Seattle campus in the last week of December 2025 for academic and research collaboration between the two institutes. In this context, a meeting with Professor Belcher Jeanie, Director Academic Partnership & Global Campuses was observed to be fruitful.

Recently, Prof. Rajiv Dubey, Professor & Chair, Dept. of Mech Engg. Director CARRT, University of Florida visited VJTI for academic and research collaboration. Various topics such as pedagogy systems, student/ faculty exchange and ways in which the two institutes can grow with mutual interaction were discussed. In this regard, meeting with faculty of the department as well as Director, VJTI was observed to be fruitful.



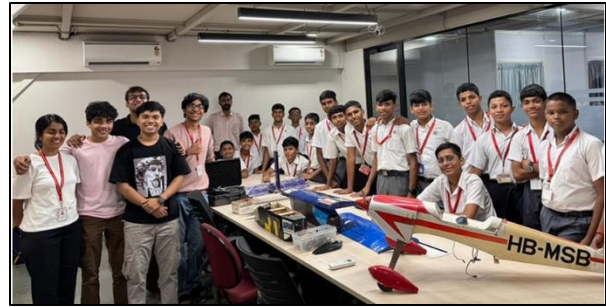


### **Aero VJTI**

Aero VJTI is actively engaged in technical, academic, and outreach initiatives throughout the year. The club involve interested students and focus on knowledge sharing as well as participation in real time competitions conducted in the field of aerospace engineering. A key highlight includes team's extensive work on proposal development for AIAA 2026, covering concept ideation, preliminary design, and documentation.

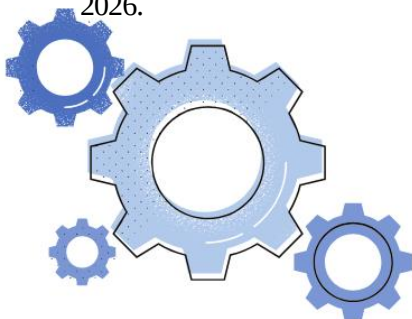
Aero VJTI organizes club launch event for freshers in order to strengthen its working behavior. Vision of the club, work domain along with ongoing projects and future competitions are normally explained in the event. The club also organized a guest lecture on "*Design of Lighter Than Air Systems*" by Prof. Rajkumar Pant (IIT Bombay), enriching academic learning.

The club has mentored aeromodelling team of other college (BSCOER) and introduced aviation basics to school students through interactive sessions. Members participated in national design competitions such as NACDeC



### **VJTI Racing, Motorbreath at eBAJA 2026**

VJTI Racing's Team Motorbreath is gearing up to compete in eBAJA 2026, a premier national-level event organized by SAEINDIA, scheduled for January 2026 at NATRAX, Pithampur, Madhya Pradesh. During the latter half of 2025, the team secured an impressive 12th rank among 94 teams in the Virtual Round held on 19th July 2025. Knowledge-sharing visits to teams such as Red Barron (PCCOE), vehicle Dussehra Pooja, club outreach events including IGNITION and THROTTLE, and student engagement activities marked the period. Notably, the team successfully cleared the Pre-Technical Inspection on 22nd December 2025 in the first attempt, earning appreciation from SAEINDIA judges. The team is now ready to represent VJTI at the main event from 7th–11th January 2026.





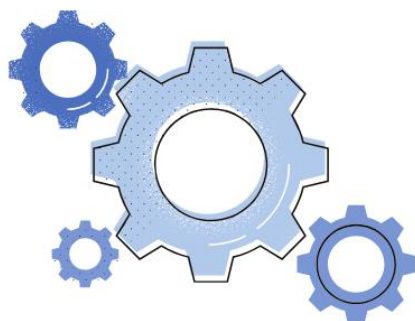
### **Koradi Thermal Power Plant**

The B.Tech second-year students visited Koradi Thermal Power Plant near Nagpur in October 2025. The plant is operated by MAHAGENCO. The informative lectures by plant officials followed by a guided tour of the facility provided insights into theoretical as well as practical aspects of power generation. Several facilities such as coal handling, pulverization, boiler operation, steam turbines, generators, transformers, and pollution control systems such as ESPs and cooling towers were observed. The visit effectively fulfilled its meant purpose. An attempt to bridge the gap between classroom learning and real-world engineering was accomplished. The significance of large-scale power generation and sustainable industrial practices along with promoting awareness about responsible use of energy was also realized by the group of students.



