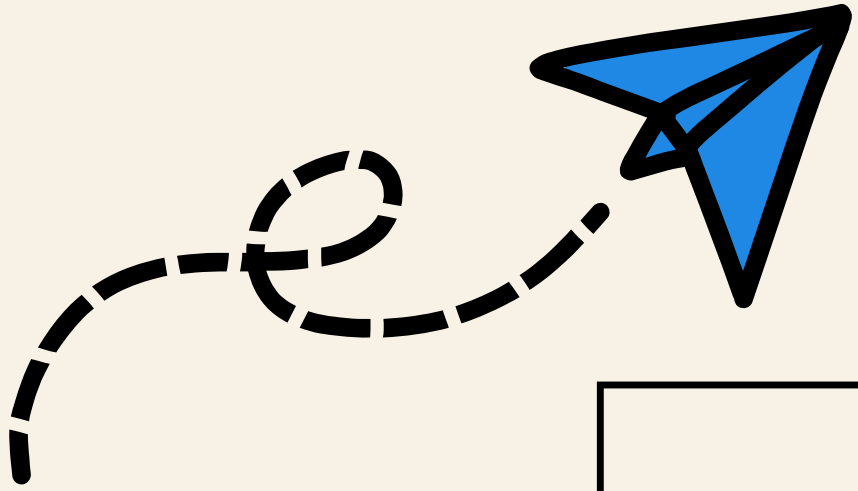
INDIAN INSTITUTE OF TECHNOLOGY, KANPUR

DEPARTMENT OF AEROSPACE ENGINEERING

Placement Brochure 2021-2022

Contents



Established in 1964, the department of Aerospace Engineering at IITK is one of the prominent centers for advanced fight research and development across the lengths and breadths of the country. Not only did the department contribute to the aerospace industry but has also endorsed projects to strengthen the air superiority of the nation. Moreover, the department is engaged in Engineering Science instruction, in-fight laboratory work, aerodynamic testing, indigenous design and fabrication of advanced facilities and instruments. The department specializes in Aerodynamics, Flight Mechanics, Propulsion and Aerospace Structures. The department still continues to grow and innovate by introducing two more specialization this year viz. Computational Mechanics and Aero-Thermodynamics and Thermal Sciences. The department houses one of a kind Flight Lab with three single engine airplanes, a motored glider and a 1000 m runway. The National Wind Tunnel Facility is one the few facilities available for public and private enterprises to test and correlate their results. Various other academic institutions and research organizations in India also make use of the department facilities.

ABOUT US

Aerospace Engineering
IIT KANPUR

Message from HoD Desk

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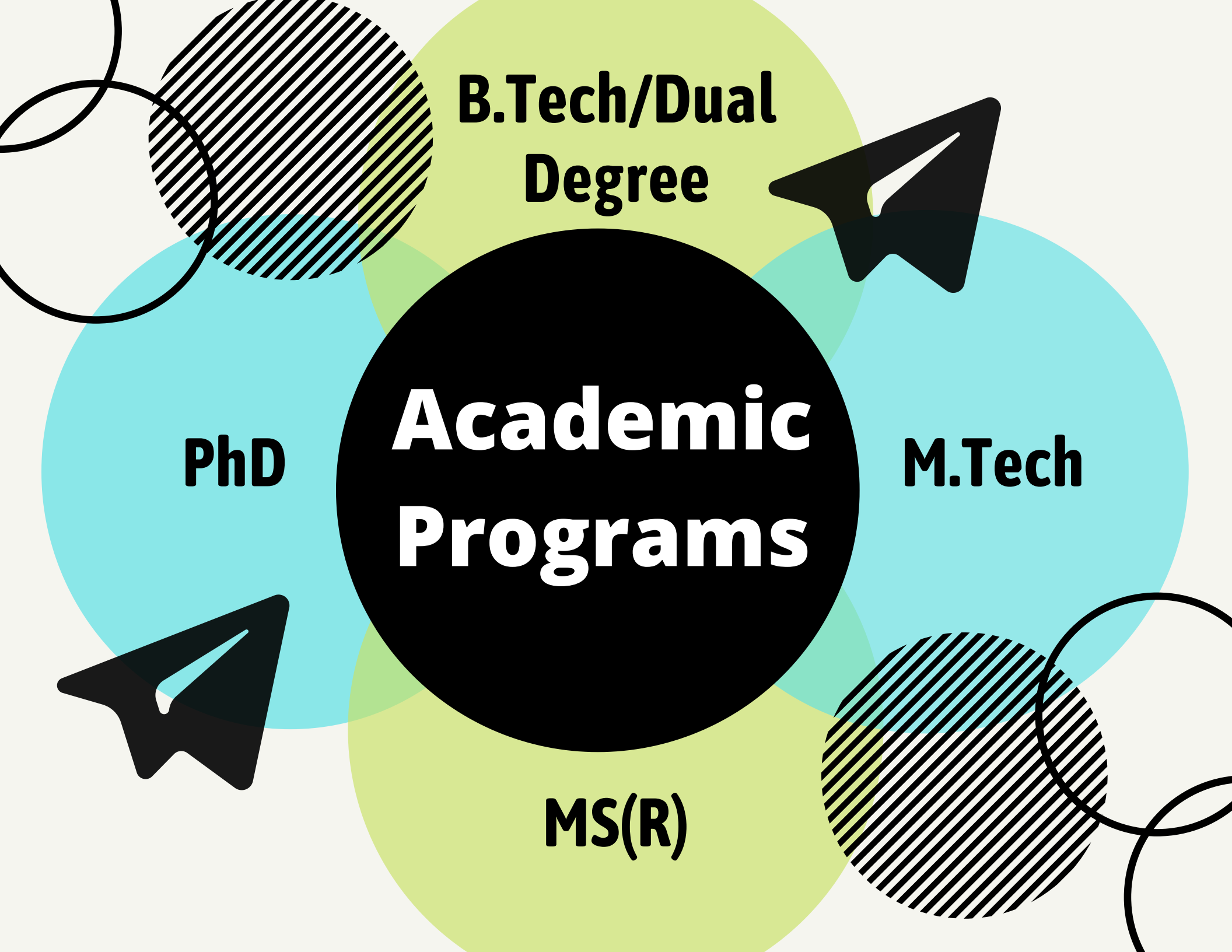
The Aerospace Engineering Department is more than 40 years old. Till 1991, it was known as Aeronautical Engineering Department.

