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MECHSTREAK

TECHNICAL MAGAZINE OF THE DEPARTMENT OF MECHANICAL ENGINEERING

VOLUME 6 | DECEMBER 2025

TECHNICAL ARTICLES

MAJOR HIGHLIGHTS IN ME - 2025

STUDENT PROJECTS & INNOVATIONS

PROJECT REPORTS

With Best wishes

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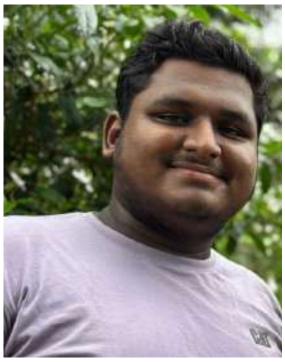


ADWAITH MOHAN
S6 ME A

RAHUL . R . SANKAR
S6 ME B

It is with great pride and gratitude that we present Volume 6 of MECH STREAK. This edition reflects the continuous efforts to create a meaningful platform that encourages learning, creativity, and the sharing of knowledge through a well-curated magazine.

This volume features a collection of student technical articles, scientific contributions, and thoughtfully prepared content that showcases innovation, analytical thinking, and academic curiosity. Along with these, the image gallery captures memorable moments, activities, and achievements, preserving the spirit and journey behind this edition.

We sincerely thank all contributors, reviewers, and supporters whose dedication and cooperation made this issue possible. Every article and visual element in this volume stands as a result of teamwork and commitment.

Above all, we express our heartfelt gratitude to Almighty God for His guidance and blessings, which enabled us to successfully complete this volume. We hope that MECH STREAK – Volume 6 serves as a source of knowledge, inspiration, and pride for all our readers.

— Editorial Team
MECH STREAK – Volume 6

HoD’s NOTE

Dr. Rejeesh CR
Professor

It is my pleasure to present this edition of MECHSTREAK, the Technical Magazine of the Department of Mechanical Engineering, FISAT, Angamaly. MECHSTREAK serves as a platform to showcase the technical skills, innovative ideas, and creative efforts of our students and faculty, reflecting the dynamic nature of Mechanical Engineering and its integration with emerging technologies and sustainable practices.

With FISAT entering a new phase as an autonomous institution, the Department of Mechanical Engineering is focused on strengthening outcome-based education, interdisciplinary learning, research orientation, and industry engagement. I appreciate the sincere efforts of the editorial team, student contributors, and faculty coordinator in bringing out this edition.

I am confident that MECHSTREAK will inspire budding engineers to think critically, innovate responsibly, and contribute positively to technological advancement and societal development. I extend my best wishes to the entire Mechanical Engineering fraternity at FISAT for continued academic and professional success.

Dr . Rejeesh CR
Head Of The Department

CONTENTS

Kalina Cycle: Hidden Heat Power

The scarcity of fossil fuels and the related emissions have drawn attention to the production of energy from alternative sources. Since there is a great potential for the conversion of low and medium temperature heat, such as from geothermal reservoirs, solar systems, biomass combustion, or waste heat sources, the use of dependable low and medium temperature heat sources has become vital in the energy transition.

Kalina cycle is a power generation cycle which uses a binary working fluid – ammonia and water mixture. A binary working fluid will undergo phase change at varying temperatures. As energy is transferred to the mixture from a source, the low boiling point fluid, ammonia, will vaporize first. The remaining low concentration mixture, boils at a higher temperature. The change in temperature during boiling makes the temperature of the binary working fluid closer to the heat source temperature. Hence the irreversibility associated with the heat transfer between the source, as well as the sink with the working fluid is minimized. Thus, Kalina cycle is promising in energy and exergy efficiencies for waste heat recovery as well as low temperature power production

DR. DEVI PARVATHY S
ASSISTANT PROFESSOR
DEPT OF ME

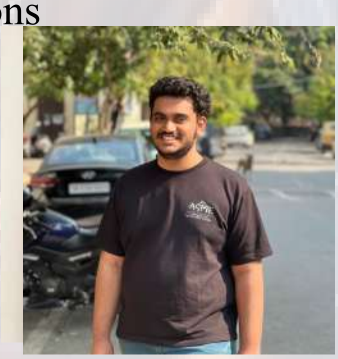
TURNING METAL WASTE INTO HIGH-PERFORMANCE TOOLS

