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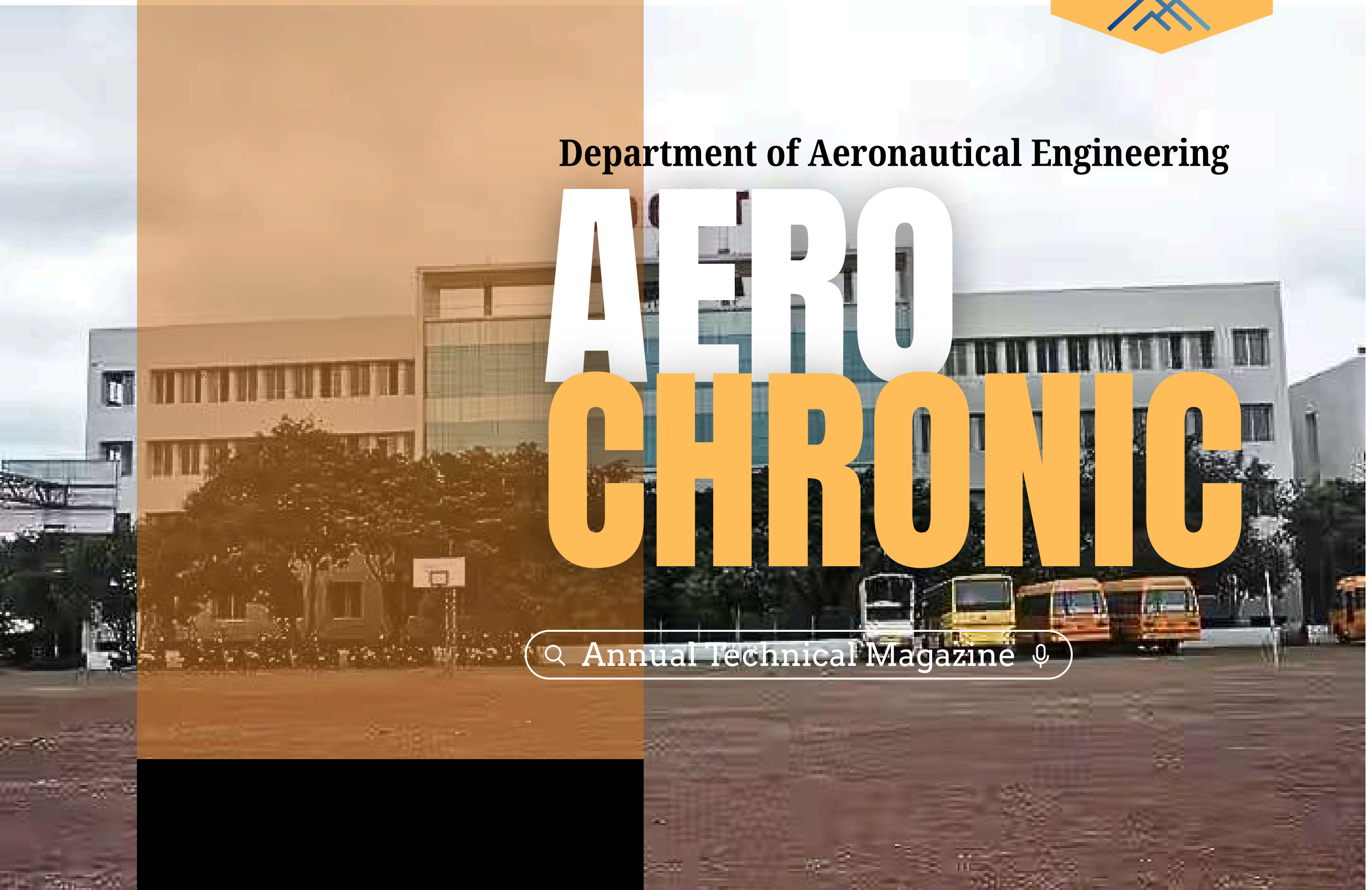
Department of Aeronautical Engineering

AERO CHRONIC



Annual Technical Magazine

ELEVATING EXCELLENCE IN **AERONAUTICAL ENGINEERING**

Since its inception in 2013, the Department of Aeronautical Engineering has emerged as a center of academic distinction and innovation. Offering an NBA-accredited B.Tech program, the department is dedicated to nurturing aeronautical talent through a dynamic, industry-relevant curriculum, hands-on training, and research-focused learning.

With state-of-the-art laboratories, skilled faculty, and a strong emphasis on real-world applications, we cultivate an environment where theory meets practice, and innovation is a way of life.

"Students don't just learn to fly—they are empowered to lead, design, and define the future of aerospace and aviation."

WHERE INNOVATION TAKES FLIGHT & **EDUCATION LEADS THE WAY**

Annasaheb Dange College of Engineering & Technology (ADCET), Ashta—an empowered autonomous institution accredited with NAAC 'A++' grade and NBA recognition—stands as a proud symbol of excellence in technical education. With a strong commitment to outcome-based learning, research-driven innovation, and holistic student development, ADCET nurtures the next generation of engineers, innovators, and leaders. Here, education goes beyond classrooms—igniting curiosity, fostering creativity, and empowering minds to engineer a better, brighter tomorrow.

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

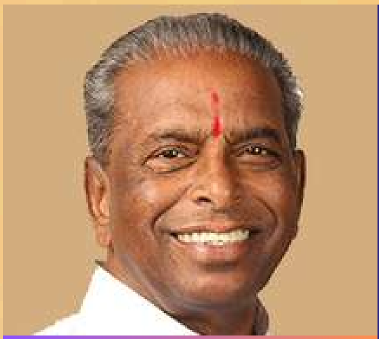
To be a Leader in producing professionally competent engineers.

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.

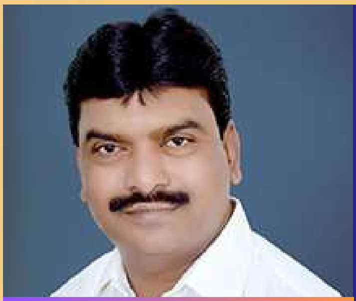
"Dream boldly, work sincerely, and help us carry forward a legacy of service and excellence."

Adv. Rajendra R. Dange
Secretary

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."



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."

Prof. Rafiq Abu Kanai
Executive Director

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.