The name change was accompanied by the addition of topics relating to spacecraft in the UG curriculum; some members of the faculty had been conducting research and guiding PG students in this area even before the formal alteration of the name in 1991. In matters of teaching, research & development, the department has always tried to strike a balance between hardware development and experiments on one hand, and theory and computational aspects on the other.

The faculty strength currently is 31. We share four faculty members with the Sustainable Energy Engineering Department, although their parent Department is Aerospace Engineering. The department has more than 250 UG Students (including those pursuing Dual Degree), 101 M.Tech students and 132 PhD students.


B.Tech/Dual Degree
PhD
Academic Programs
M.Tech
MS(R)

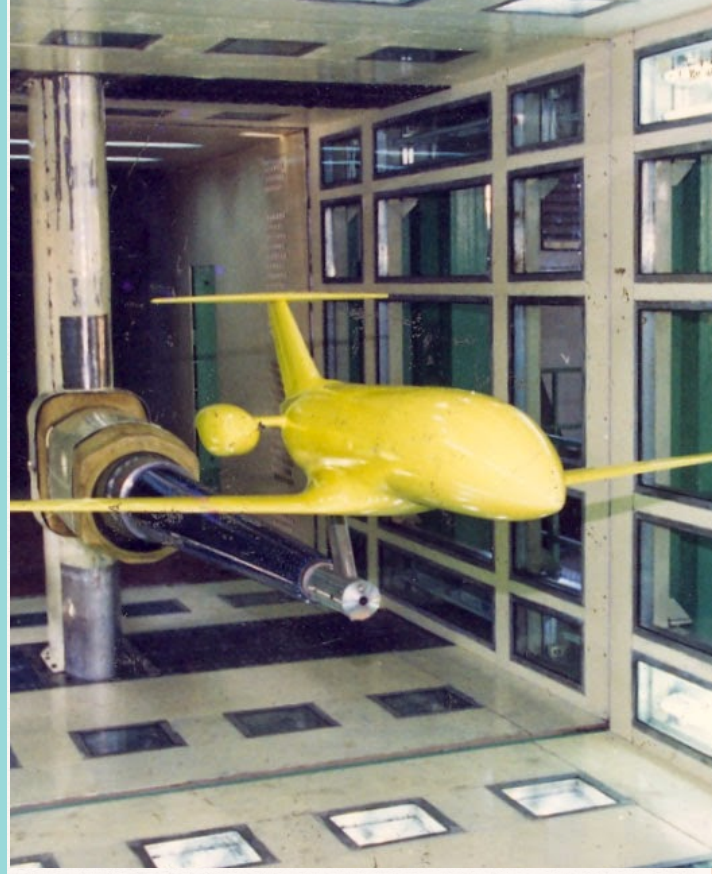
Major Courses

- Aerodynamics
- Aeromodel Design & Fabrication
- Aerospace Propulsion
- Aircraft Design
- Aeroelasticity
- Aircraft Structural Integrity
- Analysis & Composite Structures
- Advance Computational Fluid Mechanics
- Air-breathing Missile Propulsion
- Aerospace Structural Analysis
- Acoustics in Fluids
- Autonomous Navigation
- Boundary Layer Theory
- Boundary-Layer Instability & Transition
- Combustion
- Compressible Aerodynamics
- Computational Fluid Dynamics
- Continuum Hypersonic Aerodynamics
- Composite Materials
- Dynamics & Vibration
- Finite Element Method
- Flight Mechanics & Controls
- Helicopter Theory
- High-Temperature Gas Dynamics
- Hypersonic Flows
- Introduction to Virtual Instrumentation
- Introduction to Aerospace Structures
- Molecular Gas Dynamics
- Numerical Modeling of Chemically Reacting Flows
- Optimal Space Flight Control
- Rocket Propulsion
- Space Guidance Navigation & Control
- Space Dynamics
- Solid Mechanics
- Turbo Machinery
- Turbulence
- Viscous Flows

