R & D Resources

Indian Institute of Technology Bombay

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Director's Message

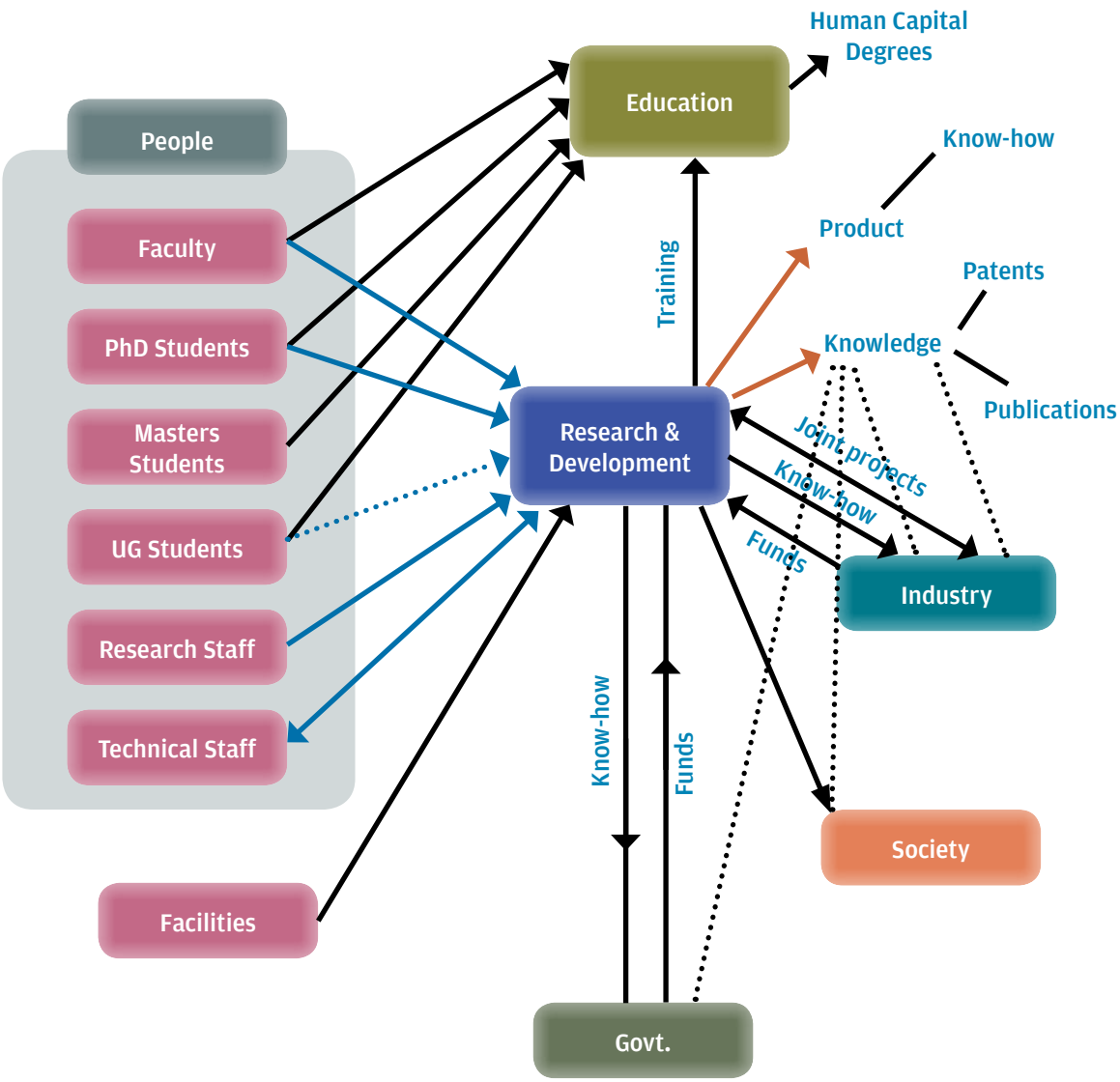
Indian Institute of Technology Bombay is one of the leading institutions in the country actively contributing to education and research in the fields of science and engineering. Over the last two decades, we have increased our emphasis on research and development. We are seeing significant growth in research funding, publications and patents. At present, of the 7670 students of our campus, more than 54% are engaged in post-graduate or research degrees. We have established strong links with industry in the form of consulting and sponsored research projects, sponsored research laboratories, chair professorships and pre-competitive consortia. We have strong links with government and public sector organizations and also with several international organizations and universities.

We are keen to see that our research makes a difference towards this goal. We are reaching out to stakeholders – industry, government and society to disseminate information about research at the Institute. In 2010, we brought out a booklet on IITB technologies. This year we have compiled a brochure on R&D resources at the Institute. We document details of the facilities, faculty expertise and agreement templates in this brochure.

I hope that you will find this brochure useful and that it will enable enhanced interaction between IIT Bombay and the industry, government and society.

Prof. Devang V. Khakhar

Flow Chart
Research & Development in IIT Bombay



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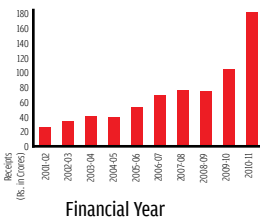
Introduction

Indian Institute of Technology Bombay (IIT Bombay), has established itself as one of the leading science and technology institutes in the country since its inception in 1958, and is emerging as a global centre of academic and research excellence. Over the last five decades, more than 37,000 engineers, scientists, designers and managers have graduated from this Institute.