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
Department of 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.

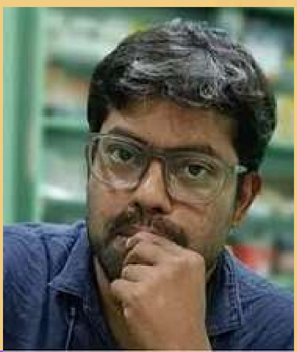
Program Outcomes (POs)

- *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

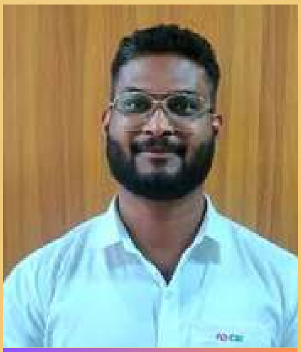


Dr. S. Yuvaraj
Associate Professor

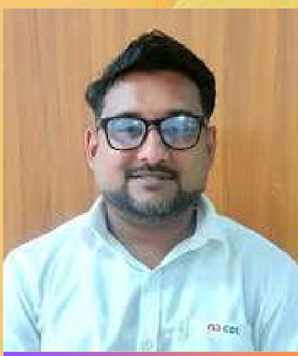
Dr. Vivekanandan
Associate Professor

Dr. Sudharson Murugan
Associate Professor

Mr. Yogesh B. Kumbhar
Assistant Professor

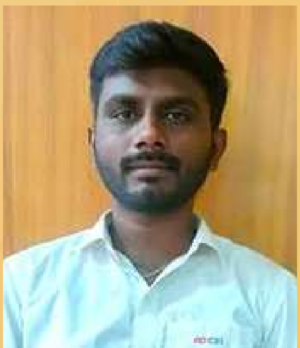


Mr. Reju R
Assistant Professor

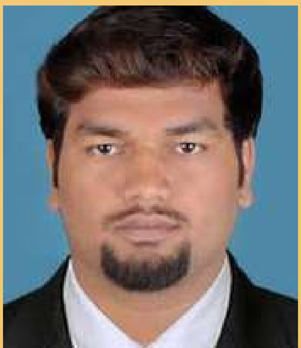


Mr. Sanoj P. Suresh
Assistant Professor

Mr. Oblisamy L .
Assistant Professor

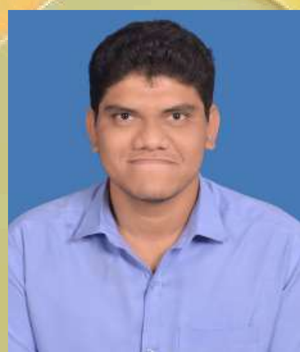


Mr. Sabarishwaran R.
Assistant Professor



Mr. Basithrahman A.
Assistant Professor

Mr. P.Kaleeswaran
Assistant Professor



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

EDITORIAL BOARD

AEROCHRONIC · AY 2023–24

Annual Technical Magazine · Department of Aeronautical Engineering

This edition of AEROCHRONIC was curated, written, and designed by the following editorial team from the Department of Aeronautical Engineering.

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B.Tech Aeronautical Engineering, Second Year

Index

Expert /Guest Technical Lectures

Guest Lecture on “Lighter Than Air (LTA) Systems”

Organized by the Department of Aeronautical Engineering | 23 October 2023

The Department of Aeronautical Engineering organized an expert lecture on “Lighter Than Air (LTA) Systems” on 23 October 2023, delivered by Dr. Rajkumar S. Pant, Professor at IIT Bombay. The session was coordinated by Mr. Reju R and witnessed the active participation of 25 students.

The lecture introduced students to the fundamental principles of LTA systems, which rely on buoyancy generated by low-density lifting gases to counteract gravitational forces. Unlike heavier-than-air vehicles, LTA platforms such as balloons and airships can remain airborne for extended durations with minimal power consumption. Dr. Pant explained the historical evolution of LTA systems and their renewed relevance in modern aerospace applications.

The session emphasized engineering aspects such as envelope design, material selection, buoyancy control, and aerodynamic stability. Special attention was given to the role of LTA systems in long-endurance missions, including atmospheric monitoring, surveillance, communication platforms, and planetary exploration. Real-world research examples, including stratospheric balloons and planetary probes, were discussed to illustrate multidisciplinary challenges involving structures, thermal effects, and trajectory control.

The lecture provided valuable insights into how classical buoyancy concepts are integrated with modern computational tools and materials technology. Overall, the session enhanced students’ understanding of alternative flight systems and inspired interest in research areas related to atmospheric and space exploration using LTA platforms.

Expert /Guest Technical Lectures

Guest Lecture on "IPR Awareness – Patent"

Organized by the Department of Aeronautical Engineering | 18 December 2023

An expert lecture on "IPR Awareness – Patent" was conducted on 18 December 2023 by Dr. S. Yuvaraj, aimed at creating awareness among students and faculty about intellectual property rights in engineering and research. The session, coordinated by Dr. S. Yuvaraj, saw enthusiastic participation from 55 attendees.

The lecture began with an introduction to the fundamentals of Intellectual Property Rights (IPR) and their importance in protecting innovations arising from academic and industrial research. Dr. Yuvaraj explained the concept of patents, types of patentable inventions, and the criteria of novelty, inventive step, and industrial applicability. Emphasis was placed on how engineering designs, processes, and experimental outcomes can be transformed into legally protected intellectual assets.

The patent filing process was explained step by step, including prior art search, drafting of patent specifications, filing procedures, and examination stages. Practical examples from engineering and technology domains were used to help participants relate patent concepts to their academic projects and research work.