Departmental Labs

- Low-Speed Aerodynamics Lab
- High-Speed Aerodynamics Lab
- Flight Laboratory

- High-Performance Computing Lab
- Aeromodelling Laboratory
- Computational Fluid Dynamics Laboratory
- Aero Propulsion Laboratory
- Structures & Material Characterization Laboratory
- Helicopter and VTOL Lab
- Advanced Combustion & Acoustics Lab



- Computational Propulsion Lab
- Structural Analysis Laboratory
- National Wind Tunnel Facility
- Multiscale Mechanics and Simulation Laboratory

LOW-SPEED AERODYNAMICS LAB

Lab Incharge: Dr. Kamal Poddar

A fully functional facility to conduct wind tunnel experiments for the aerodynamic, propulsive and aero-elastic characterization of fixed, fapping and rotary wing and micro aerial vehicles. The lab has the following wind tunnels to carry out experimental research in aerodynamics: Low turbulence tunnel, Boundary layer tunnel, Twin air or 5D tunnel, Water tunnel.

Research Areas

- Unsteady Aerodynamics
- High AoA Aerodynamics
- Flow Control on airfoils, wings & other bodies
- Bluf Body Flows
- Wind Engineering
- Decelerator Aerodynamics
- Transition & turbulence
- Vortex Dynamics
- Granular Flows
- Dynamic Stall
- Separation Control
- Fluidic Oscillator

HIGH-SPEED AERODYNAMICS LAB

Lab Incharge: Dr. Mohammed Ibrahim Sugarno

This lab of our department is well known for the research in the area of gas dynamics. The lab also houses an intermittent, blowdown type supersonic wind tunnel. The tunnel is equipped with a dedicated computer system for tunnel control and data acquisition. This facility has already made substantial contribution in establishing new testing techniques and basic research in the area of transonic/supersonic fows.

Research Areas

- Gas Dynamics: experimental & theoretical investigation
- Rarefied Flows
- Applied Gas Dynamics & High-Speed Jets
- Sudden Expansion Problems
- Supersonic, Transonic & Subsonic Aerodynamics

High Performance Computing Lab

Lab Incharge: Dr R K Mathpal

The primary focus is on developing and implementing high fidelity computing methods for various flows, including subsonic, supersonic, and hypersonic. The emphasis of the research is on developing high accuracy computing methods to aid in bridging the gap between theoretical and computational fluid dynamics and heat transfer. The instability, transition to turbulence, and control of fluid flows are analyzed in theoretical and computational framework with the help of in-house developed tools.

Research Areas

- High accuracy, scientific computing from the first principle.
- Theoretical analysis of precursor of instability and transition of fluid flows.
- Receptivity analysis and transition control by DNS and Implicit LES.
- Multiple Hopf bifurcations and proper orthogonal decomposition.
- Development of coherent structure detection methods.
- Global spectral analysis of numerical schemes.