### **VS Auto Tech Pvt. Ltd.**

The B.Tech second-year students also visited VS Auto Tech Pvt. Ltd., located in MIDC Industrial Area, Hingna Road, Nagpur. Accompanied by Dr. M.V Tendolkar, the visit consisted of informative session and a guided tour about various sections of the company such as fabrication, surface treatment, and coating. Manufacturing of automotive components such as canopy frames, pedals, brackets, and battery trays was observed by students. In addition, related operations used to fabricate the components such as sheet-metal forming, presses, welding, and assembly also attracted the students. The seven-tank hot phosphating process and painting lines were explained in detail, highlighting corrosion protection and quality control. The visit provided practical exposure to automotive manufacturing and reinforced classroom learning through current real-world practices used in industry.





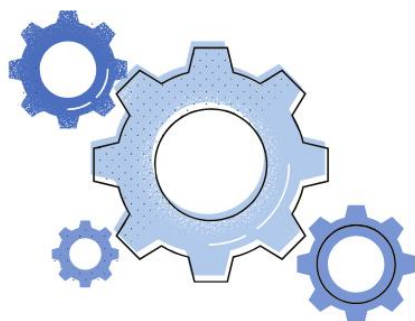
### **Solar Industries India Ltd.**

In the same visit during October, B.Tech second year students also visited Solar Industries India Ltd., Economic Explosives Division, Nagpur. Solar industries India is a premier defence manufacturing facility that is playing a key role in supporting the Indian Army. Accompanied by Dr. M V Tendolkar, the visit began with a detailed briefing followed by a guided tour of production and assembly lines. Key insights in explosives, propellants, missile balancing, UAV operations, and advanced defence systems such as Nagastra were gained. Hands-on demonstration of carbon fiber and glass fiber composites used in drones was the key highlight, showcasing their advantage about high strength-to-weight ratio. The visit offered great exposure to rarely offered highly secured defence manufacturing facility. A great exposure about modern materials used in engineering and indigenous defence technologies was observed by students.



### **Industry Visit to Godrej Aerospace**

Recently in last week of December, all (UG/PG/PhD) students of Centre for Advanced Materials and Manufacturing (CAMM-VJTI) visited Godrej Aerospace, Vikhroli Mumbai. The group was accompanied by Prof. V. B. Suryawanshi and Prof. R. M. Tayade. A detailed insight about complete workflow, advanced machinery, production processes, and quality control practices involved in aerospace composite manufacturing was explained by industry experts in detailed manner. Students were able to witness real time floor operations. They also actively interacted with engineers and technical professionals, gaining valuable exposure to real-world aerospace manufacturing practices. This will surely help students to better understand the concepts related to advanced materials and industrial applications.



### Meeting with the Alumni

Many of our distinguished alumni of year 1975 and 2000 batch visited the department. Ongoing initiatives at VJTI and opportunities for potential future collaboration were discussed. Similarly, another group of alumni connected in an online mode with VJTI from Seattle, USA. Mr. Rohan (Microsoft), Mrs Swarupa, Dr. Atul (Asst prof Portland state university), Mr. Rohan (Amazon) were delighted to interact with Director Sachin Kore. Alumni's deep rooted commitment and their emotional connection to the institute was clearly reflected.





**Veermata Jijabai Technological Institute, Matunga Mumbai**

Cordially invites you to the

**ORIENTATION PROGRAM 2025**

**For First Year -**  
B.Tech, M.Tech, M.Tech (Working Professional), MCA, Ph.D

**Direct Second Year -**  
B.Tech, B.Tech (Working Professional)




**TUESDAY, 16 SEPTEMBER, 2025**

**10:00 AM**

**DON'T MISS IT!**

**Venue :**  
Sri Shanmukhananda Chandrasekarendra Saraswathi Auditorium  
292, Com Harbhansal Marg, Sion East, Mumbai - 400022  
[https://maps.app.goo.gl/nvF8PR9HY2j6wyNQ6?g\\_st=aw](https://maps.app.goo.gl/nvF8PR9HY2j6wyNQ6?g_st=aw)