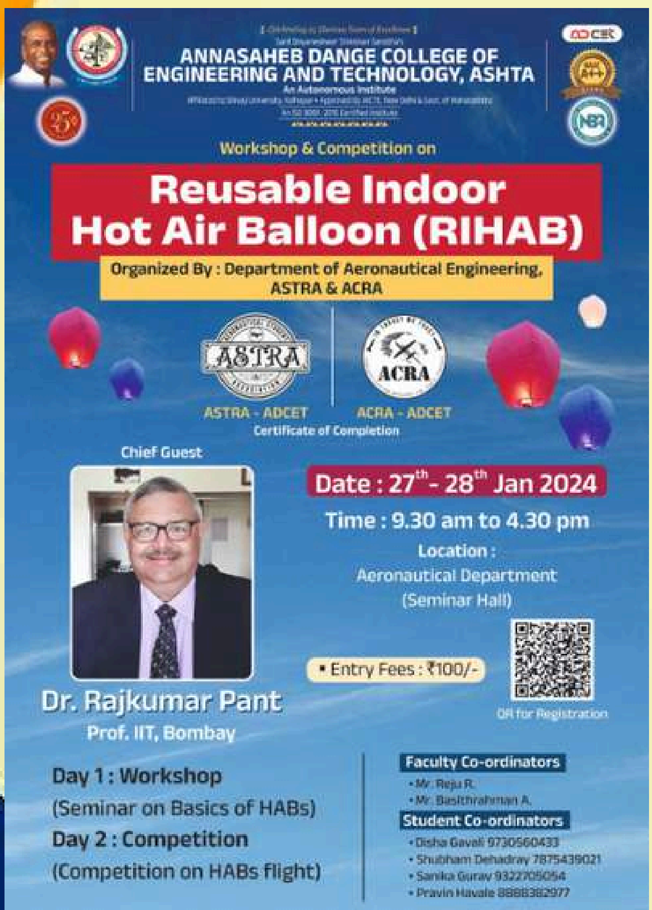
The session highlighted the role of patents in encouraging innovation, promoting technology transfer, and supporting startups and research commercialization. Students gained clarity on how early awareness of IPR can influence project planning and research documentation. Overall, the lecture successfully strengthened participants' understanding of patents as a vital component of modern engineering practice.

Expert /Guest Technical Events

Technical Event: Hot Air Balloon Workshop and Competition

Organized by the Department of Aeronautical Engineering |January 2024

- The Department of Aeronautical Engineering organized a Hot Air Balloon Workshop and Competition on 27–28 January 2024, coordinated by Dr. S. Yuvaraj, with participation from 46 students. The event provided a hands-on learning experience focused on fundamental aeronautical principles.
- The workshop introduced students to the physics of buoyancy, thermodynamics, and atmospheric behavior, which govern lighter-than-air flight. Participants learned about balloon design, material selection, heat source considerations, and safety aspects through interactive sessions and demonstrations.
- During the competition phase, students applied theoretical knowledge to design and fabricate hot air balloons, emphasizing teamwork, creativity, and engineering problem-solving. The activity encouraged experimental learning, enabling students to observe real-time effects of temperature, air density, and lift generation.
- Such experiential technical events play a crucial role in reinforcing classroom concepts and nurturing interest in aerospace engineering. The workshop successfully enhanced students' practical understanding, analytical thinking, and enthusiasm for aeronautical applications.



Expert /Guest Technical Events

FDP on Dassault Systèmes SolidWorks & 3DEXPERIENCE

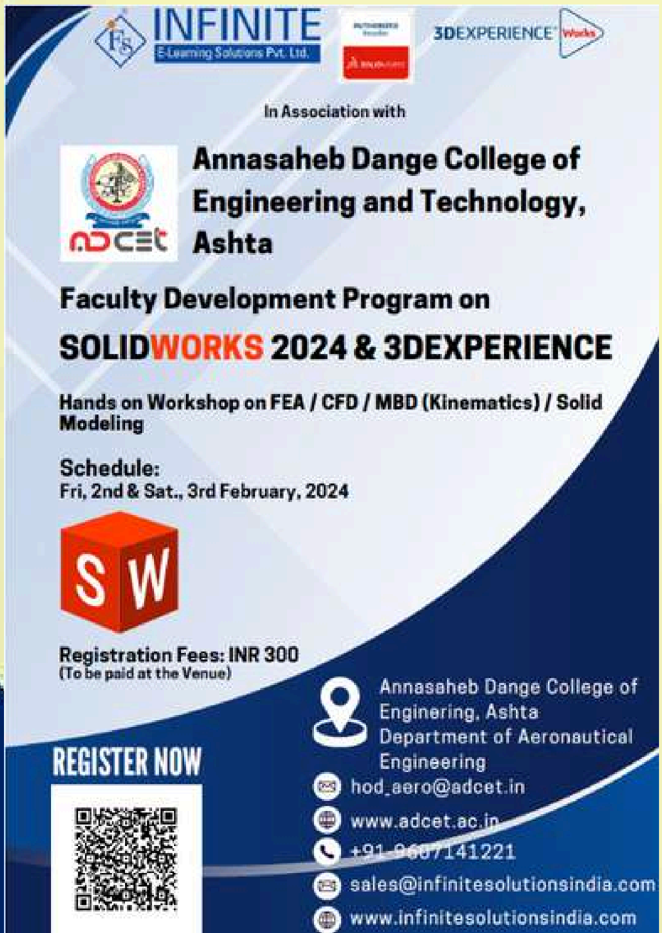
Organized by the Department of Aeronautical Engineering | Feburary 2024

The Department of Aeronautical Engineering successfully organized a Faculty Development Programme (FDP) on Dassault Systèmes SolidWorks and 3DEXPERIENCE during 02–03 February 2024. The program was conducted by Mr. Ashish G. Kulkarni, Senior Manager and 3DEXPERIENCE Edu Process Consultant, and coordinated by Mr. Basithrahman A and Mr. Karthick P.

The FDP focused on enhancing faculty competency in modern CAD, PLM, and digital design environments, which are increasingly essential in aerospace design and manufacturing workflows. Participants were introduced to advanced SolidWorks modeling techniques, assembly design strategies, and simulation capabilities relevant to aeronautical components and systems.

A major highlight of the program was the exposure to the 3DEXPERIENCE platform, which integrates design, simulation, data management, and collaboration within a single digital ecosystem. The resource person demonstrated how cloud-based collaborative tools enable seamless design iteration, version control, and lifecycle management—key aspects of Industry 4.0 and digital engineering.

Hands-on sessions allowed participants to explore parametric modeling, design intent, and virtual prototyping, reinforcing practical understanding. The FDP significantly strengthened faculty readiness to incorporate industry-relevant tools into teaching, student projects, and research activities.



