

Indian Institute of Space Science and Technology

Thiruvananthapuram



Details of Instructional and Research labs
under the
Department of Aerospace Engineering

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1 Advanced Propulsion and Laser Diagnostics (APLD) facility

- **Floor Area:** 210 sq m
- **Overall capital expenditure:** Rs. 8.5 Crores
- **Major instruments/ equipments:** High-Speed Camera (Phantom VEO 410L), CCD Camera (PCO 2000, Pixelfly), ICCD (Nanostar), Low Speed and High-Speed IRO (Image Intensifiers), Stereo PIV Camera (Imager CX), PIV Nd-YAG laser, Dye Laser, High-speed Water Cooled Dynamic Pressure Transducers, Liquid Fuel Heater, Mass Flow Meters and Controllers, Free-Field Standard Microphone set
- **Writeup about the lab:** The Advanced Propulsion and Laser Diagnostics (APLD) Facility has been established with a primary focus on conducting fundamental studies in the realm of propulsion research. It provides an invaluable platform for students and researchers at IIST to engage in cutting-edge research, primarily emphasizing fundamental studies encompassing supersonic mixing, supercritical injection, combustion, and other critical aspects of propulsion systems.



(a)



(b)

2 Aerodynamics Lab

- **Floor Area:** 151 sq m
- **Overall capital expenditure:** Rs. 40 Lakhs
- **Major instruments/ equipments:** Suction type wind tunnel, Blower type wind tunnel, Flow visualization wind tunnel, Hot-wire anemometer (Streamline Pro Dantec), 1/4" free field microphone (GRAS), Smoke generator, Mass flow controller, Pressure scanner, Manual 3-axis traverse system, Automated 4-axis traverse system, DAQ systems (NI)
- **Objective of the lab:** Aerodynamics Laboratory is established to provide hands-on experience and practical learning on various aerodynamic concepts, mainly in the areas of force/moment measurement techniques and flow visualization techniques. Lab is equipped with facilities to

conduct experiments on jet flows, flow separation and boundary layer studies. The laboratory provides the students with a venue to pursue their interests in aerodynamic domain through experiments and projects.



(a)



(b)



(c)

Figure 2: Aerodynamics Lab.

3 Aerostructures Lab

- **Floor Area:** 90 sq m
- **Overall capital expenditure:** Rs. 75 Lakhs
- **Major instruments/ equipments:** Strain Gauge Trainer, Thin Cylinder, Buckling of Struts, Continuous and indeterminate beams, Shear force in beam, Unsymmetrical and shear center, Deflection of beams, Versatile data acquisition system (VDAS)
- **Objective of the lab:** Aerostructures Lab provides valuable hands-on experience and practical skills essential for careers in aerospace engineering, including aircraft design, manufacturing, maintenance, and research. It combines theoretical knowledge with real-world applications to prepare students for challenges in the dynamic and demanding field of aerospace technology.



(a)



(b)

Figure 3: Aerostructures Lab.

4 CADD Lab

- **Floor Area:** 150 sq m
- **Overall capital expenditure:** 35 Lakhs
- **Major instruments/ equipments:** AutoCAD, CATIA, SOLIDWORKS, Autodesk INVENTOR, ADAMS, Hypermesh, MSC Patran, MSC Nastran, Scilab, FEAST etc., and Desktops
- **Objective of the lab:** In this lab, the students get opportunity to familiarize various modelling, drafting and analysis software packages. The design and analysis experience gained through CAD lab mould our students capable of contributing meaningfully in the design/analysis of payload/satellite structures in various space projects at institute level.



Figure 4: CADD Lab.

5 Computational Heat Transfer Lab

- **Floor Area:** 21 sq m
- **Overall capital expenditure:** 25 Lakhs
- **Major instruments/ equipments:** FUJITSU CELSIUS R940, HLBS CMW 1000T- Intel(R) Xeon(R), TYRONE DIT400TR-48RL- Intel(R), and Software (ANSYS 2020R1, Open Foam, MATLAB R2024a, ParaView, OriginPro 8G, Pointwise, Tecplot, 3D Slicer, Simvascular, Chitubox, LTspice, LabChart)
- **Objective of the lab:** In the Computational Heat Transfer Lab, researchers develop and validate computational models to simulate complex heat transfer phenomena. This lab supports cost-effective testing and optimization, reducing the need for extensive experimental setups. It is instrumental in research areas like electronics cooling, energy systems, and bio fluid mechanics.