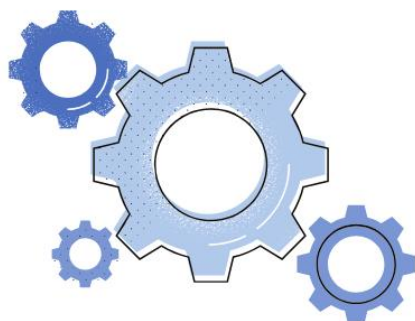
**Kindly note:**

- One parent may accompany a student
- Refreshments will be provided
- Parking facility is not available near the venue

Created by Jagruti Naik

### Orientation Day

Orientation program for newly admitted first year students was conducted at Sri Shanmukhananda Chandrasekarendra Saraswathi Auditorium in September 2025. The program aimed to welcome new students and get them familiar with the rules and regulation as well as working culture of the institute.



## Material, Design and Application in High Temperature Engineering

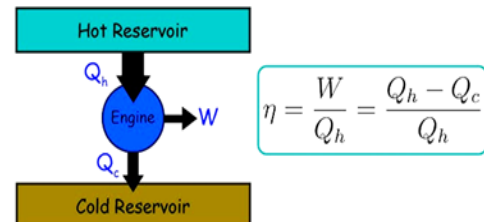
Dr A Rama Rao & Dr S S Naik

### 1. Introduction

High-Temperature Engineering (HTE) is an interdisciplinary field focused on the design, analysis, and operation of components and systems subjected to severe thermal environments, generally defined as service temperatures exceeding 500°C. The pursuit of higher operating temperatures is not merely an academic exercise; it is a fundamental driver of efficiency and performance across nearly every energy conversion technology.

According to the Second Law of Thermodynamics, the efficiency of a heat engine (like a gas turbine or steam power plant) is directly related to the difference between the high-side operating temperature and the low-side temperature. Consequently, every degree Celsius increase in the operating temperature of gas turbine blades, nuclear reactor cores, or combustors translates into concrete benefits: higher power output, reduced fuel consumption, and lower carbon emissions. HTE is, therefore, the important discipline that bridges theoretical thermodynamic gains with practical, safe, and durable structural realization.

### Heat Engines & Second Law of Thermodynamics

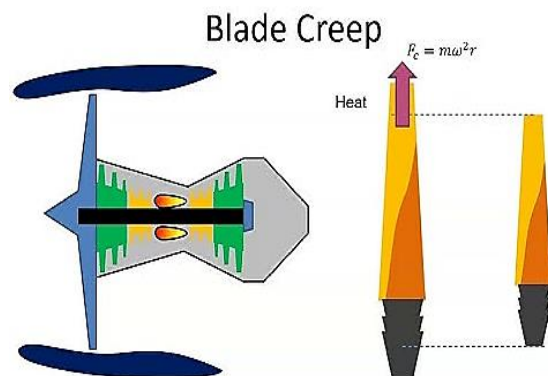


### 2. Most important challenges in High-Temperature Environments

Materials exposed to elevated temperatures undergo fundamental changes in their mechanical, chemical, and microstructural properties, presenting a unique design impediment that defines HTE. The significant among them are

#### 2.1 Mechanical Degradation (Creep and Fatigue)

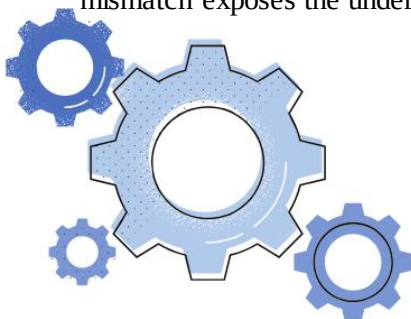
The most significant mechanical challenge at high temperatures is creep, which is the time-dependent, irreversible deformation of a material under a sustained mechanical stress. Creep deformation often occurs at stresses far below the material's yield strength, especially when operating above 40% of the material's absolute melting temperature (0.4 T). Creep leads to eventual fracture or excessive shape change, limiting component life. Furthermore, high-temperature components often experience thermal fatigue due to rapid, cyclic temperature fluctuations (e.g., during start-up and shutdown of a turbine). This thermal cycling induces significant internal thermal stresses, which, combined with mechanical loads, lead to crack initiation and propagation through a mechanism known as creep-fatigue interaction. Accurately predicting component life under this complex damage process is a core challenge in HTE.