Faculty Research Focus

Research Article: SCI/Scopus Indexed Journals

Research Spotlight: Computational analysis for optimal location of open sunroof for an SUV with ahmed body profile

DOI: https://doi.org/10.1007/978-981-19-6049-9_12

The sunroof has become a much sought-after feature in Sports Utility Vehicles (SUVs). However, opening the sunroof of the SUV modifies the streamlined profile of the SUV and adversely affects the aerodynamics both inside and outside of the vehicle. This leads to increased drag (or air resistance) on the SUV, and can also induce flow disturbances inside the cabin. Here, it is proposed to examine the aerodynamics of an SUV modeled with the simple profile of an Ahmed body, but with an open sunroof. The primary objective of this study is to examine the velocity field of air inside the cabin, and the drag on the SUV, when its sunroof is opened. Using the CFD package-ANSYS Fluent-this work assesses the velocity contours and drag coefficient for three locations of the sunroof – above the driver, middle of the roof, and above the rear passengers. The results from this study can help the automotive industry in improving the aerodynamic designs for SUVs with sunroof.

Citation: Nandagiri, Raghavendra, S. Sendhil Kumar, Purnank Nagrale, Vaibhav Chaure, Sujeet Chormare, Animesh Chandrikapure, and Devabrata Sahoo. "Computational analysis for optimal location of open sunroof for an SUV with ahmed body profile." In AIP Conference Proceedings, vol. 2890, no. 1, p. 020004. AIP Publishing LLC, 2023.

Published by 2023

Research Article: SCI/Scopus Indexed Journals

Research Spotlight: Growth kinetics of crumb-like structure formation on SnO2 nanowires during direct oxidation

DOI: https://doi.org/10.1007/978-981-19-6049-9_12

A facile AAO (anodic aluminum oxide) template-assisted vacuum die-casting technique was used to create Sn nanowires and convert them into SnO_2 without degrading the wires nanostructure. As a function of time and temperature, the controlled oxidation on the Sn nanowires of two different spatial configurations (100 and 250 nm in diameter) revealed distinct oxidation mechanisms. The 250-SnO_2 nanowires exhibits a peculiar crumb-like structure formation over the surface due to the higher level of Sn atom dislocation. Conversely, the sub-100 nm SnO_2 nanowires shows a highly crystalline, homogenous, and defect-free surfaces. The optical properties of the sub-100 nm SnO_2 nanowires were characterized using UV–Vis spectroscopy. The heat-treated tin oxides nanowires samples at temperatures of 300, 500, and 700 °C for 7 h exhibited optical energy bandgaps of 1.8, 2.6, and 3.3 eV, respectively. The observed variation in bandgap is attributed to the unique phase compositions achieved in each of the heat-treated samples. Moreover, the obtained results showed exceptional structural integrity and optical properties that are inherently interconnected with the diverse phases achieved under precise heat treatment conditions.

Citation: Kothandan, Vivekanandan Alangadu, Chang Shao-Fu, Li Zhong-You, and Chen Shih-Hsun. "Growth kinetics of crumb-like structure formation on SnO2 nanowires during direct oxidation." Heliyon 9, no. 10 (2023).

Published by 2023

Research Article: SCI/Scopus Indexed Journals

Research Spotlight: Supersonic jet noise and screech tone suppression using cross-wire

DOI: https://doi.org/10.1007/978-981-19-6049-9_12

The experimental investigation is aimed at assessing how the introduction of a cross-wire at the exit of a CD nozzle influences the performance of a supersonic nozzle. The study focuses on cold air jets generated by De Laval nozzles equipped with cross-wires and baseline configurations, particularly at design Mach numbers of 1.5 and 1.75. The investigation involves collecting measurements from the noise field emitted by the cross-wire nozzle with a 2% obstruction at the exit. This passive control approach effectively reduces the occurrence of screech tones in both over-expanded and under-expanded conditions in the azimuthal plane at appropriate operating pressures. Various acoustic parameters, including sound pressure levels (SPL), Strouhal numbers, and the overall sound pressure level spectra (OASPL) are recorded. Schlieren imaging captures images of shock cell patterns, illustrating the impact of shock-associated noise. In comparison to a baseline nozzle, the results demonstrate that a CD nozzle equipped with a cross-wire proves to be a proficient screech tone suppressor, leading to an average reduction of up to 5 dB in OASPL in under-expanded and over-expanded scenarios.

Citation: Periyasamy, Kaleeswaran, and Kadiresh Parthasarathy Natarajan. "Supersonic jet noise and screech tone suppression using cross-wire." International Journal of Aeroacoustics 23, no. 1-2 (2024): 5-19.

Published by 2023

Review Article: SCI/Scopus Indexed Journals

Research Spotlight: Sustainable wastewater treatment using magnetic nanohybrids

DOI: https://doi.org/10.1007/978-981-19-6049-9_12

Water pollution by various toxic contaminants has become one of the most serious problems across the globe. Various technologies have been used since ages to treat water and waste water that include filtration (membrane and gravel) and chemical (precipitation, coagulation, flocculation, adsorption, ion exchange, and electrochemical) methods. Although it requires an expensive material, commercial adsorbents are widely used in the industries for waste water treatment. Adsorption is generally used because of its adaptability in design and operation, reversibility, and feasibility. The choice of right and environmentally friendly adsorbent material for especially heavy metals has become the need of the hour. The nanomaterial/composites have demonstrated remarkable capacity for elimination of heavy metals from water. Different magnetic nanohybrid adsorbents have different adsorbing efficiencies for heavy metals due to their intrinsic properties such as surface area, functional group, zeta potential, and pore structure. Magnetic nanohybrid materials not only possess the properties of nanomaterials but also have magnetic properties that enable them as excellent adsorbents or catalysts in water pollution remediation. Also, extrinsic factors such as pH, temperature, and contact time influence the adsorption. In the last few decades, nanotechnology has received special attention and different nanomaterials or composites have been developed for water purification. Among which nanohybrid materials, combined with two or more compositions together possess a great advantage with new properties, diverse functionalities, and unlimited possibilities. In this chapter, sustainable waste water treatment with focus on nanohybrids is discussed that include sources of pollutants, methods of magnetic nanohybrid preparation, and factors influencing adsorption followed by applications and challenges.

Citation: Patil, Anirudh Gururaj, Vivekanandan Alangadu Kothandan, A. B. Hemavathi, Shweta Suri, Ranjana Pande, Sneha Kagale, Snehal Yadav, and Gouri Patil. "Sustainable wastewater treatment using magnetic nanohybrids." Nanobiohybrids for Advanced Wastewater Treatment and Energy Recovery (2023): 113.