Figure 5: Computational Heat Transfer Lab.

6 Computational Lab

- **Floor Area:** 42 sq m
- **Overall capital expenditure:** Rs. 50 Lakhs
- **Major instruments/ equipments:** Threadripper 5975 WX Processor Workstation, 4 Xeon Scalable Workstations, 2 High-End Intel I Series Desktops

- **Objective of the lab:**

1. **Providing Computational Support:** Offering resources and computational power to research scholars for their diverse research projects.
2. **Fostering Collaboration:** Creating a space where students can collaborate, share ideas, and work together on research initiatives.



Figure 6: Computational Lab.

7 Cryogenic Lab

- **Floor Area:** 32 sq m
- **Overall capital expenditure:** 80 Lakhs
- **Major instruments/ equipments:** Liquid Nitrogen plant and Dewar vessels
- **Objective of the lab:** The Cryogenic Lab focuses on studying systems at extremely low temperatures. It supports advanced research in flow experiments related to cryogenic fluids, and material properties at cryogenic temperatures. This lab is crucial for developing cryogenic technology used in medical, aerospace, and energy sectors.



Figure 7: Cryogenic Lab.

8 Engineering Drawing Hall

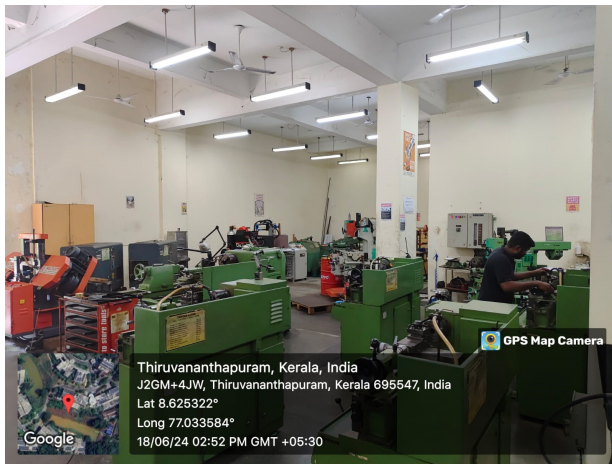
- **Floor Area:** 180 sq m
- **Overall capital expenditure:** 25 Lakhs
- **Major instruments/ equipments:** Drawing table, stools, and drawing instruments
- **Objective of the lab:** This lab is aimed at familiarizing the first-year engineering students with the principles of descriptive geometry and visual communication techniques.



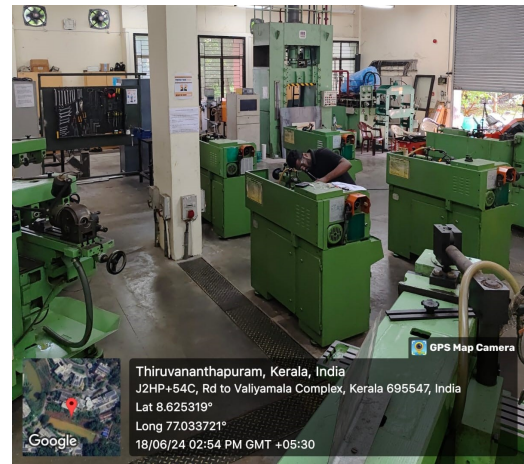
Figure 8: Drawing Hall.

9 Engineering Workshop

- **Floor Area:** 208 sq m
- **Overall capital expenditure:** 2.13 Crores
- **Major instruments/ equipments:** Centre Lathe, Heavy duty Centre Lathe (HMT), Universal Milling Machine, Vertical Milling Machine, Pedestal grinding Machine, Tool and Cutter grinding machine, Hydraulic Press (100 Ton), Manual hydraulic Press (25 Ton), Pillar type Drilling Machine, Bench Drilling Machine, Spot Welding Machine, Arc Welding Machine, Oxy-Acetylene Gas welding system, Power Hacksaw, Band Saw machine, Electric Box Furnace, Rolling Machine, Screw Air compressors
- **Objective of the lab:** Practice makes an engineer perfect; and hence this is a lab which provides hands on experience for students on various mechanical elements, hand tools, assemblies and general fabrication machines. This lab supports wide ranges of activities, for all categories of students (UG, PG, PhD etc.) for their internships, academic course projects, research activities etc. Students and faculties, across all departments of IIST, make use of this lab as a central facility in various capacities.