AEROMODELLING LAB

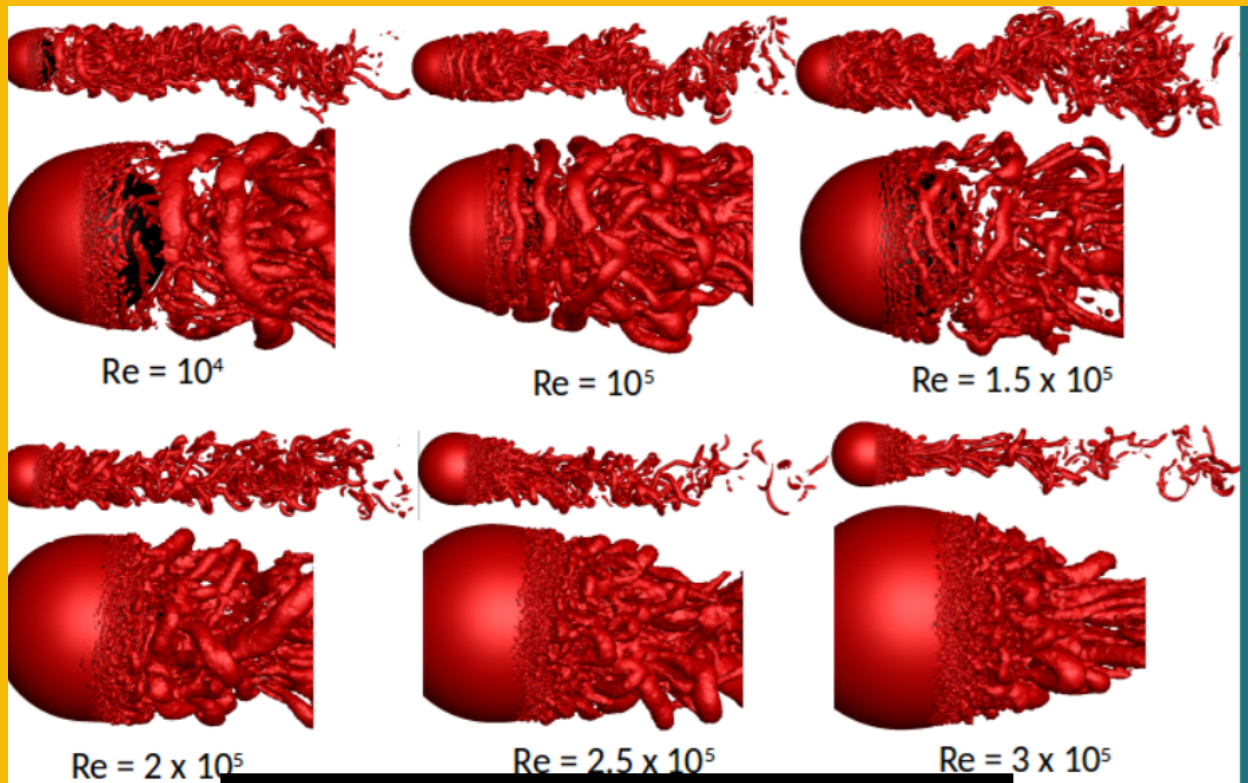
Lab Incharge: Dr. Subrahmanyam Saderla

In the Aeromodelling Lab, students design, fabricate and fly models. It not only gives a primary introduction to the world of aerodynamics, designing, controls, electronics, engine technology, wood crafting and the technology of new materials but also provides a hands-on experience necessary for developing a practical aptitude.

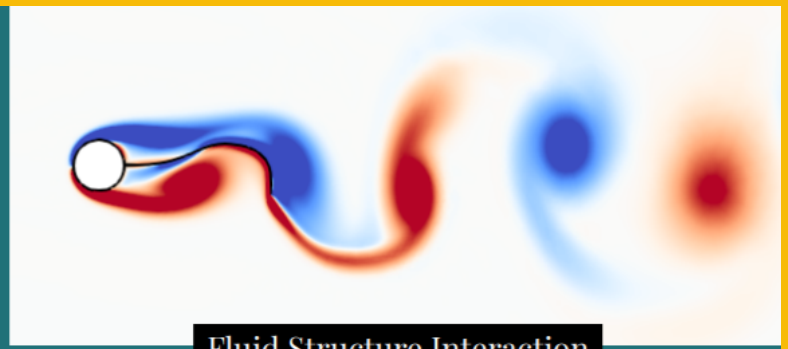
CFD LABORATORY

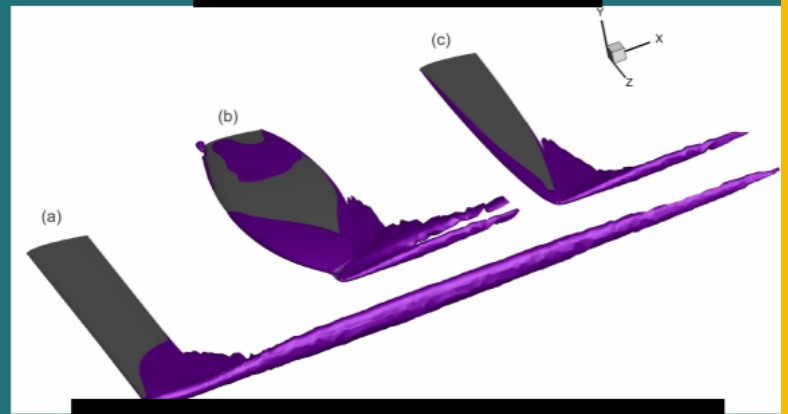
Lab Incharge: Dr. Sanjay Mittal

Computational Fluid Dynamics lab facilitates the study basics of fluid flow, design of numerical methods as well as their application to situations of practical interest. Scientific investigations mostly involve fundamentals of flow phenomena, e.g. stability and turbulence.