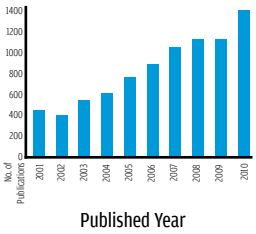
Institute's vision is to be a fountainhead of new ideas and of innovations in science and technology. There has been an increased emphasis on research. This emphasis is reflected in the increasing number of postgraduates at the Institute. In 2011, of the 1846 degrees awarded at the Convocation, 1341 were post graduate degrees (73%).

The inputs required for research are "quality" people (faculty, research staff, research students), state of the art research infrastructure, an enabling environment that facilitates research and funding for research. IIT Bombay has seen rapid growth in R&D funding with annual growth rates of 26% per year from 2001-11. The number of publications, patents filed and PhD students graduated are showing steady growth. The goal of R&D at IIT Bombay is to focus on research that makes a difference.

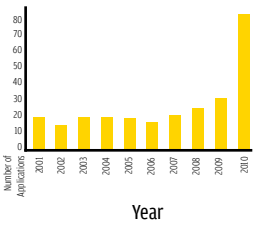
R & D Receipts in IIT Bombay



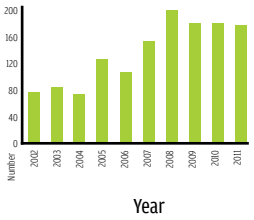
IIT Bombay Publications



No. of IP (Patent/ Design/ Trademark) Applications filed by IIT Bombay



PhDs graduated from IIT Bombay



IIT Bombay has already established strong links with Indian industry, government organisations and several international industries and universities. As part of our efforts to see that our research continues to make a difference, we have compiled this document on the resources available for R&D at the Institute. It is hoped that this will facilitate enhanced utilisation of the rich research resources available at IIT Bombay by industry, government and society.

Manpower:
IIT Bombay has about 500 faculty members, 1880 PhD students, 2280 Masters students, 3510 Undergraduate students, 750 project research staff and 1300 supporting staff as on August 01, 2011.

The diversity and capabilities of the Institute is reflected in the areas of expertise of its highly qualified faculty. In this brochure, we list the expertise of faculty distributed over the different academic entities (14 Departments, 1 school, 4 inter-disciplinary groups and 5 centres). The faculty contact details are provided for easy reference. Further details on faculty interests are available at the department web sites. The booklet is subdivided into sections, outlining the infrastructure facilities, templates for interaction with Institute, and areas of expertise of the faculty members.

Infrastructure facilities:
IIT Bombay has several state of the art equipment. Some of these form part of the Sophisticated Analytical Instrument Facility while others serve as national centres for excellence and national facilities.

In this document, the features and capabilities of the major facilities, location and contacts for further information have been provided. There are several laboratories and facilities available in the different departments and entities. These are listed as additional resources.

Processes:
The Industrial Research and Consultancy Centre (IRCC) was established in 1975 as the nodal unit responsible for managing and coordinating all activities related to research and development at the Institute including facilitating interactions with external agencies, setting up simplified processes for financial, manpower and intellectual property management, licensing activities and scheme for incentivising researchers.

IRCC has been instrumental in developing online processes for managing consulting and sponsored projects, project staff recruitment, project accounts, patenting and agreements. IRCC acts as an enabler and aims to simplify processes and allow faculty and students to focus on research. In this brochure, we have enclosed standard templates for memorandum of understanding, research agreements, standard terms and conditions and non disclosure agreement. This provides the interested stakeholder with an idea of the typical agreements and terms that IIT Bombay normally enters into. Of course these are indicative and Institute maintains the flexibility of mutually discussing and finalising other agreements based on the needs of the stakeholders and Institute's rules.

Major Facilities

^{40}Ar-^{39}Ar Geo-thermochronology Facility

This is a national facility consisting of a sophisticated state of the art noble gas mass spectrometer. This is the first such facility in the country for ^{40}Ar-^{39}Ar geo-thermochronology. The noble gas mass spectrometer is useful for researcher in the field of earth and planetary sciences. It is used for Ar - Ar geochronology and noble gas geochemistry of both terrestrial rock and fluids and extra terrestrial materials.

Make and Model:
Noble gas mass Spectrometer Argus – VI
Manufacturer: Thermo Fisher scientific
Noble gas multi-collector mass spectrometer

Specifications/Features:
Mass Range 1 to 50 d
Background: Equal or better than $5x10^{-14}$ cc STP at mass 36
Sensitivity: Argon - > 1 x 10^{-3}amps/Torr at 200μA trap current
Axial Resolution:~ 200
Peak Side Stability: Drift less than the equivalent of ±50ppm in mass over 30 minutes at mass 40
Peak Flat: Peak flat equal to or better than ±1 in $1x10^{3}$ over ±150ppm

Thermo Fisher scientific Noble gas multi-collector mass spectrometer

Applications:
- Applications: Ore petrology
- Fluid and melt inclusion studies
- Geothermal research
- Thermochronology of precambrian terrains
- Noble gas studies of terrestrial and extra-terrestrial materials

Location:
Department of Earth Sciences

Contact:
Prof. Kanchan Pande
Department of Earth science
kanchanpande@iitb.ac.in
Mr. L. S. Mombasawala,
Centre for Research in Nanotechnology and Science
laiqsm@iitb.ac.in.

