AY 2024-25

Department of Aeronautical Engineering

# AEROCHRONIC

ANNUAL TECHNICAL MAGAZINE

## EMPOWERING AERONAUTICAL ASPIRATIONS

ADCET, ASHTA

Welcome to the vibrant world of aeronautical innovation at Annasaheb Dange College of Engineering & Technology (ADCET), Ashta)—a proud Empowered Autonomous Institution, accredited by NAAC with an 'A++' grade and NBA, committed to excellence in engineering education.

Founded in 2013, the Department of Aeronautical Engineering has grown into a dynamic center for learning, creativity, and hands-on exploration. Offering an NBA-accredited B.Tech program, the department integrates strong theoretical instruction with industry-aligned curriculum, state-of-the-art laboratories, and experiential learning opportunities that prepare students to thrive in the ever-evolving aerospace sector.

At ADCET, we don't just teach aeronautics—we ignite passion for flight, encourage innovation, and foster leadership. Through project-based learning, research exposure, and skill development, our students are empowered to turn their aspirations into altitude.

This newsletter brings you the latest from our department—achievements, events, outreach activities, and the spirit of collaboration that fuels our journey. Step inside to explore how we are not just educating engineers but shaping future-ready aviation pioneers.

### IN THIS ISSUE:

BE INSPIRED BY STORIES OF LIKE-MINDED PEERS WHO PLACE LEARNING, GROWTH, AND PURPOSE AT THE CENTER OF THEIR JOURNEY.

# ABOUT ADCET

## Empowering Engineers, Shaping Futures

A Center of Excellence in Technical Education

Annasaheb Dange College of Engineering and Technology (ADCET), Ashta, is a distinguished Empowered Autonomous Institution affiliated with Shivaji University, Kolhapur, and approved by AICTE, New Delhi. Since its inception in 1999, ADCET has become a beacon of technical excellence in Western Maharashtra, offering NBA-accredited undergraduate programs and earning an NAAC 'A++' grade and ISO 9001:2015 certification.

Our 25-acre campus is home to over 3000 aspiring engineers who benefit from a student-centric environment rooted in Outcome-Based Education (OBE). ADCET emphasizes experiential learning through mini/micro/mega projects, hands-on lab sessions, community outreach, and collaborative research. The curriculum is regularly updated to reflect industry demands, guided by a transparent and measurable framework.

What sets ADCET apart is its focus on holistic student development:

- Robust mentorship and scholarship programs ensure that financial constraints do not hinder learning.
- Strategic MoUs with IITs, NITs, and research institutes expand academic and innovation opportunities.
- Strong industry linkages and placement support help students become career-ready professionals.
- Facilities like a well-stocked library, modern hostels, and advanced digital classrooms enrich the learning journey.

ADCET's inclusive culture fosters diversity, equity, and respect, empowering every student to dream big and lead with purpose. Our values are built on the 4 C's that define our mission:

COMPETENCE | CONFIDENCE | COMMITMENT | COMPASSION

## Vision of the ADCET

To be a Leader in producing professionally competent engineers.

## Mission of the ADCET

We, Annasaheb Dange College of Engineering & Technology, Ashta, are committed to achieve our vision by,

- M1. Imparting effective outcome based education.
- M2. Preparing students through skill oriented courses to excel in their profession with ethical values.
- M3. Promoting research to benefit the society.
- M4. Strengthening relationship with all the stakeholders.

# MESSAGE

**Hon. Shri. Annasaheb Dange**
Founder & Chairman

Our mission began with a simple idea—empowering rural youth through quality technical education rooted in values, purpose, and opportunity. Today, this vision lives on through dedicated efforts to offer affordable, inclusive, and transformative learning experiences.

We don't just shape engineers; we nurture leaders with character, competence, and compassion. Every achievement is a testament to the collective commitment of our faculty, students, and community.

"Dream boldly, work sincerely, and help us carry forward a legacy of service and excellence."

With a vision to uplift rural youth through world-class technical education, we have built a learning environment rooted in dedication, discipline, and development. Every initiative here—be it scholarships, mentoring, or hands-on training—is designed to support holistic student growth.

We are committed to nurturing not only skilled engineers, but also responsible citizens guided by integrity and social values. As you embark on this journey, know that you are part of a mission that transforms lives and shapes futures.