Published by 2023

Book Release: AIAA AVIATION FORUM AND ASCEND 2024

Research Spotlight: Phase Change Balloons for Venus Exploration: Conceptual Design and Initial Sizing

https://doi.org/10.2514/6.2024-4119

Phase-Change Lighter-Than-Air Systems are one of the promising potential candidates suitable for in situ study of the Venusian atmosphere due to their ability to remain afloat and oscillate in the atmosphere for a long period without much power consumption. The current work discusses the conceptual design study and sizing of the phase change LTA system operational in the altitude band of 40-60 km above the surface in the Venusian atmosphere. The mathematical model of trajectory response of the phase change LTA system with temperature variation in the atmosphere is developed and validated against the available work in the literature. A detailed methodology for the conceptual design of Dual Balloon configuration of phase change LTA system is discussed which is used for the initial sizing of a system with a payload of range of 01 - 20 kg, capable of operating in the altitude band of 40 – 60 km in the Venusian atmosphere. The Payload-System Mass Ratio for carrying the payload of 01 kg, 05 kg, 10 kg and 20 kg with the ability to operate in the altitude band of 40 – 60 km in the Venusian atmosphere is reported.

Citation: Babu, Kiran, and Rajkumar S. Pant. "Phase Change Balloons for Venus Exploration: Conceptual Design and Initial Sizing." In AIAA AVIATION FORUM AND ASCEND 2024, p. 4119. 2024.

Book Series: SCI/Scopus Indexed Journals

Research Spotlight: Numerical and Experimental Investigation of Airfoil Derived from Eagle

https://link.springer.com/chapter/10.1007/978-981-97-4500-5_17

Bionic aerodynamics is an emerging R&D sector that provides excellent cost-effective and efficient remedies to the existing shortcomings. Aerodynamic flow over birds, insects, and bats is the subject of bionics. Airfoils acquired from birds are currently emerging as a sector of Bionic Research and Development. An airfoil is derived from the Golden eagle bird's wing, and it is processed and replotted in MATLAB. Numerical investigation is done with lifting vortex panel method and CFD method. The CFD method was executed with the k-ω SST model. Results from the lifting vortex panel technique and CFD differ by around 12%. The airfoil was experimentally examined in an open-circuit subsonic wind tunnel after being 3D printed in Flash Forge™ at a higher resolution. The eagle-like airfoil (YSMAR01) results were compared with the Stork and Hawk-like airfoils. The airfoil never found a stall. The occurs at 5°AOA and is 44.45% higher than the Hawk-like airfoil and 3.29% lower than Stork-like airfoil. The CL of the eagle-like airfoil increases linearly with angle of attack.

Citation: Yuvaraj, S., Sanket Revankar, S. Sendhil Kumar, R. Reju, and A. P. Senthil Kumar. "Numerical and Experimental Investigation of Airfoil Derived from Eagle." In International Conference on Futuristic Advancements in Materials, Manufacturing and Thermal Sciences, pp. 237-250. Singapore: Springer Nature Singapore, 2024.

Published by 2024

Research Artical: SCI/Scopus Indexed Journals

Research Spotlight: Numerical and experimental investigation of airfoil derived from peregrine FALCON

https://doi.org/10.1016/j.measen.2023.100956

the Peregrine falcon's airfoil is derived and is analysed numerically and experimentally in a non-flapping, non-morphing case. The airfoil is analysed numerically using a Steady State RANS k-ω SST model at different Reynolds numbers with ANSYS Fluent solver and is compared with NACA 23015 and NACA 64–210. The numerical method of approach is validated at a high Reynolds number of 1x106 experimentally. The results dictate that FALCON airfoil has a cl, max that is 54 % and 118 % higher than NACA 23015 and NACA 64–210 respectively. Stalling at 12oangle of attack, the airfoil generates an of 84, and produces positive lift coefficients till -5o angle of attack. The cl of FALCON is higher than the NACA 64–210 and 23015 at all angles of attack. The variation of with AoA is smooth and of a parabolic nature than an abrupt one.

Citation: Yuvaraj, S., A. Adithya, G. Banu, and S. Srithar. "Numerical and experimental investigation of airfoil derived from peregrine FALCON." Measurement: Sensors 31 (2024): 100956.

Published by 2024

Book Series: SCI/Scopus Indexed Journals

Research Spotlight: Thermal Efficiency Investigation of a Solar Parabolic Trough Collector System Using Two Dissimilar Reflectors

Solar radiation consists of energy in the form of electromagnetic radiation with wavelengths ranging from infrared to ultraviolet. Solar thermal collectors gather heat energy from the sun and transfer it to the working medium to generate energy. Solar collectors are devices that capture energy from the sun and are utilized as alternative energy sources (ES) in industrial and domestic applications. A parabolic trough is a type of solar thermal collector with a polished metal mirror that is straight in one dimension and has a parabola curve in the other. In this research, two types of reflective materials, such as stainless steel 303 and aluminum A011, are employed to conduct experiments in the western zone of Tamil Nadu with two different flow rates (1.139 kg/s and 2.174 kg/s). The results are validated to select suitable reflector material with highest efficiency for the application of industrial and domestic usage. A maximum temperature of 65°C was achieved using stainless steel 303 as a 22reflector, whereas 70.1°C was achieved when aluminum A011 was employed as a reflector, which yields 5% of higher output temperature and 28.67% of higher thermal efficiency than stainless steel 303 reflective materials. Finally, it is investigated that the highest thermal efficiency can be obtained by employing aluminum A011 reflective material with a minimum flow rate (1.139 kg/s) of working medium.

Citation: Vijayan, S. N., S. Sendhil Kumar, and S. Karthik. "Thermal Efficiency Investigation of a Solar Parabolic Trough Collector System Using Two Dissimilar Reflectors." In The Internet of Energy, pp. 21-36. Apple Academic Press, 2024.