Transition of the boundary layer on a smooth sphere


Fluid Structure Interaction



Flow past finite wings of different planform

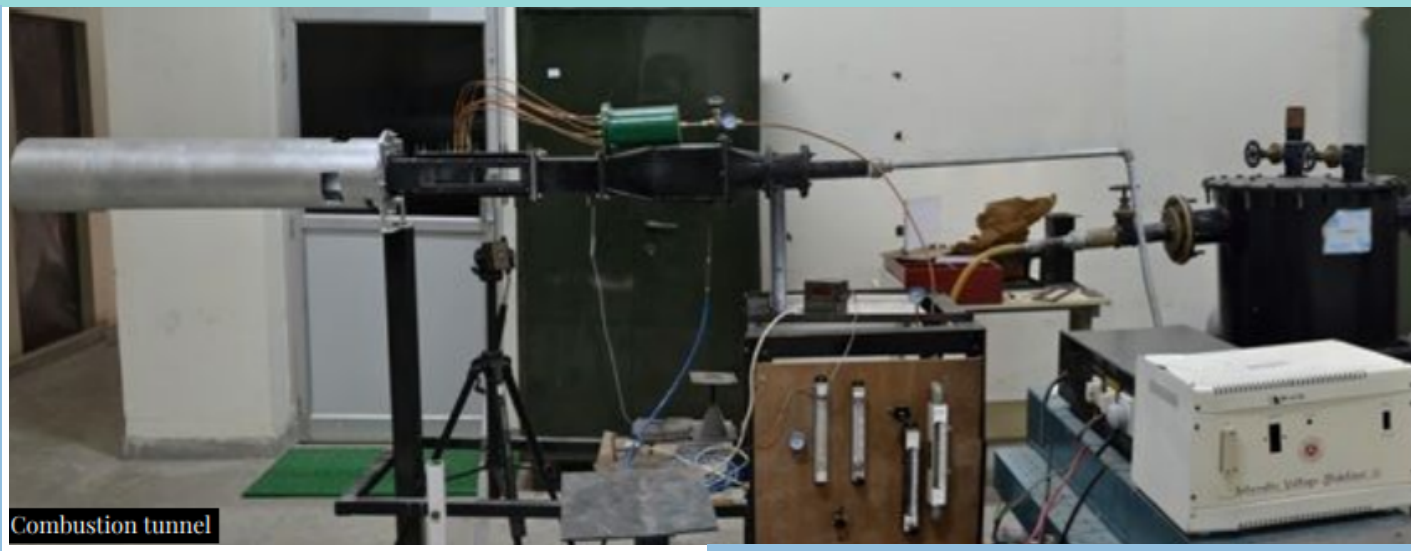
Aero Propulsion Lab

Lab Incharge: Dr. Abhijit Kushari

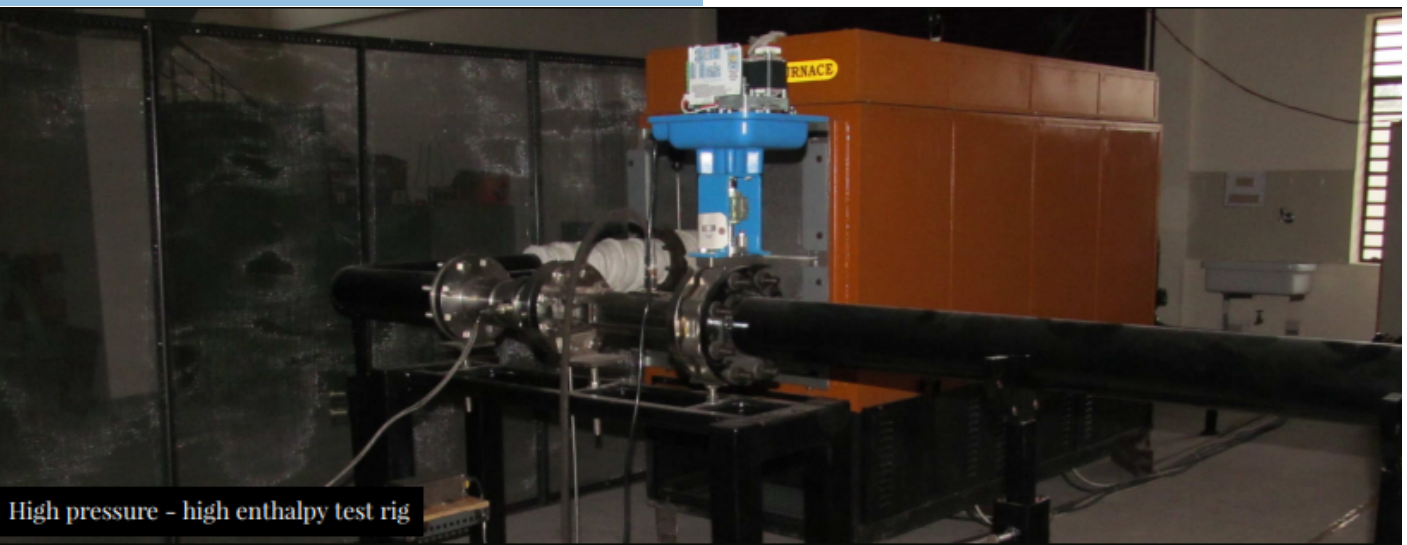
The lab is equipped with a continuous combustion unit where heat balance studies, exhaust gas composition, the effect of fuel and fame stability test can be performed. Following are the facilities available in the lab: low-speed cascade wind tunnel, 2-shaft gas turbine, continuous combustion unit, gaseous fuel combustion test rig, dump combustor with optical windows.