Every machining operation produces metal chips, often considered waste and sent for remelting. While traditional recycling recovers material, it consumes high energy, causes oxidation, and leads to alloy segregation. Modern mechanical engineering now explores direct reuse of metal chips to manufacture tools and components, offering a sustainable and energy-efficient alternative

In this process, machining chips are first cleaned and dried to remove cutting fluids and contaminants. The chips are then compacted into green billets and consolidated using hot extrusion, hot isostatic pressing (HIP), or spark plasma sintering (SPS), which avoids melting and preserves the alloy properties. During consolidation, the chips undergo plastic deformation, breaking oxide layers, promoting metallurgical bonding, and refining the grain structure. This enhances hardness, strength, wear resistance, and fatigue performance, making the material suitable for high-performance tools, dies, and wear-resistant components.

Further innovations involve adding ceramic reinforcements like TiC or WC, or applying surface coatings, creating cutting tools, dies, inserts, and wear-resistant components directly from recycled material. This approach not only reduces environmental impact but also contributes to circular manufacturing, where machining waste becomes a reliable source of high-performance tools.

Metal chip reuse demonstrates how sustainability, innovation, and engineering efficiency can converge, transforming traditional waste into value-added mechanical solutions



NIKHIL RAJEEV
S6 ME B

ADDITIVE MANUFACTURING: RESHAPING THE ROCKET ENGINEERING

Additive manufacturing (AM), widely known as 3D printing, is reshaping rocket propulsion by transforming how engines are designed and built. Traditional methods relied on machining, welding, and brazing hundreds of parts—an approach that was costly, slow, and prone to failure. AM simplifies this by enabling lighter components, faster production, and major part consolidation, where complex engine parts are printed as single pieces.

Using metal powder–based processes such as Laser Powder Bed Fusion, engineers can manufacture injector heads, cooling jackets, and even combustion chambers in one build. This eliminates multiple welds and joints, improving structural integrity and reliability. AM also enables complex internal features like regenerative cooling channels, which enhance heat transfer and engine efficiency—designs that were difficult or impossible with conventional manufacturing.

Advances in high-temperature materials such as Inconel 718 have further expanded AM's use in rocket engines, allowing components to withstand extreme thermal and mechanical loads. Rapid design iteration is another key advantage, letting engineers move from design to testing in days instead of months. While challenges like porosity and certification remain, continuous improvements are making AM a cornerstone of faster, more efficient, and cost-effective access to space.

RAHUL . R . SANKAR
S6 ME B

MAJOR HIGHLIGHTS OF 2025

2025 G20 Johannesburg Summit

M22–23 November 2025, Johannesburg, South Africa:
The 20th G20 Summit was held at the Johannesburg Expo Centre, marking the first time the G20 took place on African soil and bringing together leaders of the world's major economies to discuss global cooperation on sustainability, health, and economic recovery

. Major global political and humanitarian developments

2025 was marked by widespread geopolitical shifts, including peace negotiations and ceasefires in conflict zones, political upheavals, and large protests shaping global affairs — events identified among the most significant worldwide for the year

World Athletics Championships 2025

The 20th edition of the World Athletics Championships took place in Tokyo's National Stadium with nearly 2,200 athletes from around the world competing, and it was one of the most watched global sports events of the year.

United Nations Ocean Conference 2025

Global leaders adopted the Nice Action Plan and strengthened marine conservation efforts, including expansion of marine protected areas and tackling climate change and ocean health — a major global environmental achievement.

"The new AI platform has transformed our workflow and productivity. Highly recommended!"
— Sarah Johnson, Tech Lead at InnovateX

Escalating climate and natural disaster impacts — 2025 global climate reports:

Climate change continued to shape the year with record-breaking heatwaves, floods, cyclones, droughts, and wildfires causing significant economic and social impacts around the world, highlighting the urgency of climate action.