Photolabelling and Peptide Sequencing Facility

Photolabelling and Peptide Sequencing

This is a national facility for peptide sequencing in biomolecular systems. The lab consists of protein sequencer and MALDI TOF.

Make and Model:
Protein Sequencer (applied biosystem PROCISE 491) and MALDI TOF (Shimadzu AXIMA CFR)
Edman reaction Unit with 140C Microgradient system.

Specifications / Features:
The system consists of Edman reaction unit and an on line PTH-analyser and a CR-7A data processor.

Applications:
The sequencer can safely provide sequence information up to 20-30 cycles for a 100-500 pmole sample, though a lot depends on how the sample is prepared for sequencing

Location:
Department of Chemistry

Contact:
Prof. D. Panda,
Department of Biosciences and Bioengineering
panda@iitb.ac.in

Single Crystal X-ray Diffraction Facility

This is a national facility. Molecular structures of organic and inorganic compounds can be established by single crystal x-ray diffraction techniques.

Make and Model:
Nonius MACH 3 serial detector based automatic diffractometer
A CCD equipped Oxford diffraction XCALIBUR-S

Specifications/Features:
- Low temperature facility
- Appropriate computational support for analysis of data and complete structure determination
- Cambridge structure database is installed for literature survey of all the reported structures

Applications:
- Establishment of 3-D molecular structures of organic and inorganic complexes including sensitive organometallics complexes
- Structure-reactivity correlation studies
- Variable temperature data collection
- Bond distance and bond angles of structures
- Single-crystal to single-crystal transformation
- Hydrogen bonding and packing diagram of molecules

Location:
TCS building, Next to Centre for Environment Science and Engineering

X-ray diffractometer

Another view of diffractometer

Contact:
Prof. P. Mathur,
Department of Chemistry
mathur@chem.iitb.ac.in
Prof. G. K. Lahiri,
Department of Chemistry
lahiri@iitb.ac.in

Sudarshan: National Geotechnical Centrifuge Facility

View of a 4.5m radius large beam centrifuge

The geotechnical centrifuge is a national facility, has been indigenously fabricated and commissioned at IIT Bombay. The facility is being used for basic and applied research on modeling of geotechnical structures, as well as for manpower training. It is the first of its kind in the country.

Features:

- Configuration: Beam type
- Platform radius: 4.5m
- Model area: 1.0 x 1.2m (up to 0.66m height) 0.7 x 1.2 m (up to 1.2 m height)
- Acceleration range: 10 to 200g
- Payload: 2.5 tons at 100g
- Capacity : 250g-tons
- Run up time to 200g : 6 minutes
- In-flight balancing range: 0 to ± 100kN
- In-flight balancing time: 60 seconds
- Cost-effective cooling system
- Good swing-out at g-level
- Low power consumption

Applications:

- Slope stabilization techniques
- Reinforced soil structures
- Landslides
- Ground improvement techniques
- Environmental geotechniques
- Simulation of deep excavations and retention systems
- Geotechnical structures subjected to earthquake
- Subsidence
- Tunnels/ Tunnel lining
- Foundations/Anchors
- Non-geotechnical applications

Location:

Behind Heavy structures laboratory

Contact:
Prof. B. V. S. Vishwanadham,
Department of Civil Engineering
viswam@iitb.ac.in,
ngcf@civil.iitb.ac.in
www.civil.iitb.ac.in/~ngcf

Texture and Orientation Imaging Microscopy

This is a national facility and has three equipment. Panalytical MRD System can be used to measure the Bulk texture and residual stress, Peak Profile, Grazing incidence x-ray diffraction. Fei quanta 200 HV SEM with TSL-EDX can be used for microtexture measurements, crystallographic orientations. Fei-Quanta-3d FEG (SEM plus FIB dual column) can be used for 3-d OIM, microtexture measurements, and crystallographic orientations. And SDD EDX, WDX chemical analysis.

Texture and Orientation Imaging Microscopy

Make and Model:
Panalytical MRD System, with advanced detection and optics, for stress and texture measurements.
Fei Quanta 200 HV SEM with TSL-EDX orientation imaging microscopy (OIM) for microtexture measurements
Fei Quanta-3D FEG (FIB plus FIB dual columns) for 3-D OIM, also SDD EDX and WDX for chemically assisted scans

Specifications/Features:
This facility, together with analyses packages, constitutes a complete unit for any in-depth study of crystallographic orientations.