Research Areas

- Flow Diagnostics
- Internal Flow Control (Active & Passive)
- Liquid Atomization & Spray Combustion



Combustion tunnel



High pressure – high enthalpy test rig

- Thrust Vectoring
- Electric Propulsion
- Aeroelasticity
- Linear Cascade Compressors

STRUCTURES & MATERIAL CHARACTERIZATION

Lab Incharge: Dr. Rajesh Kittey

Over the last few years, we have been developing and testing smart structural system engineering structures with integrated sensor, information processing, feedback control and actuating devices. The smart structures experiments have been related to building innovative smart sensors, vibration control and structural health monitoring concepts. Research efforts are directed towards focused on fabricating smart materials such as piezoelectric materials and hydro gels and damage diagnostic methods.

Research Areas

- Stochastic Analysis
- Smart Structure Modeling & Analysis
- Generalized Damage Mechanics
- Composite Structure Analysis & Design

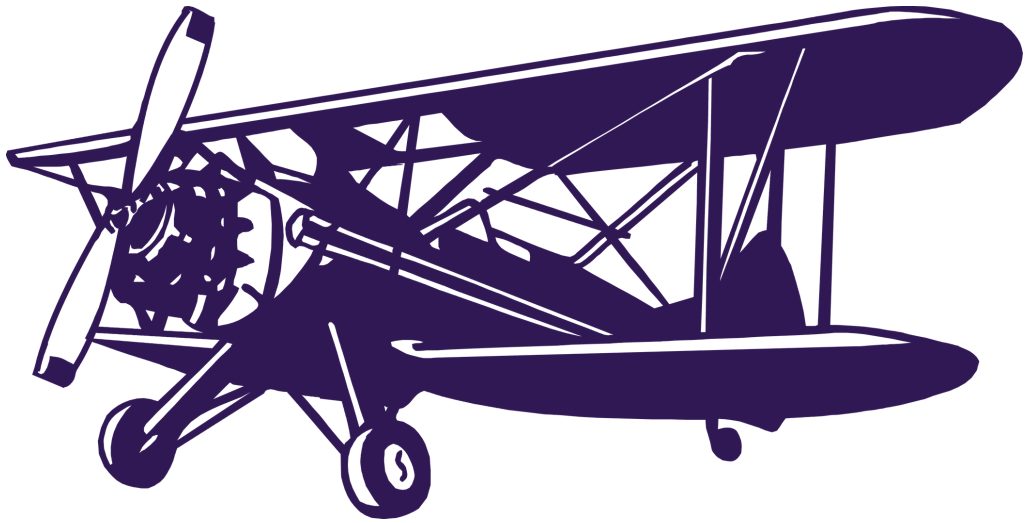
FLIGHT LAB

Lab Incharge: Dr. G. M. Kamath

The fight lab is a unique national facility with three single-engine aeroplanes: Cessna 206H, Hansa-3 and Piper Saratoga. The Flight Lab also has a Pipistrel Sinus 912 motored glider. The operations and maintenance of the Flight Lab are carried out in compliance with DGCA regulations. The Flight Lab conducts courses for students wherein they are taught various aspects of conducting experiments in flight and obtaining and analysing different aircraft fight parameters. The lab also provides an opportunity for faculty focusing on broad areas of aircraft structures, flight mechanics, aerodynamics and avionics to conduct experiments as part of their research.

Research Areas

- Parameter Estimation
- System Identification
- Guidance & Control of Aircraft & Unmanned Aerial Systems
- Aircraft Structural Health & Usage Monitoring



HELICOPTER & VTOL LAB

Lab Incharge: Dr. Abhishek

This focuses on the fundamentals of design, manufacturing and testing of systems. Sub-systems for mini-helicopter are also developed. Autonomous Mini-Helicopter which while weighing only a few kilograms incorporates most of the functions of a real-life helicopter and achieves autonomous fight.

RESEARCH AREAS

- Design & Development of avionics package:
  - a. Ground Control
  - b. Sensing & Actuation
  - c. Communication Navigation
  - d. Automatic Flight Control
- Flight testing of autonomous helicopters & expanding its utility by making the vehicle perform intelligent tasks.
- Structural design & development of a mini helicopter

ADVANCED COMBUSTION & ACOUSTICS LABORATORY

Perform investigations in in-house developed test rigs, which are instrumented with state of art measuring instruments. Experiments are performed in a wide variety of confgurations, starting from a simple Bunsen type burner to a realistic gas turbine type annular combustor. Perform numerical investigations and validate experimental fndings.