International Conference of Glaciers' Preservation

From 29May to 1June2025, the International Conference of Glaciers' Preservation was held in Dushanbe, Tajikistan, leading to the Dushanbe Glacier Declaration on climate adaptation, research cooperation, and glacier conservation

"The year 2025 marked a turning point in global innovation, where breakthroughs in artificial intelligence, space exploration, genetic medicine, and renewable energy redefined what humanity can achieve. From record-breaking scientific discoveries to landmark global collaborations, this year has demonstrated the power of creativity, perseverance, and international cooperation in addressing some of the world's greatest challenges. Every innovation, whether it was the launch of a groundbreaking satellite, the development of personalized medicine, or the hosting of transformative global summits, has shown that progress is not just about technology, but about improving lives, connecting communities, and inspiring the next generation of thinkers and leaders."

Energy-Efficient CO_2–R-448A Cascade Refrigeration with Modular Architecture

Rising energy demand and environmental concerns have accelerated the need for advanced refrigeration technologies that combine efficiency, sustainability, and practical scalability. Conventional transcritical CO_2 refrigeration systems often experience significant energy losses due to flash gas formation, throttling irreversibility, and high compressor pressure ratios. To overcome these limitations, a modular refrigeration architecture is proposed that integrates optimized component selection with multi-stage thermodynamic enhancement. A flash gas separation chamber positioned after the expansion device divides the refrigerant into liquid and vapor phases, ensuring stable evaporator operation while redirecting flash vapor to an intermediate compression stage, thereby reducing unnecessary compressor work and improving system COP.

System performance is further enhanced through three-stage compression with intercooling, which lowers discharge temperatures, reduces thermal stress, and improves volumetric efficiency. To maintain high efficiency under elevated ambient conditions, a cascade configuration is adopted in which CO_2 (R-744) functions as the low-temperature stage and R-448A serves as the high-temperature stage. Additive manufacturing enables compact, high-performance heat exchangers and modular flow components, resulting in a cost-effective, low-GWP refrigeration solution suitable for real-world deployment.

iSHRAE NSDC Competition Project
Susmitha | Hrishikesh Sajith | Aquil Mohammed
Guided by Dr. Deviparvathy S.

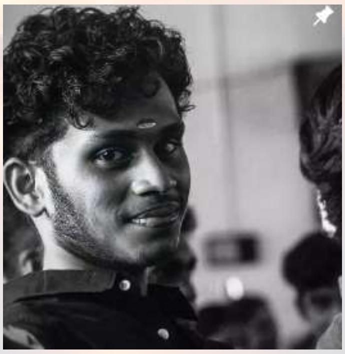
SUSMITHA V MAHESH
S4 ME B

Hydrogen Energy: A Clean Path for Future Engines

Hydrogen energy is emerging as a promising solution to reduce dependence on fossil fuels and minimize environmental pollution. It is considered a clean energy carrier because its use produces very low emissions, mainly water vapour. Hydrogen also has a high energy content per unit mass, making it suitable for future transportation and power generation systems. With growing concerns over climate change and energy security, hydrogen is gaining attention as a sustainable alternative fuel.

Hydrogen can be utilized in internal combustion engines as well as in fuel cells to generate power efficiently. Mechanical engineers play an important role in modifying engine designs, developing hydrogen-compatible fuel injection systems, and controlling combustion characteristics. Fuel cell systems convert hydrogen directly into electricity with high efficiency and low noise. These technologies are being explored for vehicles, buses, and stationary power applications.

However, challenges such as safe storage, transportation, and limited infrastructure still exist. Hydrogen requires high-pressure or cryogenic storage methods. Continuous research in materials, safety systems, and thermal management is helping overcome these challenges, making hydrogen energy a strong candidate for future clean energy systems.



ACHUTH SANKAR
S6 ME A

AUTONOMOUS DRONES: SHAPING THE FUTURE OF AERIAL TECHNOLOGY

Autonomous drones have emerged as one of the most impactful technological advancements in 2025, transforming how aerial tasks are performed across industries. Unlike conventional remotely operated drones, autonomous drones rely on artificial intelligence, onboard computing, and advanced sensors to make real-time decisions without continuous human control. Using technologies such as GPS, LiDAR, computer vision, and sensor fusion, these drones can navigate complex environments, detect obstacles, and optimize flight paths independently.