Applications:
In-depth study of crystallographic orientations

Location:
G 007, Department of Metallurgical Engineering and Materials Science

Contact:
Prof. I. Samjadar,
Department of Metallurgical Engineering and Material Science,
indra@iitb.ac.in
www.met.iitb.ac.in/~texture

Sophisticated Analytical Instrument Facility

Sophisticated Analytical Instrument Facility

Sophisticated analytical instrument facility houses several sophisticated instruments. It is funded and supported by the Department of Science and Technology, Government of India. It caters to the instrumentation needs of educational institutions, R&D laboratories and the industry. These facilities are available on payment of a modest fee

Contact:
Prof. Soumyo Mukerji,
Head, Centre for Research in Nanotechnology and Science
head.saif@iitb.ac.in, office.saif@iitb.ac.in

Facilities available at SAIF

- Carbon Hydrogen Nitrogen Sulphur and Oxygen Elemental Analyzer (CHNSO)
- Electron Spin Resonance Spectrometer (ESR)
- Field Emission Gun-Scanning Electron Microscope (FEG-SEM)
- Fourier Transform Infra-Red Spectrometer (FTIR)
- Fourier Transform Infra-Red Spectrometer Imaging System (FTIR Imaging System)
- Gas Chromatograph-Mass Spectrometer (GC-MS)
- Gas Chromatograph High Resolution Mass Spectrometer (GC-HRMS)
- Image Analyzing System (IAS)
- Inductively Coupled Plasma - Atomic Emission Spectrometer (ICP-AES)
- Liquid Chromatograph - Mass Spectrometer (LC-MS)
- Nuclear Magnetic Resonance Spectrometer (NMR)
- Thermal Analysis System (TAS)
- Transmission Electron Microscope (TEM)
- Time-of-Flight Secondary Ion Mass Spectrometer (ToF SIMS)
- X-Ray Fluorescence Spectrometer (XRF)

Location:
Centre for Research in Nanotechnology and Science

Carbon Hydrogen Nitrogen Sulphur and Oxygen Elemental Analyzer

The CHNSO Analyzer finds utility in determining the percentages of Carbon, Hydrogen, Nitrogen, Sulphur and Oxygen in organic compounds, based on the principle of "Dumas method" which involves the complete and instantaneous oxidation of the sample by "flash combustion". The combustion products are separated by a chromatographic column and detected by a thermal conductivity detector (TCD), which gives an output signal proportional to the concentration of the individual components of the mixture.

Thermo Finnigan, Italy, FLASH EA 1112 series

Make and Model:
Thermofennigan, Italy, FLASH EA E1112 series

Specifications/Features:
- Autosampler for 30 samples
- Two parallel combustion tubes for oxygen & carbon ,hydrogen, nitrogen, sulphur
- GC column for separation of evolved gas
- TCD detector for GC

Applications:
- For elemental analysis of the following
  - Organic compounds
  - Pharmaceuticals
  - Organometallics
  - Gasoline and fuels
  - Coal and coke
  - Graphite and carbides
  - Metals and alloys
  - Polymers and explosives
  - Building materials
- In addition, geological, environmental, food and agricultural samples can be analyzed

Location:
Centre for Research in Nanotechnology and Science

Contact:
chnlab@iitb.ac.in

Electron Spin Resonance Spectrometer

Electron Spin Resonance Spectrometer

Electron Spin Resonance (ESR), is a powerful non-destructive and non-intrusive analytical method. ESR yields meaningful structural information even from ongoing chemical or physical processes, without influencing the process itself. It is the ideal technique to complement other analytical methods in a wide range of application areas.

Electron spin resonance spectroscopy is based on the absorption of microwave radiation by an unpaired electron when exposed to a strong magnetic field. Species that contain unpaired electrons (free radicals, odd-electron molecules, transition metal complexes, rare earth ions, etc.) can therefore be detected by ESR.

Make and Model:
Varian, USA, E112 ESR Spectrometer

Specifications/Features:

- Varian's E-Line Century series ESR spectrometer performs ESR operation at X-band microwave frequencies [9.5 GHz] with a sensitivity of 5 x 10^{10} ΔH spins
- Choice of modulation of requencies from 100 KHz to 35 Hz

Applications:
Applied to studies related to :

- Molecular structure
- Crystal structure
- Reaction kinetics
- Valence electron wave functions
- Molecular motion
- Relaxation properties
- Electron transport
- Crystal / ligand fields
- Reaction mechanisms etc.

Location:
Centre for Research in Nanotechnology and Science

Contact:
esrlab@iitb.ac.in

Field Emission Gun-Scanning Electron Microscope

The field emission gun-scanning electron microscope combines two proven technologies – an electron column with semi-in-lens detectors and an in the lens Schottky field emission gun – to deliver ultrahigh resolution combined with wide range of probe currents for all applications (1pA to more than 200 nA).

Make and Model:
JSM-7600F

Specifications / Features:
Resolution: 1.0 nm (15 kv), 1.5 nm(1 kv)
Accerating Voltage: 0.1 to 30 kv
Magnification: x25 to 1,000,000

Applications:
- Nanotechnology
- Material science
- Biology
- Compositional and microstructural analysis
- X-ray micro analysis
- Elemental mapping

Location:
Centre for Research in Nanotechnology and Science

Field emission gun-scanning electron microscope

Contact:
office.saif@iitb.ac.in

Fourier Transform Infra-Red Spectrometer

Fourier Transform Infra-Red Spectrometer

Infrared Spectroscopy gives information on the vibrational and rotational modes of motion of a molecule. The infra-red spectrum of an organic compound provides a unique fingerprint, which is readily distinguished from the absorption patterns of all other compounds; only optical isomers absorb in exactly the same way. Hence FTIR is an important technique for identification and characterization of a substance.
Fourier Transform Infrared Spectroscopy is especially suitable for obtaining spectra in energy limited situations (small quantities of samples, trace impurities in mixtures, weakly absorbing samples, etc.) and conditions under which conventional dispersive instruments fail to produce the desired spectra.