#### 2.2 Environmental Degradation

High temperatures dramatically accelerate chemical reactions between the component surface and the surrounding environment:

1. Oxidation: Metals react with oxygen in the air to form surface oxide scales. While a stable, protective oxide layer e.g.  $\text{Al}_2\text{O}_3$  or  $\text{Cr}_2\text{O}_3$  is desirable, spallation (flaking off) of this layer due to thermal expansion mismatch exposes the underlying metal to further attack, leading to rapid material loss.



2. Hot Corrosion: This is accelerated oxidation or degradation in the presence of molten salts, typically sulphates e.g.  $\text{Na}_2\text{SO}_4$  from impurities in fuel or air. This highly aggressive form of corrosion destroys the protective oxide layer and is particularly problematic in marine or industrial gas turbines

### 3. Challenges in Material selection

Addressing these challenges requires specialized materials that retain strength and stability at temperatures where conventional alloys fail. These special materials are

#### 3.1 Nickel- and Cobalt-Based Super-alloys

These alloys form the backbone of modern HTE, particularly in jet engines and gas turbines. They are strengthened primarily by precipitates e.g. gamma phase in Ni-based alloys and grain boundary engineering. Advanced processing techniques include:

- Directional solidification (DS): Aligns the grain boundaries parallel to the principal stress axis, improving creep resistance.
- Single-crystal (SX) Technology: Eliminates all grain boundaries entirely, providing maximum creep strength and thermal fatigue resistance, making them ideal for the hottest turbine blades.

#### 3.2 Ceramics and Ceramic Matrix Composites (CMCs)

When temperatures exceed the limits of super-alloys (typically above  $1200^\circ\text{C}$ ), ceramics like Silicon Carbide (SiC) and Alumina ( $\text{Al}_2\text{O}_3$ ) are essential.

- Benefits: Extremely high melting points, low density, and high hardness.
- Drawbacks: Inherently brittle and susceptible to catastrophic failure.

To mitigate brittleness, Ceramic Matrix Composites (CMCs) are used. These consist of ceramic fibers like SiC embedded in a ceramic matrix. CMCs offer high temperature tolerance with significantly improved damage tolerance and fracture toughness, making them key candidates for next-generation aerospace and nuclear components.

#### 3.3 Refractory Metals

Metals like Niobium (Nb), Molybdenum (Mo), and Tungsten (W) have extremely high melting points. However, their industrial application is limited because they suffer from catastrophic oxidation (forming non-protective oxides) at high temperatures, necessitating complex and reliable protective coatings

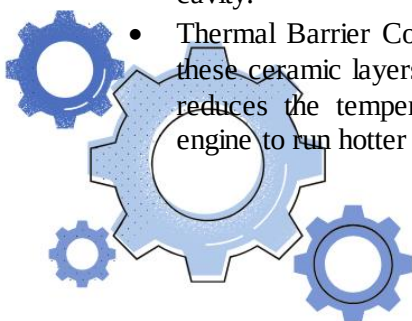
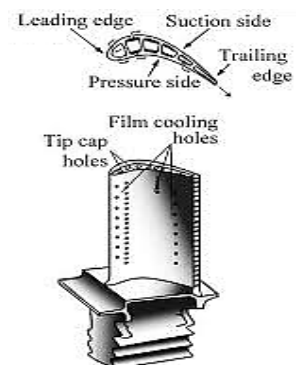
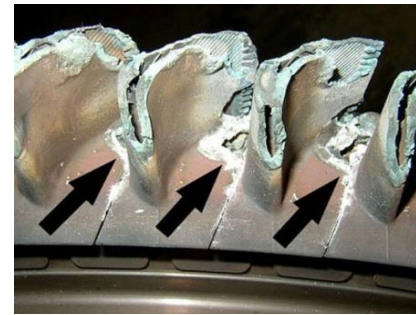
### 4. Specialized Design and Analysis Techniques

Designing for HTE requires methods beyond traditional elastic analysis. Multi-scale modelling with nonlinear analysis for tackling special consideration for combination of loads is required. Some of the damage mitigating techniques are

#### 4.1 Thermal Management and Cooling

Since even the most advanced materials have temperature limits, active and passive cooling techniques are common. For gas turbine blades, this involves:

- Film Cooling: Ejecting cooler air through thousands of small holes on the blade surface to create an insulating cool-air layer
- Impingement Cooling: Directed jets of cooling air inside the blade cavity.
- Thermal Barrier Coatings (TBCs): Applied to the outer surface, these ceramic layers e.g. Yttrium-Stabilized Zirconia dramatically reduces the temperature of the underlying metal, allowing the engine to run hotter without exceeding the alloy's limit.