"Your success fuels our purpose."

**Adv. Rajendra R. Dange**
Secretary

**Hon. Vishwanath R. Dange**
Joint Secretary

It is a matter of great pride to see the institution's steady rise as a hub of academic excellence and innovation. Guided by the vision of inclusive and value-driven technical education, we are committed to empowering students with not just knowledge, but also purpose and responsibility. Through the dedication of faculty, the enthusiasm of students, and the support of our alumni and partners, we continue to shape socially conscious, industry-ready professionals prepared to meet global challenges.

"Together, let's build a future grounded in excellence, values, and innovation."

We are committed to shaping industry-ready, ethically grounded engineers through quality technical education, modern infrastructure, and innovation-driven learning. With a strong focus on employability, entrepreneurship, and societal impact, we aim to empower students with global competence and local responsibility. Let us move forward together toward new horizons of excellence through collaboration, inclusivity, and continuous growth.

**Prof. Rafiq Abu Kanai**
Executive Director

# ABOUT AERONAUTICAL DEPARTMENT

## Department of Aeronautical Engineering

Soaring Beyond Limits | Engineering Flight & Future

Since its establishment in the academic year 2013–14, the Department of Aeronautical Engineering has emerged as a dynamic hub of innovation and excellence, offering a full-time NBA-accredited B.Tech program with an annual intake of 60 students. The department is driven by a clear vision: to produce skilled and industry-ready aeronautical engineers capable of addressing the challenges of aviation and allied sectors.

With a strong foundation in Outcome-Based Education (OBE) and a track record of academic distinction, the department has successfully graduated six batches totaling over 350 students—many of whom have achieved remarkable success in placements, higher education, and research.
What makes the department stand out is its cutting-edge infrastructure and experiential learning approach. Key highlights include:

- Subsonic Wind Tunnel for aerodynamic experiments
- Gas Turbine and Radial Piston Engines for propulsion studies
- Ultrasonic Testing Setup for NDT training
- A full-scale Cessna 152 Trainer Aircraft equipped with original cockpit instrumentation
- A modern computing lab with 40 systems and high-performance workstations

Backed by highly qualified faculty, the department encourages student innovation through micro-projects, internships, national competitions, and research engagement. Emphasis is placed not only on theoretical mastery but also on practical application and industry interface.
At its core, the department remains committed to empowering students with technical competence, ethical values, and the confidence to take flight into a challenging global aerospace landscape.

## Our Department's Vision

To be a leader in producing competent aeronautical engineers to meet the present and future needs of the aeronautical and allied industries

## Our Department's Mission

We, at the Department of Aeronautical Engineering, Annasaheb Dange College of Engineering and Teaching, Ashta, are committed to achieve our vision by,

- Preparing the students with good fundamental knowledge of aeronautics through outcome-based education.
- Imparting technical knowledge in tune with the current industry requirements through skill-oriented courses.
- Promoting research culture among the faculty and students through sponsored and consultancy projects with industries and research establishments.
- Establishing relationships with all the stakeholders for the benefit of students.

# MESSAGE FROM THE HEAD OF DEPARTMENT

Mr. Kiran Babu
Head of the Department

## Dear Readers,

It gives me immense pleasure to present to you the first issue of Aerochronic, our department's quarterly newsletter. This initiative aims to serve as a bridge between our students, faculty, staff, alumni, and external partners, showcasing our collective achievements, innovations, and aspirations.

The past quarter has been particularly exciting. From student accolades in national competitions to new research collaborations and the successful inauguration of our Advanced Wind Tunnel Facility, our department continues to grow in both capability and reputation. I am especially proud of our students and faculty whose commitment to excellence drives our mission forward.

As we step into a future driven by aerospace innovation, sustainability, and global collaboration, I encourage all members of our community to actively engage with the opportunities and initiatives highlighted in this newsletter.

I hope you enjoy reading through the updates and stories that reflect the spirit and strength of our department. Let us continue to aim high and push boundaries.