The use of FTIR in research, analytical and quality control laboratories has brought new and extended capabilities to all users

Make and Model:
Nicolet Instruments Corporation, USA, MAGNA 550

Specifications/Features:
Range - 4000 to 50 cm^{-1}
Different types of liquid and solid (including thin films) sampling accessories are available for regular absorption.
Grazing Angle accessory facility is also available for spectral search experiments.

Applications:
- Chemistry & Chemical Engineering
- Polymer & Rubber Industries
- Forensic Labs
- Pharmaceutical Labs
- Food Industries
- Agriculture
- Petroleum Industries
- Nanotechnology

Location:
Centre for Research in Nanotechnology and Science

Contact:
ftirlab@iitb.ac.in

Fourier Transform Infra-Red Imaging System

Infrared Spectroscopy gives information on the vibrational and rotational modes of motion of a molecule and hence is an important technique for identification and characterization of a functional; group. The infra-red spectrum of applications include the identification of trace contaminants, analysis of failure modes and characterization of production defects. An organic compound provides a unique fingerprint, which is readily distinguished from the absorption patterns of all other compounds.

FTIR-Imaging System

Make and Model:
Bruker, Germany, 3000 Hyperion Microscope with Vertex 80 FTIR System

Specifications/Features:

- Focal plane array: 128 x 128, Range: 4000-900 cm^{-1}
- Single point detector: Range: 7500-450 cm^{-1}
- Analysis area: 128x128 in 2D format on the sample plane 300 x 300 µm
- Accessories: Micro ATR, Grazing angle
- Spatial resolution with 15x objective -2.7 µm
- 20x objective (ATR): 0.5 µm.
- Temperature controlled sample stage.
- Spectral resolution of FTIR 0.2 cm^{-1}
- Rapid scan & step scan available
- Rapid scan 65 spectra/sec at 16cm^{-1}
- Library search for organic compounds & polymers

Applications:
Applications include the identification of trace contaminants, the analysis of failure modes and characterization of production defects.

Location:
Centre for Research in Nanotechnology and Science

Contact:
ftirlab@iitb.ac.in

Gas Chromatography-Mass Spectrometer

Gas Chromatography-Mass Spectrometer

Mass spectrometry is an analytical technique that measures the mass of individual molecules and atoms. The neutral analyte molecules are converted into gas-phase ionic species. The excess energy transferred to the molecule during ionization leads to fragmentation. A mass analyzer separates these molecular ions and their charged fragments according to their m/z ratio. Finally the ion current due to these mass-separated ions is detected by a suitable detector, and displayed in the form of a mass spectrum. Each of these steps is carried out under high vacuum (10^{-4} to 10^{-8} torr)

Contact:
gcmslab@iitb.ac.in

Make and Model:
Hewlett Packard, GCD-1800 A

Specifications/Features:

- EI Source Quadrupole Analyzer Mass range : 10 - 425 amu
- Integrated gas chromatograph - electron ionisation detector operated through a data system
- Split/Splitless capillary injection port. Generates traditional retention times and abundance information as also the mass spectral data for each sample component.
- Library search using NIST library of about 75,000 compounds.

Applications:

- Chemical synthesis - identification of intermediates
- Environmental science - separation, identification & estimation of composition of pollutants
- Pharmaceutical chemistry - structure elucidation
- Pesticides - structure elucidation and degradation pattern of pesticide
- Clinical & Biomedical science Identification of metabolites

Location:
Centre for Research in Nanotechnology and Science

Gas Chromatograph High Resolution Mass Spectrometer

A gas-chromatograph coupled with mass spectrometer (GC-HRMS) is a combined analyzer that has a superior ability in analyzing organic compounds qualitatively and quantitatively. It inherits the features of high resolution, accurate mass measurement with simple operation and high sensitivity.

Make and Model:
JEOL, AccuTOF GCv

Specifications/Features :
It has EI/CI ion source with GC, DIP and headspace inlets. The time of flight analyser and the high speed analog to digital converter in combination with a continuous averager helps in getting high sensitivity and resolution.

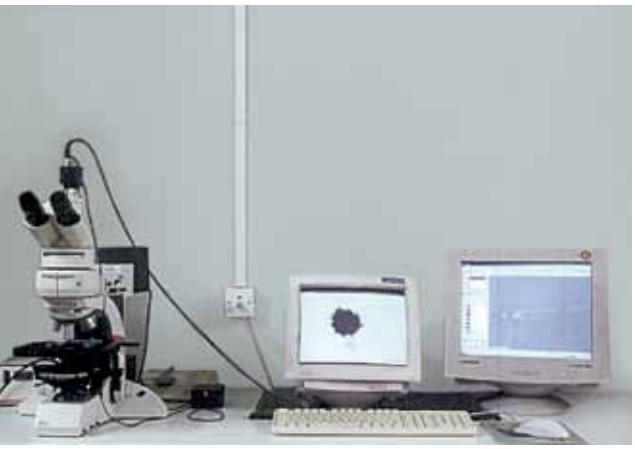
Applications:
- Synthesis of new organic molecules
- Environmental pollution studies
- Drug studies
- Pesticide degradation

Location:
Centre for Research in Nanotechnology and Science

Gas Chromatograph High Resolution Mass Spectrometer

Contact:
office.saif@iitb.ac.in

Image Analyzing system



Optical Microscope/Image Analyzing system

Image analysis can be used to investigate micro and macro specimens objectively to provide information regarding the microstructure, their quantity, size, area, shape and phase analysis. Images are captured using light optical Microscope. Grabbed images are analyzed using Soft Imaging System analysis software.