#### 4.2 High-Temperature Structural Mechanics

Numerical techniques, particularly Finite Element Analysis (FEA), are essential. These analyses must incorporate sophisticated material models that describe visco-plasticity the coupled, non-linear time-dependent response of the material to both stress and temperature.

Life prediction in HTE relies on damage mechanics, often utilizing:

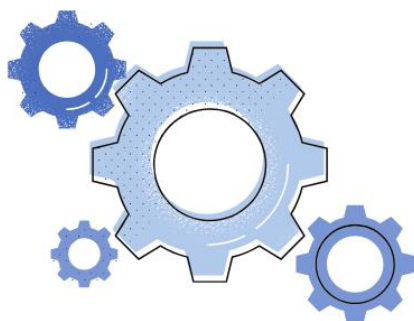
- Creep damage laws: To calculate rupture life based on accumulated creep strain.
- Miner's rule: Modified to account for the synergistic damage caused by creep and fatigue cycling over the component's lifetime.

#### 5. Key Industrial Applications

HTE is central to several high-impact sectors

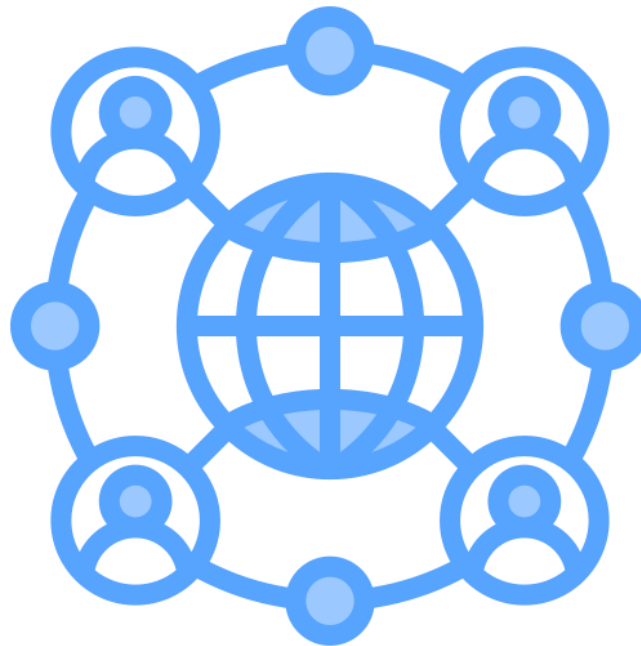
| Sector        | Application                                                         | Key HTE Requirement                                                                                      |
|---------------|---------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| Energy        | Gas and Steam Turbines (Power Generation)                           | Maximum efficiency via highest possible inlet temperature 1600°C.                                        |
| Aerospace     | Jet Engines, Hypersonic Vehicles                                    | Thrust-to-weight ratio; high-temperature strength and oxidation resistance in combustors and nozzles     |
| Nuclear       | Generation IV Reactors (e.g., High Temperature Gas cooled Reactors) | Structural integrity of core components and heat exchangers under high radiation and temperatures 950°C. |
| Manufacturing | Furnaces, Kilns, High-Efficiency Heat Exchangers                    | Long-term reliability and chemical stability of refractory linings and heat transfer surfaces.           |

The future of high-temperature engineering lies in further materials innovation, particularly the deployment of CMCs in more widespread applications, and the use of Additive Manufacturing (AM) to create highly complex, optimized cooling channels within super-alloy components that are impossible to cast, pushing the boundary of operating temperatures even higher





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Stay in touch with us for the latest updates on research, events, and achievements in in our department.

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 <https://vjti.ac.in/mechanical-engineering>

 hod\_degree@me.vjti.ac.in