With warm regards,
Mr. Kiran Babu
Head of the Department
Aeronautical Engineering
ADCET, Ashta

# Program Educational Objectives (POEs)

The graduates of the Department of Aeronautical Engineering at ADCET, Ashta will be able to,

- PEO-1: Pursue successful career in technical profession, entrepreneurship, research and higher studies in the field of aeronautical and allied engineering.
- PEO-2: Demonstrate technical competency in aeronautical engineering by offering best possible engineering solutions.
- PEO-3: Work effectively as an individual and as a team member with professional ethics, social and environmental concern.
- PEO-4: Engage in lifelong learning and adapt to the changing professional requirements.

# Program Outcomes (POs)

- *PO-1 Engineering knowledge:* Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the conceptualization of engineering models.
- *PO-2 Problem analysis:* Identify, formulate, research literature and solve complex engineering problems reaching substantiated conclusions using first principles of mathematics and engineering sciences.
- *PO-3 Design/development of solutions:* Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
- *PO-4 Conduct investigations of complex problems:* Conduct investigations of complex problems including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
- *PO-5 Modern tool usage:* Create, select and apply appropriate techniques, resources, and modern engineering tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
- *PO-6 The engineer and society:* Demonstrate understanding of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering practice.
- *PO-7 Environment and sustainability:* Understand the impact of engineering solutions in a societal context and demonstrate knowledge of and need for sustainable development.
- *PO-8 Ethics:* Understand and commit to professional ethics and responsibilities and norms of engineering practice.
- *PO-9 Individual and team work:* Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
- *PO-10 Communication:* Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- *PO-11 Project management and finance:* Demonstrate a knowledge and understanding of management and business practices, such as risk and change management, and understand their limitations.
- *PO-12 Life-long learning:* Recognize the need for, and have the ability to engage in independent and life-long learning.

# Program Outcomes (POs)

- *PSO 1:* Apply the knowledge of aeronautical engineering in the Design and Development, Operating, Maintaining and overhauling of the products enhancing the mobility in the society.
- *PSO 2:* Develop aeronautical and aviation frameworks, and subsystems to overcome the challenges faced by the aviation industry through innovative solutions leading to employability and entrepreneurial development.

# Department Faculties

**Mr. Kiran Babu**
Head of the Department

Dr. S. Sendhil Kumar
Professor

Dr. S. Yuvaraj
Associate Professor

Dr. Vivekanandan
Associate Professor

Dr. Sudharson Murugan
Associate Professor

Dr. Sakthipriya Balu
Associate Professor

Dr. Kalpit P. Kaurase
Associate Professor

Dr. P.Kaleeswaran
Assistant Professor

Mr. Yogesh B. Kumbhar
Assistant Professor

Mr. Reju R
Assistant Professor

Mr. Sanoj P. Suresh
Assistant Professor

Mr. Oblisamy L .
Assistant Professor

Mr. Sabarishwaran R.
Assistant Professor

Mr. Basithrahman A.
Assistant Professor

Mr. P. V. S. Karthik Reddy
Assistant Professor

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# EDITORIAL BOARD

## Aerochronic — Annual Technical Magazine

*Meet the team behind the pages*

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| **Student Editor** | Ms. Samiksha Sonavane<br>*B.Tech Aeronautical Engineering, Third Year* |
| **Student Co-Editor** | Mr. Prathmesh Patil<br>*B.Tech Aeronautical Engineering, Second Year* |

# STUDENT/FACULTY RESEARCH FOCUS

Conference

## DEVELOPMENT OF 2D ROCKET BODY USING APPLICATION PROGRAMMIN INTERFACE (API) WITH PYTHON AND AUTOCAD: A KNOWLEDGE-BASED SYSTEMS APPROACH FOR SUSTAINABLE ENGINEERING EDUCATION

A Knowledge-Based Systems Approach for Sustainable Engineering Education

The development of engineering design tools that integrate automation and intelligence has become essential for modern aerospace education. This work focuses on the development of a 2D rocket body using an Application Programming Interface (API) with Python and AutoCAD, adopting a knowledge-based systems (KBS) approach to enhance sustainable engineering education.

Traditionally, conceptual rocket design involves repetitive drafting tasks and manual parameter modifications, which are time-consuming and prone to error. In this study, Python is used as a scripting language to interact with AutoCAD through its API, enabling automated generation of a 2D rocket body based on predefined design rules and parameters. Key geometric features such as nose cone profile, cylindrical body, fin geometry, and nozzle outline are generated programmatically by modifying input parameters like length, diameter, fin span, and angle.