(a)



(b)

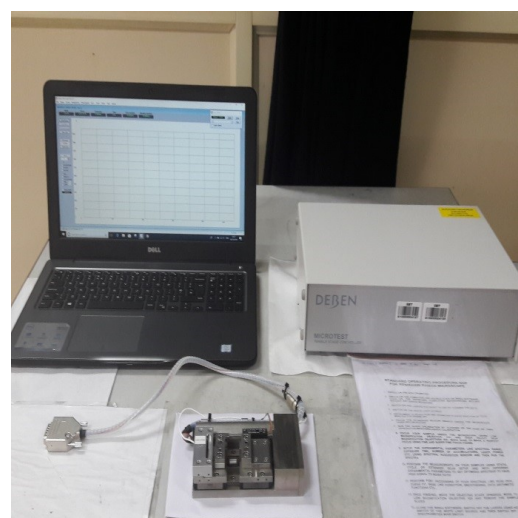
Figure 9: Engineering Workshop.

10 Experimental Composite Micro-mechanical lab and Raman Spectroscopy Facility

- **Floor Area:** 60 sq m
- **Overall capital expenditure:** 3 Crores
- **Major instruments/ equipments:** Renishaw in via raman Spectroscopy, Deben Micro tensile tester 2KN capacity, Holmarc Optical table, Digital Image Correlation syystem (DIC), Workstation & Software
- **Objective of the lab:** Experimental Composite Micro mechanical lab and Raman Spectroscopy Facility are specialized laboratories focusing on the characterization, analysis, and testing of composite materials at micro and molecular levels.



(a) Raman Spectroscopy.



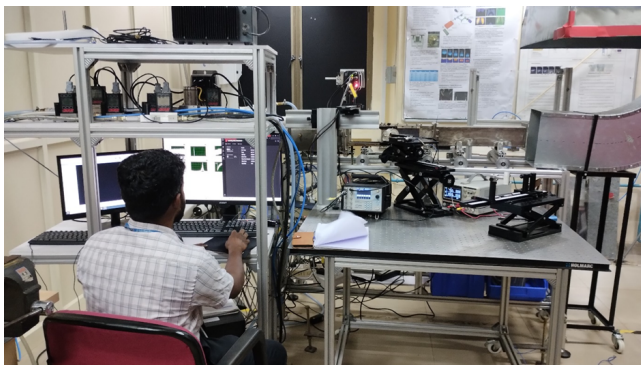
(b) Deben 2KN Micro Tensile Tester.

Figure 10: Experimental Composite Micro mechanical lab and Raman Spectroscopy Facility.