Make and Model:
Leica, Soft Imaging Systems, Germany (version 5.2), : DMLM MPS3O

Specifications/Features:
Reflected Light and Transmitted light
5 nos/piece for BF / DF Lamp housing
107/2 with 12V 100W
Mechanical state N-Plan objectives 5x-100x; for DM LM Head; N-Plan 5x-20x & eye pieces
Filter set for reflected and transmitted light
Complete system with polarizer on slider and DIC prisms A+D 5x-100x
Fluorescence module with 100W Hg Lamp resolution

Image Analysis Software
Make: Soft Imaging Systems, Germany (version 5.2)

Applications:
- Materials Science
- Biological Science
- Life Science
- Pharmaceuticals
- Semiconductors
- Environmental Science

Location:
Centre for Research in Nanotechnology and Science

Contact:
iaslab@iitb.ac.in

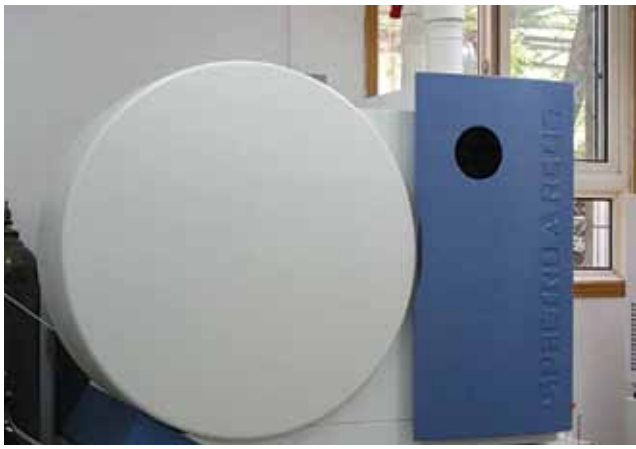
Inductively Coupled Plasma - Atomic Emission Spectrometer

When solution passes through the Argon plasma, all the bond break and atom goes to excited state owing to jumping of electrons to higher shell. They come down to ground state by emitting energy at their characteristic wavelength. This wavelength is measured to get qualitative information about element present and the intensity of the line is measured at that wavelength to quantify the element present.

Make and Model:
Model: Spectro ARCOS
Make: Spectro Analytical Instruments GmbH, (Boschstrasse 10, 47533 Kleve) GERMANY, Division of Ametek Instruments, U S A

Specifications/Features:

- R. F. Generator: 1.7 KW, 27.12 MHz Free running.
- Plasma: Radial Plasma
- Spectrometer: Wavelength Range: 130 nm to 770 nm to cover VUV range with resolution of 8.5 pm.
- Detector: CCD detector mounted along the Rowland circle to measure full wavelength simultaneously.
- Nebulizers: Cross flow, Concentric, Organic and HF resistant.
- Spray Chambers: HF resistant, Cyclonic, Double pass for cross flow and organic nebulizer, double pass cyclonic Spray chamber for organic samples.



Inductively Coupled Plasma - Atomic Emission Spectrometer

Applications:
Precious metal estimation at Low level
Heavy metal estimation at sub ppm level
Rock, soil, fly ash, sediments, clay analysis.
Environmental samples analysis (Air, surface water, soil, plants, ground water)
Biological sample analysis (Urine, teeth, bone, tissues etc)
Polymer and pharmaceutical sample analysis.

Location:
Room 409, Centre for Research in Nanotechnology and Science.

Contact:
icplab@iitb.ac.in

Liquid Chromatograph Mass Spectrometer

Liquid Chromatograph Mass Spectrometer

Liquid chromatograph / Mass Spectroscopy (LC / MS) is a technique which combines high performance liquid chromatography HPLC, a analytical separation technique with mass spectroscopy ,a powerful analysis & detection technique.

- HPLC can be combined with Photo Diode Array detector (PDA).
- HPLC seperations can be detected by PDA & Mass spectrometer as different detectors.

Ion Trap MS/MS (MS n) Function :

- Ion Injection & accumulation
- Isolation (Ejection of masses above & below parent ion)
- Fragmentation(CID of precursor of all product ions)
- Ejection of product ions to detector Ion trap facility

Make and Model:
Varian Inc, USA, 410 Prostar Binary LC with 500 MS IT PDA Detectors.