The knowledge-based approach embeds fundamental aerospace design logic and constraints into the code, allowing students to understand the relationship between design parameters and geometric outcomes. This methodology promotes parametric and rule-based design thinking, which is a core requirement in modern aerospace and manufacturing industries. By automating routine drafting tasks, students can focus more on design optimization, analysis, and conceptual understanding rather than repetitive drawing work. From a sustainability perspective, the approach reduces material waste in prototyping stages, minimizes design iteration time, and encourages efficient use of digital resources. It also supports outcome-based education by integrating programming, CAD automation, and aerospace fundamentals within a single learning framework.

Authors: Sendhil Kumar S and Sarim Rizvi

Published by 2024

# STUDENT/FACULTY RESEARCH FOCUS

Conference

## CFD ANALYSIS ON JET DECAY CHARACTERISTICS OF SUPERSONIC JET THROUGH A CD NOZZLE WITH A CROSS-WIRE

Supersonic jets issuing from convergent–divergent (CD) nozzles are widely encountered in aerospace propulsion systems, where jet decay behavior plays a critical role in noise generation, mixing efficiency, and thrust performance. This study presents a Computational Fluid Dynamics (CFD) analysis of jet decay characteristics of a supersonic jet through a CD nozzle with a cross-wire, aimed at understanding flow modification and its impact on jet structure.

In conventional supersonic jets, shock-cell structures and high velocity gradients contribute to increased acoustic emissions and reduced mixing efficiency. The introduction of a cross-wire at the nozzle exit acts as a passive flow control device, disturbing the jet core and promoting enhanced mixing with the surrounding ambient fluid. The CFD simulations were carried out using appropriate turbulence models to capture shock formation, expansion waves, and jet shear layer development.

The numerical analysis focused on key jet decay parameters such as centerline velocity decay, potential core length, shock-cell strength, and jet spreading rate. Results indicated that the presence of the cross-wire significantly altered the jet flow field by accelerating velocity decay and reducing the length of the potential core. The cross-wire induced localized flow disturbances that weakened shock-cell structures and enhanced turbulent mixing downstream of the nozzle.

Flow visualization in the form of Mach number and velocity contours provided clear insight into the interaction between the cross-wire and the supersonic jet. These findings demonstrate that passive control elements can effectively modify supersonic jet behavior without additional energy input.

Authors: Sahriq Alam Ansari, Kaleswaran P, Kadiresh PN

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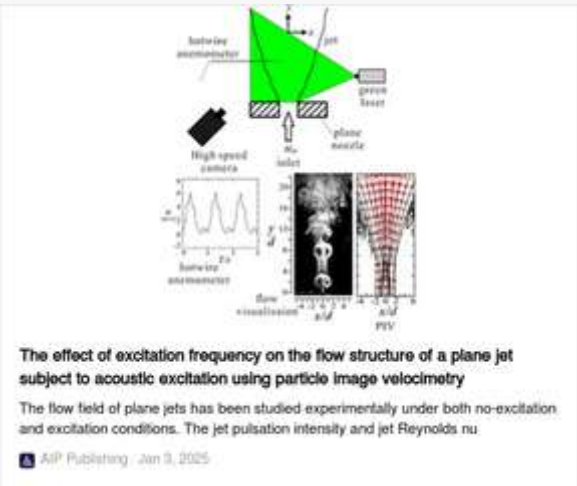
# FACULTY RESEARCH FOCUS

**Research Article**

## THE EFFECT OF EXCITATION FREQUENCY ON THE FLOW STRUCTURE OF A PLANE JET SUBJECT TO ACOUSTIC EXCITATION USING PARTICLE IMAGE VELOCIMETRY