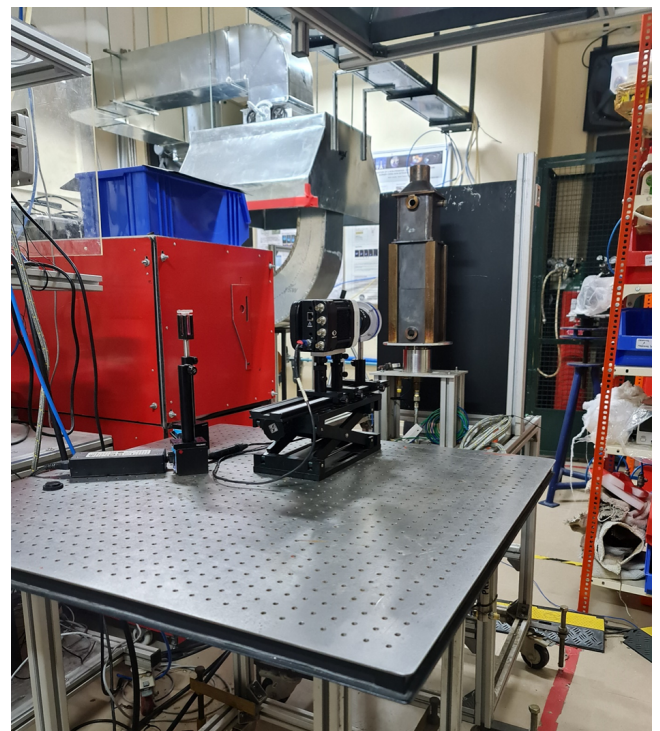
11 Flame Diagnostics Lab

- Floor Area: 60 sq m
- Overall capital expenditure: Rs. 1 Crore
- **Major instruments/ equipments:** Nd:YAG laser, High-speed (kHz) camera, Mass flow controllers, Stereo PIV imaging system, acoustic pressure transducers
- **Objective of the lab:**

The Flame Diagnostics Lab, set up in the Aerospace Department, is an experimental test facility for combustion research. Combustion or propulsion research is critical in developing novel propulsion systems and power & energy systems. The goal is to develop strategies for an ‘energy transition’ towards renewable sources, significantly enhancing our fundamental understanding of the complex processes associated with such practical combustion systems. Current research focuses mainly on turbulent gaseous and liquid-fueled flames, and the topics investigated include the different combustion phenomena like flame stabilization, fuel flexibility, instability, pollutant emissions, and the development of new standard burners and injectors for combustion/propulsion applications.



(a)



(b)

Figure 11: Flame Diagnostics Lab.

12 Flight Mechanics Lab

- **Floor Area:** 130 sq m
- **Overall capital expenditure:** 20 Lakhs
- **Major instruments/ equipments:** Flight Simulator - Stick, Thruster and Rudder Pedals, Flight Simulator – Yoke and Throttle Quadrant, Bi-Filar Pendulum Rig, GoPro Camera, Laptop, and Desktops
- **Objective of the lab:** The lab acts as a focal point for the design, fabrication and flight testing of unmanned aerial vehicle-related activities.



(a) Four winged UAVs with IC engines.



(b) Hexacopter.



(c) Flight simulator.



(d) Flight simulator.

Figure 12: Flight Mechanics Lab.

13 Fluid Mechanics Lab

- **Floor Area:** 120 sq m
- **Overall capital expenditure:** 20 Lakhs
- **Major instruments/ equipments:** Centrifugal Pump Test Rig, Pipe Friction Apparatus, Calibration Test Rig for, Orifice/Venturi Meter, Francis Turbine Test Rig, Pelton Turbine Test Rig, Reynolds Apparatus, Hele-Shaw Apparatus, Reciprocating Pump Test Rig
- **Objective of the lab:** The Fluid Mechanics Lab, tailored for undergraduate Aerospace Engineering students, is equipped with various apparatus and instruments designed to measure and analyse flow properties, such as velocity, pressure, and flow rate. The lab also includes experimental test rigs for performance analysis of pumps, turbines, and other fluid systems.

14 Heat Transfer Lab

- **Floor Area:** 32 sq m
- **Overall capital expenditure:**
- **Major instruments/ equipments:** Temperature Trainer Module, Unsteady apparatus, Convection test rig, Extended Surface apparatus
- **Objective of the lab:** The Undergraduate Heat Transfer Lab is designed to provide hands-on experience with various heat transfer experiments and equipment. It helps students apply theoretical knowledge to practical scenarios, developing their technical skills and experimental techniques. This lab is essential for reinforcing concepts taught in heat transfer courses, preparing students for engineering careers, and fostering teamwork and problem-solving skills through collaborative projects.



Figure 13: Heat Transfer Lab.