Major industry players such as DJI, Wing (a subsidiary of Alphabet), and Skydio have driven rapid innovation in this field. Autonomous drones are now widely used in parcel delivery, precision agriculture, infrastructure inspection, defense surveillance, and disaster management. Their ability to operate Beyond Visual Line of Sight (BVLOS) has significantly increased operational efficiency and coverage.

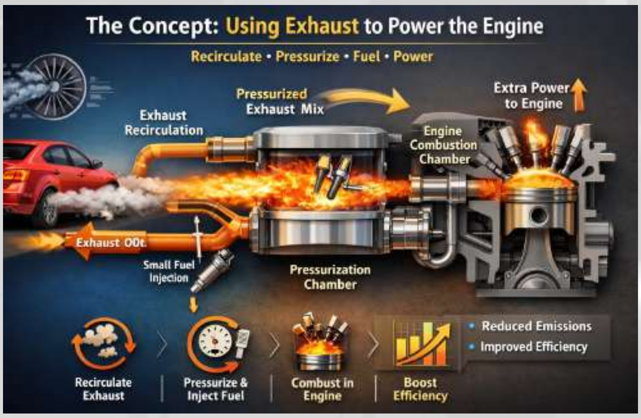
As regulations evolve and AI algorithms become more reliable, autonomous drones are expected to play a vital role in smart cities and automated logistics networks. Improved battery technology, swarm coordination, and real-time data processing will further enhance their capabilities. In the coming years, autonomous drones will not only reduce human workload but also improve safety, accuracy, and response time, marking a major leap forward in modern engineering and automation.

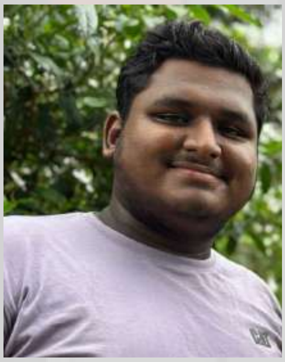
AKHILA A
S4 ME A

TURNING EXHAUST INTO ENGINE POWER: A NOVEL CONCEPT

Vehicles release exhaust gases full of untapped energy. Traditionally, this energy escapes into the atmosphere, along with a significant portion of fuel. This concept envisions a revolutionary way to reuse exhaust gases to assist engine power.
The idea involves recirculating the emitted exhaust gases, pressurizing them, and adding a small amount of fuel. This pressurized mixture is then introduced back into the engine to provide additional energy, effectively boosting engine performance while reducing fuel consumption. By converting what was once wasted exhaust into usable energy, the engine operates more efficiently, with lower fuel usage and reduced emissions.

Unlike conventional EGR systems that focus solely on emission control, or turbochargers that harness exhaust mechanically, this concept directly transforms exhaust into a secondary combustion source, creating a hybrid energy system within the engine itself.
If successfully implemented, this approach could reshape vehicle efficiency standards, providing a sustainable and innovative solution to fuel wastage. Exhaust is no longer just a byproduct—it becomes a valuable source of energy that powers the engine while supporting environmental sustainability.





ADWAITH MOHAN
S6 ME A

"ENGINEERING EXCELLENCE IN ACTION: MY JOURNEY WITH MR FLUIDS"

Participating in the ASME EFX India National-Level Oral Competition was one of the most memorable achievements of my academic journey. Students from all over India, including many experienced fourth-year engineers, competed, making it both challenging and inspiring. Initially, I lacked confidence, but I dedicated nearly a month to researching, preparing, and revising my topic: Magnetorheological (MR) Fluids.

MR fluids are smart fluids composed of magnetic particles suspended in a liquid. When exposed to a magnetic field, they instantly transform from a liquid to a semi-solid state, making them ideal for applications in automotive suspension systems, dampers, brakes, and vibration control. During my presentation, I explained their working principle, real-world applications, future potential, and challenges like cost and particle settling, giving a complete overview of this cutting-edge technology.