Lab Incharge: Dr. Sathesh Mariappan & Dr. Vaibhav Arghode

Research Areas

- Design clean and quiet combustors for fuel-lean conditions
- Reduce unwanted large-amplitude flow oscillations in Combustion Chamber
- Mitigating Combustion Instability
- Thermoacoustics Interactions
- Colorless Difusion combustion
- Alternative Fuel & Combustor Performance

COMPUTATIONAL PROPULSION LAB

Lab Incharge: Dr. Ashoke De

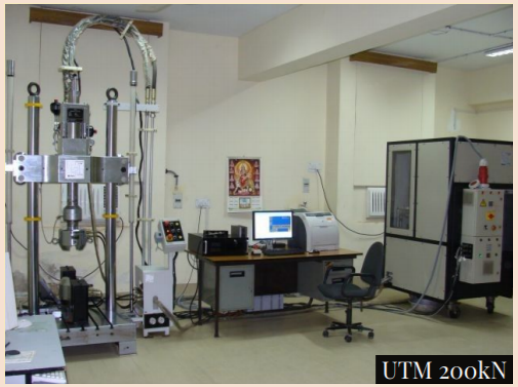
The lab is primarily focused on computation-based research in the area of Fluid Dynamics and Combustion. We are involved in both development, and application of algorithms for fluid flow, heat and mass transfer. At CPL, we work on cutting-edge research using CFD and their application to multidisciplinary engineering problems starting from the Mesoscopic level to programs in Space, Energy, Aero-elasticity. Applications include all regimes of steady-unsteady flows in combustion as well as in gas turbines, acoustics, turbulence modelling, supersonic flows, fluid-structure interaction, conjugate heat transfer and multidisciplinary fluid flow problems. We are involved in the simulation of the problems in areas of RANS, LES, hybrid RANS-LES, DNS, Lattice-Boltzmann, depending on its type and conditions.

Research Areas

- High-Speed Flows
- Flow-Acoustics Coupling
- Fluid-Structure Interaction
- Turbulence Modelling: DNS, LES, Hybrid RANS/LES
- Combustion & Multiphase modelling
- Flow Control

STRUCTURAL ANALYSIS LAB

Helicopter blade & mould


UTM 200kN

Lab Incharge: Dr P M Mohite

The research domain comprises both fundamental and advanced problems that arise in the areas of research. Several high-end state-of-the-art computational codes have been developed in-house for multi-scale mechanics for damage; damage mechanics-based modelling of composite structures; modelling and analysis of piezo-material based structures; adaptive modelling of laminated plates; structural optimization and stochastic analysis of laminated structures.


Hydraulic chamber

Research Areas

- Solid Mechanics
- Damage & Fracture Mechanics
- Adaptive FEM
- Structural Dynamics
- Stochastic Processes & Structural Optimization

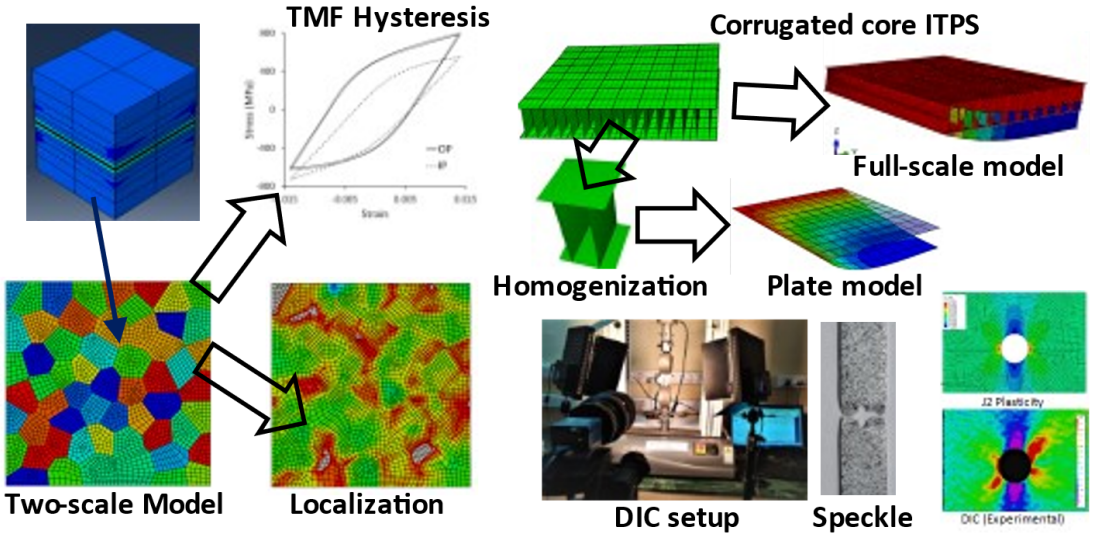
Multiscale Mechanics and Simulation Laboratory

Lab Incharge: Dr. Pritam Chakraborty

The aerospace industry strives for lean and durable design, requiring reduced maintenance and inspection. Our laboratory's focus is on the application of multiscale modelling, micromechanics, high-performance computing and digital image correlation techniques to enable these objectives. Applications include fatigue, creep, creep-fatigue, thermo-mechanical fatigue and corrosion fatigue modelling of aero-engine components. Sandwich and cellular structure design of launch vehicles, space shuttles, etc. for energy absorption and light-weight.