The flow field of plane jets has been studied experimentally under both no-excitation and excitation conditions. The jet pulsation intensity and jet Reynolds number were fixed at 1.0 and 500, respectively, while the excitation frequency increased gradually from 40, 60, and 100 Hz. Acoustic excitation characteristics were determined using hotwire anemometry. Laser-assisted smoke flow visualization techniques were used to render flow features, and an edge detection technique was employed to quantify jet spreading characteristics. The velocity fields were measured using particle image velocimetry. The results show that the velocity pulsation near jet exits exhibited hump-like periodic oscillation signals. Kármán vortex street is generated periodically downstream of plane jet on flow in natural jet flow. These instabilities are replaced with mushroom-shaped coherent vortex structure when jet is under excitation. Higher excitation frequencies intensified these mushroom-shaped structures, which then became puff-like structures and eventually led to vortex breakdown resulting in turbulence eddies. Lagrangian integral time scales and length scales attribute strong vortex stretching effect to vortices breakup phenomenon, which was strong in near field in cases of excitation. In addition, small-length scales of fine turbulence eddies confirmed cascade of turbulent kinetic energy. Flow pulsation magnifies jet spread and vortex's strength. The streamline patterns revealed a two-counter rotating vortex structure in outer shear layers of plane jet flow. Turbulence intensities were significantly higher in near field due to the rapid roll-up of vortices and strong entrainment effect, leading to a higher momentum exchange rate and prominent mixing enhancement significantly during excitation.




Kumar, Sanjay, Sudharson Murugan, Ali Anwar Brohi, and Zaheer Ahmed. "The effect of excitation frequency on the flow structure of a plane jet subject to acoustic excitation using particle image velocimetry." Physics of Fluids 37, no. 1 (2025).

**Published by 2025**

# FACULTY RESEARCH FOCUS

Research Article

## HIGH-PERFORMANCE ELECTROCHEMICAL SENSORS WITH $SNBI_2O_3$/GRAPHENE OXIDE NANOCOMPOSITE FOR SELECTIVE ANTIBIOTIC DETECTION

https://doi.org/10.1016/j.jtice.2025.106033

Environmental contaminants like nitrofurans (NF) can be detected using rapid, sensitive, and efficient monitoring techniques. However, ineffective detection systems delay responses, allowing contaminants to persist in the environment, increasing their toxicity, and causing long-term harm to ecosystems and human health. An alternative is the electrochemical method for NF detection, which is fast, cost-effective, and reliable. They developed a low-cost, portable nanocomposite material, Sn-$Bi_2O_3$/GO, for the detection of NF, marking its first reported use. The crystallinity, functional groups, surface structure, and oxidation states of the materials were analyzed through various analytical and spectroscopic techniques. $SnBi_2O_3$/GO composites modified glassy carbon electrode (GCE) surface was employed to detect NF using cyclic voltammetry (CV) and differential pulse voltammetry (DPV). Then, the $SnBi_2O_3$/GO/GCE showed outstanding selectivity, even in the presence of interfering substances, with a wide linear detection range from 0.023 µM to 814.36 µM, a detection limit (LOD) of 0.0124 µM (S/N = 3), and an ultra-sensitivity of 2.857 µA $\mu M^{-1}$ $cm^{-2}$. Additionally, the $SnBi_2O_3$/GO/GCE successfully detected NF in biofluids and water samples, demonstrating satisfactory accuracy and recovery.

Alagumalai, Krishnanpandi, Nandhini Munusamy, Shen Ming Chen, Alangadu Kothandan Vivekanandan, Shih-Hsun Chen, Mani Sivakumar, Seong-Cheol Kim, and B. Prakash. "High-performance electrochemical sensors with SnBi2O3/Graphene oxide nanocomposite for selective antibiotic detection." Journal of the Taiwan Institute of Chemical Engineers 171 (2025): 106033.

# FACULTY RESEARCH FOCUS

Research Article

## CHEMICAL TREATMENT EFFECT ON HYDRATION AND MECHANICAL PROPERTIES OF BASALT AND KEVLAR FIBER-EPOXY-BASED HYBRID COMPOSITES

https://doi.org/10.1016/j.jtice.2025.106033

The mechanical and hydration properties of the Kevlar fiber-, basalt fiber-, and epoxy resin-based composites were analyzed under three conditions (untreated raw fiber, Alkali-treated fiber (NaOH treatment), and hydrochloric acid-treated fiber (HCl treatment)) for structural applications. Both treated and untreated Kevlar-, basalt fiber-, and epoxy-based hybrid composites were fabricated through the hand layup method. Then, the samples were characterized through SEM and FTIR analysis, later the samples underwent hydration property evaluation and mechanical properties evaluation. FTIR result confirms the treated fibers limit the content of hemicellulose and lignin content. The negation of these hydroxyl groups, lignin, and hemicellulose during chemical treatment can enhance the water-resistant properties. HCl-treated fiber included composite shows a better result of 1.67% water absorption to its initial weight. The HCl-treated fibers show superior mechanical properties as compared to untreated fibers and treated fiber (NaOH) based composites with values of 358.6N/mm$^2$ as tensile strength, 193.5 N/mm$^2$ as flexural strength, and 4.23 J/mm$^2$ impact strength. These results make the treated fiber composite materials suitable for aircraft structural applications and contribute to reduced environmental hazards.