The competition involved a 12-minute presentation and a 7-minute Q&A, which I handled with growing confidence. My hard work was rewarded with Second Prize, a $300 award, and national-level recognition. Beyond the accolades, this experience strengthened my confidence, research skills, and commitment to engineering excellence, showing me that preparation, passion, and persistence are key to success.

P. ASHWATHI
S6 ME B

Innovations Shaping the Future of Automobiles

The automotive industry is evolving rapidly with technological innovations that enhance efficiency, safety, and sustainability. Electric and hybrid powertrains are reducing carbon emissions, while autonomous driving systems aim to make transportation safer and smarter. Connected vehicles use IoT and AI for real-time traffic updates, predictive maintenance, and enhanced driver assistance, transforming how we interact with vehicles.

Mechanical engineers are leveraging advanced materials such as carbon fiber, high-strength steel, and lightweight alloys to reduce vehicle weight and improve fuel efficiency. Modern braking, suspension, and steering systems are also being optimized to enhance ride comfort, handling, and safety on diverse road conditions.

Additionally, 3D printing and additive manufacturing allow rapid prototyping and production of complex components, accelerating innovation. Together, these advancements are shaping a future where vehicles are more intelligent, sustainable, and efficient, paving the way for a smarter automotive world

ADINDHAN . R
S6 ME A

Bio-Inspired Sensors: The Future of NDT

In the rapidly evolving world of non-destructive testing (NDT), one of the most exciting frontiers lies not in machines or metal, but in biological inspiration. Engineers and researchers are increasingly looking to nature — from the sonar of bats to the sensory systems of fish — to design bio-inspired NDT methods that could transform how we inspect structures, components, and materials with higher sensitivity, efficiency, and adaptability.

Bio-inspired NDT is rooted in the idea that millions of years of evolution have already perfected certain sensing strategies that humans can learn from. For example, echolocation in bats, which uses sound waves to detect tiny insects and navigate complex environments, is now inspiring adaptive acoustic sensors that can detect microscopic cracks and internal flaws in materials with remarkable resolution. Similarly, the lateral line system in fish — a network of tiny sensory organs that detect fluid motion — has motivated the development of distributed vibration-sensing arrays capable of monitoring structural integrity in large or flexible systems like aircraft wings, bridges, and pipelines

What makes bio-inspired NDT especially promising is its blend of simplicity and sophistication. Unlike traditional methods that often require large equipment or high-energy sources, bio-inspired sensors aim to be lightweight, low-power, and highly adaptable to complex shapes. These systems can ultimately be integrated into autonomous inspection robots or drones, bringing smart sensing to environments that are difficult or dangerous for human inspectors. As materials and structures become more advanced — from carbon-fiber composites in aerospace to smart infrastructure in cities — bio-inspired NDT offers a forward-looking solution that harnesses the elegant problem-solving strategies of nature to keep technology safe, reliable, and future-ready.

AALIYA M A
S6 ME A

INTERNSHIP EXPERIENCE AT DRDO: EXPOSURE TO AIRBORNE MISSION SYSTEMS

Undertaking my internship at the Centre for Airborne Systems (CABS), under the Defence Research and Development Organisation (DRDO), Bengaluru, was a highly enriching and transformative experience that provided firsthand exposure to India's advanced defence research and development ecosystem. The internship enabled me to gain practical familiarity with a wide range of testing rigs and validation setups used for the evaluation and qualification of critical airborne subsystems, thereby strengthening my understanding of real-world engineering verification practices

During the course of the internship, I developed a foundational understanding of integrated mission systems deployed on strategic airborne platforms such as the C-295 aircraft and the EMB-145 AEW&C (NETRA). This exposure offered valuable insights into system-level architecture, sensor integration, data fusion, and the operational requirements that govern airborne surveillance and early warning missions.

I also had the opportunity to closely interact and collaborate with experienced scientists, engineers, and defence personnel, which helped me gain deeper insights into disciplined engineering practices, system integration challenges, rigorous testing methodologies, and the importance of reliability and safety in mission-critical defence systems.