Research Areas

- Solid mechanics
- Micromechanics and Homogenization
- Multi-scale Modeling (Time and Space)
- Inverse Modeling
- Finite Element Method (FEM)
- Computational and Numerical Method
- Fatigue and Fracture; Creep and Corrosion
- Plasticity, Crystal Plasticity and Damage Modeling



Sponsored Projects

YEAR 2020 TILL NOW

1. Microscale Modeling Of Steels
2. Autopilot And Trajectory Generation For Swarm
3. Fabrication And Characterization Of A Low-Cost Hybrid Composite Blast And Ballistic Applications
4. Low-Speed Wind Tunnel Test On AMCA, "Air Intake Model"
5. Development Of A Coupled Machine Learning-Based Approach For Origami-Inspired Deployable Multi-Functional Metamaterials
6. Investigation Of Combustion Characteristics Of Carbon Coated Aluminium Nanoparticles
7. Experimental Identification Of Laminar To Turbulent Transition And Separation Locations Using In-House Made Temperature Sensitive Paint In Wings And Launch Vehicles
8. Experimental Investigation Of Leading-Edge Bluntness On Heat Transfer Rate And Flow Unsteadiness In Shock-Induced Boundary Layer Separation In A Scramjet Intake
9. Miniature Pneumatic Recoil Management Mechanism For Micro UAV
10. Mechanical Characterization And Structural Integrity Of Radar Absorbing Paints (RAP)
11. Uncertainty Resilient Multi- Harvester Metamaterials For Optimal Non-Linear Energy Harvesting
12. Study Of Shocks And Wakes In Granular Flows
13. Design And Develop Indigenous Tactical UAV With Maximum Local Content Through Collaboration Between The Parties
14. Establishment Of Hypervelocity Expansion Tunnel Test Facility And Heat Flux Measurements Over Payload Configurations

Consultancy Projects

YEAR 2020 TILL NOW

1. Wind Tunnel Testing of two Chimneys (180 mtr & 225 mtr High) for 5x210 MW Unchahar WFGD
2. VTOL UAV Design And Development for 7 kg Payload
3. Wind Tunnel Testing for 2x700 MW Rajpura STPR Rajpura Punjab
4. Wind Tunnel Testing for 150 mtr RCC Chimney for FGD package at Vallur TPS (3x500mw) Tamil Nadu
5. Wind Tunnel Testing For 150 mtr RCC Chimney for FGD package at Talcher TPS Stage I & II (2x250 MW + 4x500 MW) Odisha
6. Wind Tunnel Study of 150 mtr High RC Chimney for DVC Bokaro FGD Project
7. Wind Tunnel Testing for 125 mtr High FGD Chimneys for 5x830mw CGPL Mundra TPS

Notable Achievements

YEAR 2020 TILL NOW

International Competition

- A small helicopter Unmanned Aerial System designed by Mendu Rama Krishna (PhD) and Mr Chirag Jain (MSR) from VTOL and Helicopter Laboratory, guided by Dr Mangal Kothari and Dr Abhishek, have won first prize in stage 3 of 2021 First Responder Endurance Challenge organized by National Institute of Standards and Technology (NIST), USA. The National Institute of Standards and Technology is a physical sciences laboratory and a non-regulatory agency of the United States Department of Commerce. Its mission is to promote innovation and industrial competitiveness. So far they have won $40,000 in this competition.

Patents

- A Peripheral Vortex Reverse Flow Combustor with Coaxial Fuel Injection (PVRF-COAX) And Method Thereof
- Real-time Spherical Omnidirectional Visual Gyroscope

Books

- Foundations of Space Dynamics, Wiley, Hoboken, N.J., U.S.A., 2021, by A. Tewari.
- Computational Aerodynamics and Aeroacoustics, Springer Nature, Singapore, 2020, by Tapan K. Sengupta and Yogesh G. Bhumkar.

PhD Thesis

YEAR 2019-2020

[1] Sharp Interface Immersed Boundary Framework for All-Speed Flow Solver

[2] Receptivity, instability and structure identification in three-dimensional routes of transition

[3] Influence of filler shape and strain rate on the mechanical and failure characteristics of glass-filled Epoxy composites

[4] Attitude Control of Agile Rotorcrafts: A Geometric Approach

[5] A Micromechanical Study of Unidirectional Fibre Composites with Emphasis on Randomness in Spatial Distribution, Boundary and Interface Effects

[6] Linear and non-linear Aerodynamics parameter estimation using genetic algorithm

[7] Linear instability of transient flows: Numerical approach and experimental validation

Faculty

AERODYNAMICS

PROPULSION

COMPUTATIONAL MECHANICS

FLIGHT MECHANICS & CONTROL

STRUCTURES, STRUCTURAL DYNAMICS & AEROELASTICITY

AERO-THERMODYNAMICS AND THERMAL SCIENCES

*Click on any tab to get directed to the respective faculty page

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