15 Heat Treatment and Metallography Lab

- **Floor Area:** 99 sq m
- **Overall capital expenditure:** 70 Lakhs
- **Major instruments/ equipments:** Twin Disc Variable Speed Grinder/Polisher, Automatic Mounting Press, Chemical Polisher / Etcher, Laser Engraving Machine, Trinocular Reflected Light Microscope, Stereo Microscope, Metallography Microscope, Micro Vicker hardness Tester, Hot Air Oven, Muffle Furnace, Quenchometer, Precision Balance, Thermal expansion Apparatus
- **Objective of the lab:** This lab caters to students of undergraduate and graduate categories and has equipment to carry out various heat treatment processes and to obtain the microstructure and macrostructure of metallic materials. This lab facility goes hand-in-hand with the manufacturing process lab to study the microstructural evolution of samples subjected to various processes such as rolling, forging, extrusion, etc, and to correlate the microstructure with the strength of materials lab and other laboratories that are equipped with testing of materials.



(a)



(b)



(c)



(d)

Figure 14: Heat Treatment and Metallography Lab.

16 High Speed Flow Lab

- **Floor Area:** 230 sq m
- **Overall capital expenditure:** 40 Lakhs
- **Major instruments/ equipments:** Shock tunnel, Supersonic wind tunnel and Free jet facility with anechoic chamber, High pressure shock tube facility
- **Objective of the lab:** The High speed flow laboratory is currently being established at the Aerospace Engg dept, IIST with the aim of supporting academic and research activities in the areas of Compressible flows, High enthalpy flows and Aeroacoustics.



Figure 15: Shock Tube.

17 Laser Absorption Spectroscopy Lab

- **Floor Area:** 54 sq m
- **Overall capital expenditure:** 25 Lakhs
- **Major instruments/ equipments:** DFB diode laser, diode laser controllers, detectors and high speed DAQ, High temperature calibration cell
- **Objective of the lab:** This lab aims to develop diode laser based sensors for combustion and high speedflow applications. These non intrusive sensors can be used for the measurement of Temperature and concentration and can also be used in harsh environments.