Furthermore, I explored the emerging scope and potential applications of AR/VR/XR technologies in mission planning, simulation-based training, and operational support, highlighting their growing relevance in modern defence environments.

Overall, this internship served as a defining milestone in my academic and professional journey, reinforcing my interest in aerospace and defence technologies and motivating me to apply my technical skills toward the development of meaningful, high-impact systems that contribute to national security and technological self-reliance.

PRADAMESH PRASAD PILLAI
S6 ME B

CAD Relay: A Collaborative Design Challenge at Arcane 2.0

As part of Arcane 2.0, the ISTE FISAT Chapter successfully conducted CAD Relay on 26th September 2025, offering participants a refreshing and collaborative twist to conventional CAD competitions.

CAD Relay was a team-based design challenge conducted in a relay format, where two participants from a team worked on a single CAD drawing by taking turns. Each participant had to seamlessly continue the work left by their teammate, demanding a high level of coordination, design consistency, and mutual understanding. The format tested not only individual technical skills but also the ability to think collaboratively under time constraints.

The teams were evaluated based on CAD proficiency, clarity and accuracy of the design, adherence to drafting standards, and teamwork. Special emphasis was placed on ensuring that the final drawing appeared uniform, coherent, and professionally refined, reflecting the combined effort of both team members.

The event witnessed enthusiastic participation from students, creating an engaging and competitive atmosphere. CAD Relay stood out as an innovative platform that effectively highlighted the importance of collaborative design practices, a crucial skill in real-world engineering and industrial environments.

Winners

🥇 1st Prize – Team TURBO

🥈 2nd Prize – Team HAWALA

Nikhil Rajeev (ME Forum Head _ ISTE FISAT

Stellar – Engineering an Autonomous Drone Platform

Stellar is a multidisciplinary team of 10 engineering students formed to participate in the SAE Autonomous Drone Development Challenge, with the objective of developing an autonomous delivery drone capable of scanning a QR marker and accurately dropping a payload (egg) at a designated target location as part of the competition mission.

The team is led by Aaliya M.A. (Team Captain), with Aravind (Vice-Captain) supporting operations. The technical team is headed by Vigneshwar, the design team is led by Pradamesh, and the documentation team is coordinated by Adwaith, with multiple members contributing across each group.

The drone features a lightweight carbon-fibre composite frame, a centrally mounted 3300 mAh Li-Po battery, protected rotors with safety guards, and a modular multi-deck architecture for easy maintenance and rapid sensor integration. A dedicated payload release mechanism enables controlled and accurate delivery during the mission.

Autonomous mission execution, including QR-based target detection and decision-making, is handled by an onboard Raspberry Pi, which processes camera input and communicates with the flight controller to achieve precise navigation and payload drop.

The team works under the guidance of Mr. Joseph Papachan, Assistant Professor (ME) and gratefully acknowledges Mr. Rejeesh C.R., Head of the Department, for their continuous support and encouragement.

Adwaith Mohan - Doc Head - Stellar

VISION

To evolve as a centre of excellence in Mechanical Engineering, fostering innovation, sustainability, and leadership by empowering socially responsible engineers capable of addressing global and industrial challenges.

MISSION

M1: To deliver quality education in Mechanical Engineering and allied areas to accomplish academic excellence, innovative solutions, and technical competence.

M2: To foster leadership, entrepreneurship, and ethical responsibility through industry-aligned curriculum with emphasis on multi-disciplinary and hands-on learning.

M3: To encourage research and development with focus on solving real-world engineering problems through sustainable and concurrent technologies and tools.

M4: To promote holistic growth and lifelong learning to adapt to global trends and technological developments and contribute meaningfully to society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO 1: Graduates will emerge as true professionals, capable of designing and analyzing products or processes based on engineering practices and scientific knowledge for sustainable development.

PEO 2: Graduates will be equipped to shape their career and pursue higher studies in Mechanical Engineering and allied fields by embracing entrepreneurship, professionalism, and ethical values.

PEO 3: Graduates will succeed in a multicultural and multidisciplinary environment, imbibing the spirit of lifelong learning and societal responsibility.

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