Published by 2024

Research Article: SCI/Scopus Indexed Journals

Research Spotlight: Progress and Perspective in harnessing MXene–carbon-based composites (0–3D): Synthesis, performance, and applications

https://doi.org/10.1016/j.chemosphere.2024.141838

MXene is recognized as a promising catalyst for versatile applications due to its abundant metal sites, physicochemical properties, and structural formation. This comprehensive review offers an in-depth analysis of the incorporation of carbon into MXene, resulting in the formation of MXene–carbon-based composites (MCCs). Pristine MXene exhibits numerous outstanding characteristics, such as its atomically thin 2D structure, hydrophilic surface nature, metallic electrical conductivity, and substantial specific surface area. The introduction of carbon guides the assembly of MCCs through electrostatic self-assembly, pairing positively charged carbon with negatively charged MXene. These interactions result in increased interlayer spacing, reduced ion/electron transport distances, and enhanced surface hydrophilicity. Subsequent sections delve into the synthesis methods for MCCs, focusing on MXene integrated with various carbon structures, including 0D, 1D, 2D, and 3D carbon. Comprehensive discussions explore the distinctive properties of MCCs and the unique advantages they offer in each application domain, emphasizing the contributions and advancements they bring to specific fields. Furthermore, this comprehensive review addresses the challenges encountered by MCCs across different applications. Through these analyses, the review promotes a deeper understanding of exceptional characteristics and potential applications of MCCs. Insights derived from this review can serve as guidance for future research and development efforts, promoting the widespread utilization of MCCs across a broad spectrum of disciplines and spurring future innovations.

Citation: Muthukutty, Balamurugan, Ponnaiah Sathish Kumar, Alangadu Kothandan Vivekanandan, Mani Sivakumar, Sungwon Lee, and Daeho Lee. "Progress and Perspective in harnessing MXene–carbon-based composites (0–3D): synthesis, performance, and applications." Chemosphere 355 (2024): 141838.

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Research Article: SCI/Scopus Indexed Journals

Research Spotlight: Relocation of the Double-Bump on the Ramp of a Supersonic Air-intake for its Improved Performance

https://doi.org/10.1016/j.chemosphere.2024.141838

The performance of a supersonic air-intake is important for efficient combustion in an air-breathing engine. Recent literature shows study of the design of a supersonic air-intake, with bumps located on its ramp surface. The bumps generate oblique shocks which should result in pressure jump downstream of the shocks. This would result in compressed and decelerated flow at the exit of the intake, for efficient combustion downstream. However, some recent studies found that a double-bump degrades the performance of the air-intake compared to a single bump. This sounds counter-intuitive. In this work, this problem is investigated and an improved location for the double-bump is proposed based on physics of high-speed gas dynamics. Computational analysis is then done to analyze the performance of the supersonic air-intake with an incoming freestream flow of Mach 2.2, using CFD package ANSYS Fluent. The computational methodology is first validated using results of surface pressure distribution on the wall of the intake, for a standard test case available in literature. The methodology is then applied for the supersonic air-intake with the proposed location of the double-bump. The resulting Mach contours and pressure contours are discussed in relation to the compression and Mach number obtained at the exit of the intake. The results show that with the location proposed in this work, the double-bump results in a system of shocks and reflected shocks which are contained well within the air-intake. This results in higher pressure recovery and lower Mach number at the exit of the intake, compared to a single-bump intake. As the air with higher static pressure and lower speed enters the combustion chamber downstream, both these favourable features should help in more efficient combustion.

Citation: Mahadev, Dhanlobhe Mayuri, Suryawanshi Pratik Ashish, Nale Pritee Dattatray, Shejwal Vishal Sanjay, Devabrata Sahoo, and Raghavendra Nandagiri. "Relocation of the Double-Bump on the Ramp of a Supersonic Air-intake for its Improved Performance." Semarak Engineering Journal 5, no. 1 (2024): 1-11.

Published by 2024

Advances in Aircraft and Space Systems: A Global Technical Review

NASA X-59 QueSST: Advancing Quiet Supersonic Aircraft Design:

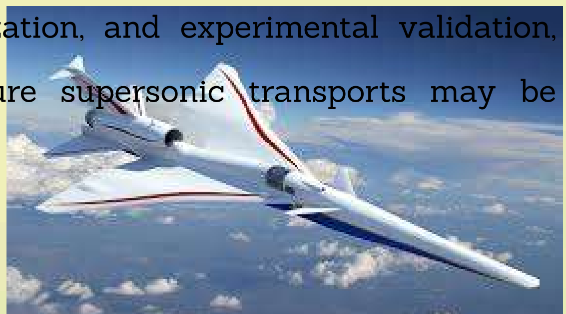
NASA advanced the development of the X-59 Quiet Supersonic Technology (QueSST) aircraft during the 2023–24 academic year, marking a major milestone in low-boom supersonic aerodynamics. The X-59 is a purpose-built experimental aircraft designed to demonstrate that supersonic flight over land can be achieved with dramatically reduced sonic boom intensity through advanced aerodynamic shaping.

From an engineering standpoint, the X-59 embodies a design-driven noise mitigation strategy rather than relying on operational restrictions. Its elongated fuselage, highly cambered wing, and carefully positioned engine inlet are optimized to redistribute shock waves generated at supersonic speeds. Instead of forming a single strong N-wave, the pressure disturbances are spread into multiple weaker shocks, significantly reducing perceived ground-level noise.

During 2023–24, NASA conducted extensive ground integration tests, including structural verification, avionics validation, and flight control system checks. The aircraft's unconventional configuration necessitated advanced fly-by-wire control laws, developed using high-fidelity CFD and wind-tunnel data. These control systems compensate for reduced forward visibility and unique aerodynamic coupling effects at high Mach numbers.

The program also validated manufacturing precision and structural alignment tolerances, which are critical for maintaining the intended shock-shaping geometry. Even minor surface deviations can significantly alter shock formation at supersonic speeds.

The X-59 QueSST program provides students with a real-world example of CFD-driven aircraft design, aero-acoustic optimization, and experimental validation, representing a paradigm shift in how future supersonic transports may be engineered.