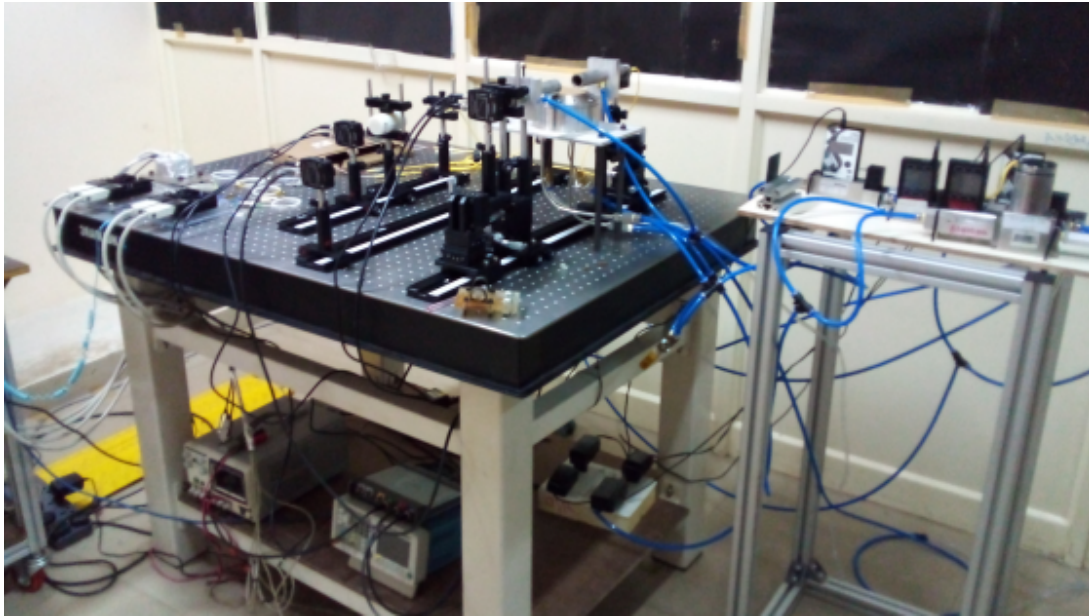


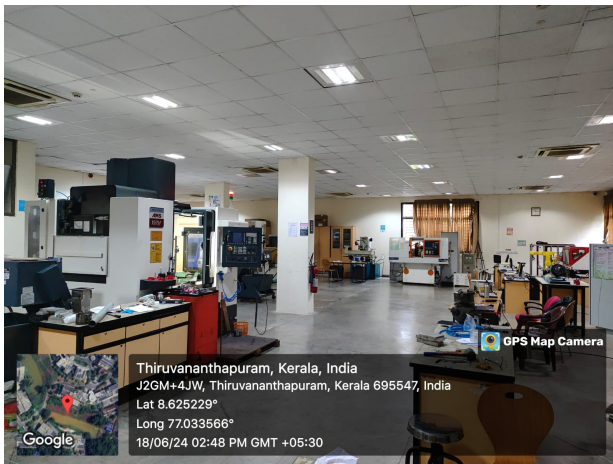
Figure 16: Laser Absorption Spectroscopy Lab.

18 Manufacturing Processes Lab

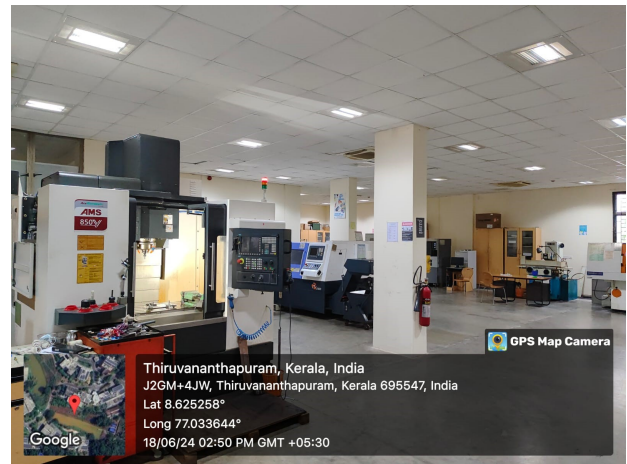
- **Floor Area:** 366 sq m
- **Overall capital expenditure:** 2.39 Crores
- **Major instruments/ equipments:** CNC Machine Tools : CNC turn-mill centre, CNC Milling machines, CNC lathe, CNC grinding machines, Non Traditional Machining System: EDM machine, CNC simulation trainer, Flexible Manufacturing System & Pick and Place industrial robots
- **Objective of the lab:** It is one of the important facilities established under Department of Aerospace that cater to the needs of academic curriculum, research as well as other projects, wide across the institute. The facilities in this lab are extensively used by the UG, PG and Ph.D students of IIST to perform engineering exercises as well as to develop experimental setups. All the Aerospace UG students at IIST are getting an opportunity to work on CNC machines and similar sophisticated systems available in this lab during their curriculum. Manufacturing lab at IIST also support various Institute level space activities/IIST-ISRO project activities towards the prototype development, machining and precision manufacturing, design for SM/AM etc.

19 Mechanisms and Machine Elements Lab

- **Floor Area:** 60 sq m
- **Major instruments/ equipments:** Mechanisms, machine elements
- **Objective of the lab:** In this lab, the students get opportunity to familiarize with the real-life mechanisms for various applications, and basic machine elements.



(a)



(b)

Figure 17: Manufacturing Processes Lab.

20 Metrology and Computer Aided Inspection Lab

- **Floor Area:** 145 sq m
- **Overall capital expenditure:** 1 Crore
- **Major instruments/ equipments:** Vision inspection system, Universal length measuring machine, Microhite-600, Profile projector, Autocollimator, Micro alignment telescope, Air gauge system, Taly surf- roughness measuring machine, Tool Maker's microscope
- **Objective of the lab:** The main objective of this lab is to crater the needs of UG /PG curriculum as well as to support various engineering measurements/inspection requirements at IIST as a part of R&D activities.



(a)



(b)

Figure 18: Metrology and Computer Aided Inspection Lab.

21 Micro-PIV Lab

- **Floor Area:** 18 sq m
- **Overall capital expenditure:** 70 Lakhs
- **Major instruments/ equipments:** Micro-PIV

- **Objective of the lab:** The Micro Particle Image Velocimetry (Micro-PIV) Lab allows for high-resolution visualization and measurement of fluid flow patterns in microscale systems. This non-intrusive technique is vital for analyzing fluid dynamics in microfluidic devices and biological flows. Research conducted in this lab has applications in biomedical engineering, such as diagnostics and therapeutic devices, and in optimizing the performance of microscale heat exchangers. The Micro-PIV lab enhances understanding of microscale fluid dynamics, which is crucial for the development of efficient microfluidic technologies.