Specifications/Features:
Mass Range : 50-2000 amu
Ionisation Method : Atmospheric Pressure Ionisation

- ESI positive & negative
- APCI positive & negative
- Direct Infusion for Mass Analysis
- Ion Trap facility to study selected mass over other interference and fragmentation pattern
- Binary HP- LC system with Mass as detector
- Binary HP- LC system with PDA detector
- HPLC PDA Mass Spectrometer

Applications:

- Qualitative of Quantitative Analysis
- Impurity Profiling
- Metabolite Studies
- Pharmacokinetics
- Pharma & biomedical applications

Location:
Centre for Research in Nanotechnology and Science

Contact:
lcmslab@iitb.ac.in

Nuclear Magnetic Resonance Spectrometer

Make and Model: Varian Inc, USA, Mercury Plus 300MHz NMR spectrometer

Specifications / Features:

- 5mm Autoswitchable probe with PFG (1H/ 13C/ 31P/ 19F) 5mm Dual Broad Band probe with PFG for Multinuclear NMR (13C, 15N, 27Al, 31P, 29Si, 77Se, 119Sn, 125Te, 199Hg, 51V, 7Li etc.)
- 5mm multinuclear probes for solution studies.
- Multi nuclear CP-MAS probe for solids application.
- VT Accessory: Variable temperature facility is available from -80 degree to +130 degree with suitable solvent.
- NMR Probe is switch-able high frequency range (1H, 19F) and broad band frequency range (13C, 15N, 27Al, 31P, 29Si, 77Se, 119Sn, 125Te etc.).
- In case of solids, only broad band frequency range is available and the sample can be spun up to a maximum of 5 KHz at the magic angle.
- High power decoupling in case of solids is limited to a power of 100 W.
- Total spectral width is limited to 100 KHz

Applications:

- Molecular conformation in solution
- Quantitative analysis of mixtures containing known compounds
- Determining the content and purity of a sample

Nuclear Magnetic Resonance Spectrometer

- Through space connectivity (overhauser effect)
- Chemical dynamics (Lineshapes, relaxation phenomena)
- Solid State NMR is widely popular for the characterization of polymers, rubbers, ceramics, glasses and molecular sieves.

Location:
Centre for Research in Nanotechnology and Science

Contact:
nmrlab@iitb.ac.in

Thermal Analysis System

Thermal Analysis System

The Diamond Thermogravimetric/ Differential Thermal Analyzer (TG/ DTA) combines the high flexibility of the differential temperature analysis (DTA) feature with proven capabilities of the Thermogravimetry (TG) measurement technology. The combination not only ensures that the sample is exposed to identical thermal treatment and environment but allows one to determine whether an endothermic or exothermic transition is associated with weight loss in contrast to a melting or crystallization process.

DSC-Measures the amount of energy absorbed or released by a sample as it is heated, cooled or held at a constant temperature.

Contact:
tgdta@iitb.ac.in

Make and Model:
VSimultaneous TGA & DTA: PERKIN ELMER,USA, Diamond TG/DTA

Specification:
Temp. range : - Ambient to 1500°C
Heating Rate : 0.01 -100° C/min.
Balance Type :Horizontal differential type
Atmosphere : Air,Inert Gas, Vacuum (10-2 Torr)
Purge Gas flow rate :0 - 1000 ml/min

Make and Model:
DSC & TGA: Dupont ,USA, 2000

Specification:
TGA- Temp. range : - Ambient to 1000° C
Heating Rate : 10° C-40° C/min
DSC- Temp. range : - Ambient to 500° C (Ambient Pressure)
Heating Rate : 5°C-20°C/min

Applications:
- Compositional analysis
- Decomposition and Transition temperatures
- Filler content
- Heat of Transition
- Measurement of volatiles
- Oxidative and Thermal stabilities

Location:
Centre for Research in Nanotechnology and Science

Transmission Electron Microscope

Transmission Electron Microscope images are formed using transmitted electrons (instead of the visible light) which can produce magnification details up to 1,000,000x with resolution better than 10 Ao. The images can be resolved over a fluorescent screen or a photographic film. Further more the analysis of the X-ray produced by the interaction between the accelerated electrons with the sample allows detemining the elemental composition of the sample with high spatial resolution.

Make and Model:
PHILIPS, CM200

Specification / Features:
Operating voltages : 20-200kv
Resolution :2.4 Ao

Applications:
- Materials Science/Metallurgy biological Science
- Nanotechnology
- Ceramics
- Pharmaceuticals
- Semiconductors

Location:
Centre for Research in Nanotechnology and Science

Transmission Electron Microscope

Contact:
temlab@iitb.ac.in

Time-of-Flight Secondary Ion Mass Spectrometer

Time-of-Flight Secondary Ion Mass Spectrometer

Time-of-Flight Secondary Ion Mass Spectroscopy (ToF SIMS) is a surface sensitive Spectroscopy that uses a pulsed Primary Ion beam to induce the desorption and ionization of atomic and molecular species from a solid sample surface. The resulting Secondary Ions are accelerated into the Mass Spectrometer where they are mass separated by measuring the time-of-flight from the sample to the detector and a mass spectrum is recorded. An Image may be generated by rastering a finely focussed Ion beam across the sample surface. A depth profile may be constructed by using an Ion beam to remove sequential layers of material from the surface while acquiring mass spectra at each depth.

Make and Model: Ion Guns: LMIG, Cesium and Gas Ion guns.

Applications:
Nanodevices; Polymer blends; Pharmaceuticals; Thin films/surface coatings; corrosion; Catalysis; Geologic materials etc

Location:
Centre for Research in Nanotechnology and Science

Contact:
office.saif@iitb.ac.in

X-Ray Fluorescence Spectrometer

When an X - Ray beam strikes the samples, an inner shell electron is excited by incident X Ray Photon and removed from the shell. The excited atom allows the outer shell electron to jump to inner shell during de excitation process by releasing the extra energy it has in the form of soft X - Ray photon. This X -Ray energy emitted by Atom, called fluorescence and gives the characteristic peaks of atoms. The wavelength / energy of the peak gives qualitative information about the atom present and intensity of the peak gives the quantitative (concentration) information of the elements present.