Lockheed Martin's X-59 supersonic jet

Boom Supersonic XB-1: Validating Next-Generation Supersonic Aircraft Technologies

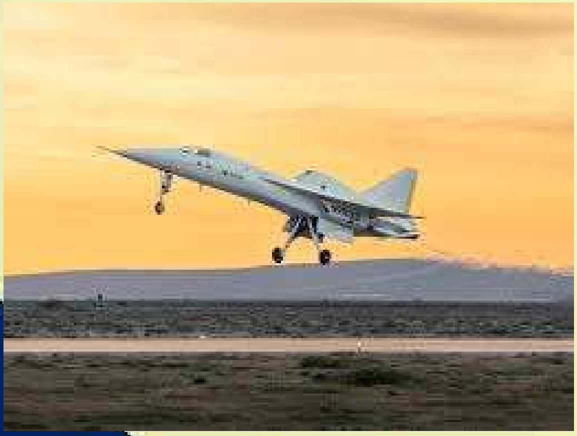
Boom Supersonic achieved a significant engineering milestone in January 2024 when its XB-1 demonstrator successfully completed supersonic flight. The XB-1 serves as a technology testbed for validating aerodynamic, structural, and control concepts intended for future commercial supersonic aircraft.

The aircraft's design is the result of extensive CFD-based aerodynamic optimization, targeting efficient supersonic cruise while maintaining stable subsonic and transonic performance. Its slender fuselage, delta-influenced wing planform, and optimized inlet geometry were refined through iterative simulation and wind-tunnel testing. The successful transition through transonic drag rise validated predictive aerodynamic models used during the design phase.

From a manufacturing perspective, the XB-1 incorporates advanced composite materials to achieve high strength-to-weight ratios while tolerating thermal loads associated with high-speed flight. Ground and taxi tests conducted prior to flight allowed engineers to evaluate structural stiffness, landing gear dynamics, braking performance, and low-speed control behavior.

The aircraft also demonstrated digital flight control systems, designed to manage nonlinear aerodynamic characteristics encountered at supersonic speeds. These systems were incrementally validated through structured flight test expansion, reflecting best practices in experimental aircraft certification.

For students, the XB-1 program illustrates how modern supersonic aircraft development integrates CFD, materials engineering, manufacturing precision, and flight testing methodology into a cohesive engineering workflow.



Boom - XB-1

SpaceX Starship Integrated Flight Tests: Advancing Reusable Space Vehicle Engineering

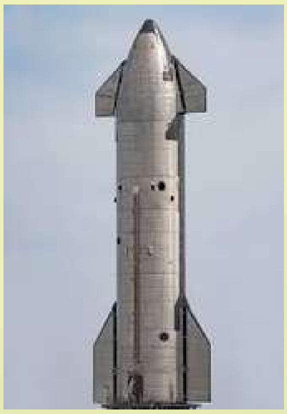
SpaceX conducted multiple Starship integrated flight tests during the 2023–24 academic year, providing unprecedented engineering data on fully reusable heavy-lift space systems. These tests focused on validating design concepts rather than mission success, aligning closely with experimental aerospace engineering principles.

A key innovation in Starship design is the use of stainless-steel primary structures, chosen for their high-temperature tolerance, manufacturability, and cost efficiency. Flight tests evaluated structural behavior under extreme aerodynamic loads, cryogenic propellant conditions, and dynamic engine thrust environments. The clustered Raptor engines, operating on full-flow staged combustion, provided critical propulsion performance data, including thrust vector control and engine-to-engine interaction.

The tests also demonstrated hot-stage separation, an advanced staging technique requiring precise timing, structural reinforcement, and plume interaction management. Thermal protection systems, composed of reusable ceramic tiles, were evaluated for durability during ascent and atmospheric re-entry.

From a systems engineering perspective, Starship integrates avionics, propulsion, structures, and thermal systems into a tightly coupled architecture, offering valuable lessons in design for reusability and rapid iteration. The extensive instrumentation onboard generated datasets essential for validating computational models and refining future designs.

For aerospace students, the Starship program represents a real-world case study in large-scale vehicle integration, experimental testing, and advanced manufacturing, redefining modern launch vehicle engineering.



SpaceX Starship Super Heavy Booster

GE Aerospace and CFM RISE: Open-Fan Propulsion Engineering Advancements

GE Aerospace, through the CFM RISE (Revolutionary Innovation for Sustainable Engines) program, advanced open-fan propulsion technologies during the 2023–24 academic year. This effort focuses on redefining aircraft propulsion through radical aerodynamic and mechanical design changes rather than incremental improvements.

The open-fan architecture departs from conventional turbofan designs by eliminating the nacelle, enabling significantly higher bypass ratios. From an engineering standpoint, this introduces complex challenges related to fan blade aerodynamics, structural integrity, aeroelasticity, and acoustic behavior. Extensive CFD and wind tunnel studies were conducted to optimize blade geometry for efficiency while managing unsteady aerodynamic loads.

Advanced composite materials were employed for fan blades to achieve the necessary strength-to-weight ratios while withstanding centrifugal forces and vibratory stresses. Additive manufacturing techniques were used for complex engine components, reducing part count and enabling geometries not feasible through traditional methods.

Noise mitigation is a critical design driver, requiring precise blade spacing, rotational speed control, and aerodynamic shaping. Structural integration studies also addressed engine-airframe interactions, including mounting configurations and vibration isolation.

For students, the RISE program exemplifies how propulsion design integrates aerodynamics, materials science, manufacturing, and structural dynamics, offering insights into the future of aircraft engine engineering.

NASA X-66 Sustainable Flight Demonstrator: Truss-Braced Wing Engineering

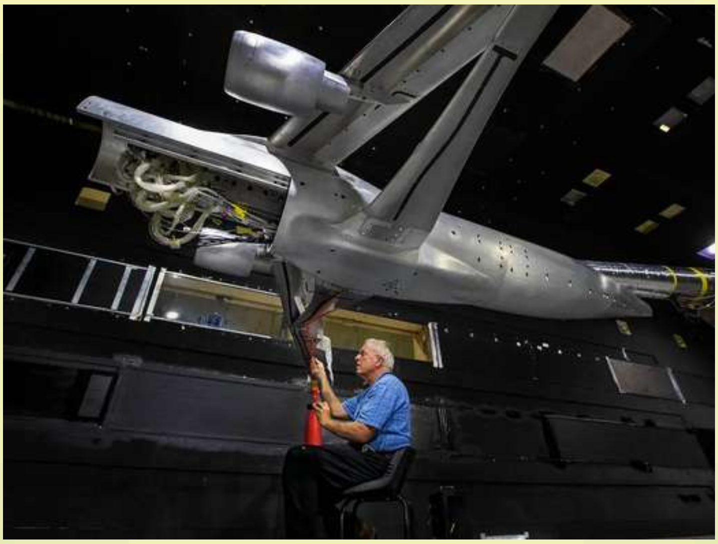
NASA progressed the X-66 Sustainable Flight Demonstrator during 2023–24, focusing on validating truss-braced wing (TBW) aircraft configurations. The X-66 represents a departure from conventional cantilever wing designs, targeting reduced drag and improved aerodynamic efficiency.