Figure 19: Micro PIV Lab.

22 Robotics and Dynamics Lab

- **Floor Area:** 180 sq m
- **Objective of the lab:** In this lab, the students gets an opportunity to work in robotics and dynamics related areas.

23 Strength of Materials Lab

- **Floor Area:** 250 sq m
- **Overall capital expenditure:** 1 Crore
- **Major instruments/ equipments:** Universal testing machine, Impact Testing machine, Torsional testing machine, Creep and rupture testing machine, Fatigue tesing machine, Brinell hardness testing machine, Rockwell hardness testing machine, Vickers hardness testing machine, Spring testing machine, Muffle Furnace
- **Objective of the lab:** Strength of Materials (SoM) labs typically involve experiments and tests to determine the mechanical properties of materials under various loads and conditions.



(a) Universal Testing Machine.



(b) Creep and Fatigue Machine.

Figure 20: Strength of Materials Lab.

24 Structural Dynamics and Vibration Lab

- **Floor Area:** 60 sq m
- **Overall capital expenditure:** 1 Crore
- **Major instruments/ equipments:** Modal shaker, Miniature modal shaker, Uni & Triaxial Accelerometers, M+P Analyser, Accelerometer and hammer, and Workstation

- **Objective of the lab:** In the Structural Dynamics and Vibration Lab, students typically study the behavior of structures and mechanical systems under dynamic loading conditions, including vibrations.



Figure 21: Modal Shaker with M+P Analyser with Triaxial Accelerometer.

25 Structural Health Monitoring (SHM) Lab

- **Floor Area:** 60 sq m
- **Overall capital expenditure:** 2.5 Crores
- **Major instruments/ equipments:** Laser Scanning dopler vibrometer, Oscilloscope, Arbitrary function generator, High voltage amplifier, Angle beam ultrasonic transducers, Dynamic signal analyser and Workstation
- **Objective of the lab:** In the Structural Health Monitoring (SHM) Lab, the focus is on assessing the condition of structures to ensure their safety, longevity, and optimal performance over time.



Figure 22: Laser Scanning Doppler Vibrometer from Polytec.

26 Thermal Engineering and Propulsion Lab

- **Floor Area:** 228 sq m
- **Overall capital expenditure:** 2 Crores
- **Major instruments/ equipments:** High-speed Camera, PIV laser, CCD Camera, Seeding particle generator, Mass flow meters , Mass flow controllers , Delay pulse generator, Data Acquisition system, Oscilloscopes, Static pressure transmitters, Unsteady pressure transducers with charge Amplifiers, Elgi Air compressor (10 bar with a 500L storage tank), Shadowgraph rig, Spherical flame rig, Swirl flame rig, Atmospheric burner rig, Petrol Engine with dynamometer, Diesel Engine with dynamometer, Refrigeration rig, Heat pump rig, Portable Turbojet engine, Portable Ram jet Engine, Axial Blower rig, Blade cascade Analysis rigs, Portable CD nozzle rig, Portable axial turbine rig
- **Objective of the lab:** The laboratory facilitates various experiments related to heat transfer, combustion, multiphase flow, propulsion and thermal engineering. The students can work with many flow, pressure and temperature measuring sensors/associated data acquisition systems of industrial standards for their experiments.



Figure 23: Thermal Engineering Lab.

27 Thermal and Fluid Engineering Calibration Facility

- **Floor Area:** 60 sq m
- **Overall capital expenditure:** 24 Lakhs
- **Major instruments/ equipments:** High temperature calibrator FURNACE, Low temperature dry block calibrator, Pneumatic pressure calibrator, Oscilloscope, Portable HART protocol communicator
- **Objective of the lab:** The lab caters to regular calibration requirements, used by M.Tech and PhD students for various experiments relating to heat transfer and fluid flow. Different thermal and fluid measurements, and pressure measurements are also carried out in this lab.



Figure 24: Instruments in Thermal and Fluid Engineering Calibration Facility.