Rathinavel, S., A. Basithrahman, J. Karthikeyan, T. Banu, S. Senthilkumar, and T. Sathish Senthilkumar. "Chemical treatment effect on hydration and mechanical properties of basalt and Kevlar fiber-epoxy-based hybrid composites." Biomass Conversion and Biorefinery 15, no. 7 (2025): 10719-10731.

# ADVANCES IN AIRCRAFT AND SPACE SYSTEMS: A GLOBAL TECHNICAL REVIEW

## ISRO GAGANYAAN PROGRAM – CREW MODULE AND ABORT TESTS

ISRO advanced the Gaganyaan human spaceflight program through crew module and abort system tests, focusing on safety-critical engineering. Human spaceflight demands higher reliability standards than uncrewed missions, influencing every design decision.

Abort tests validated the Crew Escape System (CES), designed to rapidly separate the crew module from the launch vehicle during emergencies. Aerodynamic stability, thrust alignment, and separation dynamics were evaluated under high-speed conditions. The crew module's thermal protection system and re-entry configuration were also assessed.

Parachute deployment tests confirmed controlled deceleration and landing behavior, while avionics and guidance systems demonstrated fault tolerance and redundancy. Manufacturing precision and quality assurance were key factors due to tight safety margins.

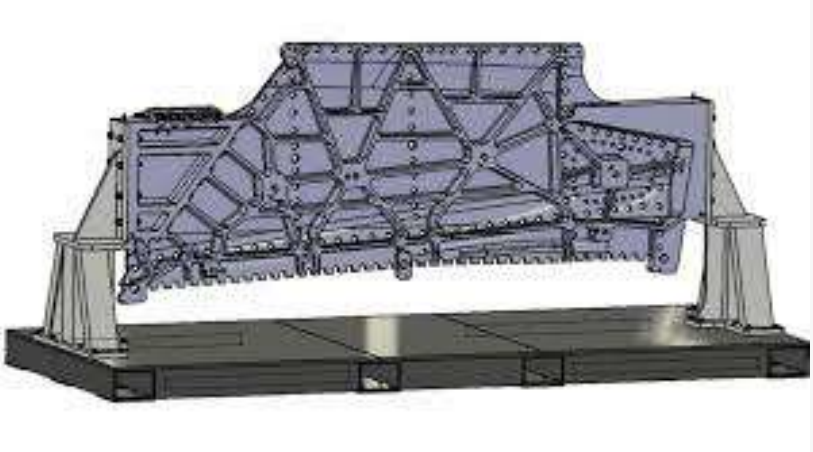
For students, Gaganyaan provides a comprehensive example of human-rated spacecraft engineering, integrating aerodynamics, structures, propulsion, thermal protection, and safety systems into a single mission architecture.

Image Source : PTI (FILE)

# ADVANCES IN AIRCRAFT AND SPACE SYSTEMS: A GLOBAL TECHNICAL REVIEW

## ADDITIVE MANUFACTURING IN AEROSPACE STRUCTURES

Relativity Space further demonstrated large-scale metal additive manufacturing (AM) for rocket structures. AM enables topology-optimized designs, reduced part counts, and rapid iteration.
Load-bearing components such as tanks and engine structures were produced with integrated features that eliminate fasteners and welds. Material characterization ensured strength and fatigue performance under launch conditions.
For students, AM highlights how manufacturing constraints influence design philosophy, reinforcing the importance of design-for-manufacture and structural optimization.



# DEPARTMENT OF AERONAUTICAL ENGINEERING

Sant Dnyaneshwar Shikshan Sanstha's

**Annasaheb Dange College of Engineering and Technology (ADCET), Ashta**

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*Accredited by NAAC 'A++' Grade, Bangalore*

*Eligible Programs Accredited by NBA, New Delhi*