The TBW concept enables wings with higher aspect ratios by using external truss structures to manage bending loads. From a structural engineering perspective, this allows significant weight reduction while maintaining stiffness. Extensive computational analysis and wind tunnel testing were conducted to assess aeroelastic behavior, load paths, and flutter margins.

Aerodynamically, the long, slender wings reduce induced drag but require careful integration with propulsion systems and fuselage structures. The X-66 program validated CFD predictions related to flow interaction between wings, struts, and fuselage components.

Manufacturing considerations included precision fabrication of truss elements and joints, where tolerance control is essential to ensure load sharing and structural reliability. Ground testing verified static strength, fatigue life, and vibration characteristics.

The X-66 provides students with a compelling example of structural–aerodynamic coupling, unconventional aircraft configurations, and sustainable aircraft design, reinforcing advanced concepts in aircraft structures and performance optimization.



Instrumentation technician Michael Hodgins performs installation measures on the trans-sonic truss-braced wing model at Langley Research Center's 14x22 subsonic wind tunnel.

Relativity Space: Large-Scale Additive Manufacturing for Launch Vehicle Structures

Relativity Space advanced the state of aerospace manufacturing during 2023–24 by validating large-scale additive manufacturing (AM) techniques for primary launch vehicle structures. The company's work demonstrated how metal additive manufacturing can fundamentally alter the design–build–test cycle for space systems.

From a design perspective, additive manufacturing enabled topology-optimized structures with reduced part count and integrated functionality. Components such as propellant tanks, engine structures, and load-bearing airframe sections were redesigned to exploit geometric freedom, eliminating fasteners and weld joints that traditionally act as stress concentrators.

Manufacturing innovations centered on robotic metal deposition systems capable of producing meter-scale components with controlled microstructure and dimensional accuracy. Extensive material characterization was conducted to validate tensile strength, fatigue behavior, and fracture toughness under cryogenic and dynamic loading conditions typical of launch environments.

Structural testing and hot-fire demonstrations provided validation of AM-built components under realistic operating conditions. Instrumentation data confirmed the reliability of additively manufactured structures when subjected to vibration, pressure cycling, and thermal gradients.

For students, this work highlights how advanced manufacturing directly influences design philosophy, enabling rapid iteration, reduced supply-chain complexity, and tighter integration between analysis and fabrication. The Relativity Space approach represents a paradigm shift toward digitally driven aerospace manufacturing.

Hypersonic Vehicle Technologies: Materials and Aerothermal Design Advancements

DARPA and partner research institutions advanced hypersonic vehicle technologies during 2023–24, focusing on materials, aerothermal behavior, and structural survivability at extreme Mach numbers.

Hypersonic flight introduces severe aerothermal loads, where surface temperatures can exceed material limits within seconds. Engineering efforts emphasized the development of advanced thermal protection systems (TPS), including ceramic matrix composites, ultra-high-temperature ceramics, and actively cooled structures. These materials were evaluated through arc-jet testing and high-enthalpy wind tunnel experiments.

Design studies addressed shock–boundary layer interaction, a dominant factor in hypersonic heating and pressure loading. CFD models coupled with experimental validation were used to predict localized heat flux spikes and structural stresses. These insights informed vehicle shaping strategies to manage thermal loads while maintaining aerodynamic efficiency.

Structural design challenges included thermal expansion mismatches, material degradation, and dynamic instability at high speeds. Advanced sensor integration enabled real-time measurement of temperature, strain, and pressure during test flights, providing critical validation data for predictive models.

For aeronautical engineering students, hypersonic research offers a rigorous example of multidisciplinary design under extreme conditions, integrating aerodynamics, materials science, heat transfer, and structural mechanics into a unified engineering problem.

Space Robotics and On-Orbit Manufacturing: Engineering Autonomous Systems

NASA advanced space robotics and on-orbit manufacturing technologies during 2023–24, supporting future missions that require in-space assembly, repair, and construction.

Engineering efforts focused on robotic manipulators capable of precise motion in microgravity, where traditional assumptions about weight and friction no longer apply. Kinematic modeling, force control, and vibration suppression were critical to ensuring stable operations when interacting with large structures.

Autonomous guidance, navigation, and control algorithms were validated for rendezvous, capture, and manipulation tasks. These systems rely on advanced sensing, including vision-based navigation and force-torque feedback, to operate with minimal human intervention.

Manufacturing experiments explored additive and modular construction techniques in orbit, addressing challenges such as material handling, thermal control, and structural alignment. These demonstrations validated the feasibility of assembling large space structures beyond launch vehicle size constraints.

For aerospace students, space robotics illustrates systems engineering at the intersection of mechanics, controls, and autonomy, highlighting the importance of reliability and precision in remote environments.

Advanced Materials and Structures for Reusable Space Systems

NASA and international research organizations advanced materials and structural technologies for reusable space systems during 2023–24, focusing on durability, thermal resistance, and lifecycle performance.

Reusable vehicles demand materials that withstand repeated thermal cycling, mechanical loads, and environmental exposure. Engineering studies evaluated high-temperature alloys, ceramic composites, and novel insulation systems for structural and thermal protection applications.

Structural design emphasized damage tolerance and inspectability, integrating health-monitoring sensors to detect fatigue, cracking, and material degradation. Ground testing replicated ascent and re-entry conditions to validate design margins and refurbishment requirements.

Manufacturing techniques were refined to ensure repeatability and repairability, enabling rapid turnaround between missions. These efforts support long-term sustainability in space operations through reduced material consumption and improved system longevity.

For students, reusable space systems provide a comprehensive case study in advanced materials engineering, structural design, and lifecycle optimization, reinforcing the importance of durability-driven design in aerospace engineering.

Until the next issue—keep reaching for new altitudes.

DEPARTMENT OF AERONAUTICAL ENGINEERING

Sant Dnyaneshwar Shikshan Sanstha's

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