X-Ray Fluorescence Spectrometer

Make and Model:
Spectris Technology, The Netherlands, Panalytical: PW 2404 X Ray Fluorescence Spectrometer

Specifications/Features:
X Ray Tube: Rh Target
X Ray Generator: 4 KW, 60 KV, 125 m Amp.
Detector: Scintillation detector, Proportional (Flow) detector and Xenon gas filled detector for mid range of elements in tandem with proportional detector.

Applications:

- XRF Spectrometry is widely used for qualitative and quantitative elemental analysis of environmental, biological, geological, industrial, material and all other types of solid, liquid and powder samples.
- It can analyse most elements from ppm level to percentage level, including S, P, F, Cl, Br & Iodine.

Location:
Room 308, Centre for Research in Nanotechnology and Science.

Contact:
xrflab@iitb.ac.in

Central Surface Analytical Facility

Central Surface Analytical Facility

Central surface analytical facility (also called as ESCA) is a surface analytical tool (up to depth ~1 nm). This is used for surface characterization such as XPS, UPS, Auger, and Depth profiling.

Make and Model :
Thermo VG Scientific, Multilab 2000

Specifications/Features:

- High transmission electron energy analyzer Concentric hemispherical analyzer (CHA), Option of large area, small area spectroscopy, Multi channel spectroscopic detector
- High flux dual anode X-ray, High flux UV source, and monochromatic X-ray source
- AES/SEM/SAM electron gun Auger Electron Gun (FEG1000)
  Energy range up to 7 keV
- Low energy charge neutralization source
- Broad spot sample cleaning source
- XPS Sources: Twin anode (Mg$K\alpha$/ Zr$L\alpha$) 300 W and Microfocused monochromatic (AlKα) 250 W X-ray sources
- Differentially pumped ion gun: high performance gun for precision depth profiling, Energy range 100 eV to 5 keV for sample etching (cleaning) and depth profiling

Applications:

- Elemental composition of surface and quantification of there relative concentrations with some limitations
- Chemical states of elements
- Relative quantification of chemical state of each element
- Thickness of thin films
- Depth profiling
- Spatial distribution of material

Location:
Room No. 2, Ground Floor,
Department of Physics

Contact:
Prof. V.S. Raja,
Department of Metallurgical Engineering and Materials Science
esca@iitb.ac.in

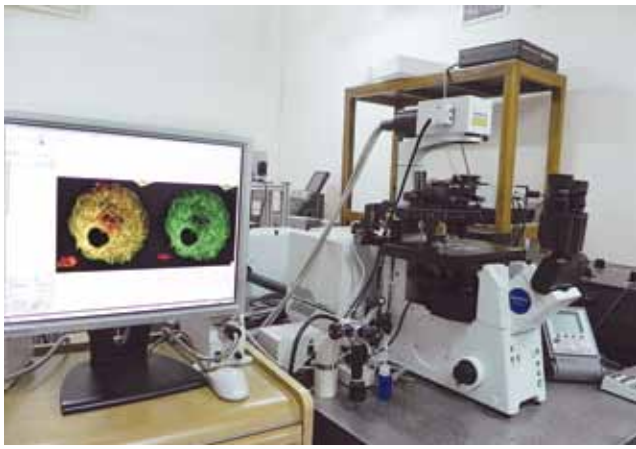
Confocal Laser Scanning Microscopy

Confocal laser scanning microscopy has become an essential tool for research in the areas of biological, biomedical and material sciences owing to its several advantageous over conventional widefield optical microscopy.

Make and Model :
Olympus, IX81

Specifications / Features:
The IX 81 combined with FV-500 is Olympus most advanced confocal laser scanning motorized microscope providing high standards of observation, measurement and functional operation. A V-shaped optical path, improved fluorescence illuminators and further expanded UIS optics provide excellent performance for research applications. A modular system of motorized accessories allows for complete customization to individual research needs.

Multi-Dimensional analyses can be performed automatically or even remotely via computer control. Additionally, the IX 81 features numerous input and output ports allowing the use of several light sources and detectors. The IX 81 is the optimum imaging platform for research and automation.



Confocal Laser Scanning Microscope

Applications:
It is used for imaging thin optical sections in living and fixed biological specimens ranging in thickness up to 100 micrometers

Location:
Lab No 310,
Centre for Research in Nanotechnology and Science

Contact:
Prof. Dulal Panda,
Department of Biosciences and Bioengineering
clsm@iitb.ac.in

Cryo Transmission Electron Microscope

Cryo Transmission Electron Microscope

This facility enables one to explore the native state of low-contrast, beam-sensitive biological specimens, or other soft materials like polymers.

Make and Model:
FEI Tecnai , 12 BioTwin

Specifications/Features:
High-contrast imaging
Low-dose operation
Low-temperature observation
- Magnification —22 to 3,40,000

Contact:
Prof. Jayesh Bellare,
Department of Chemical Engineering
ctem@iitb.ac.in

- Electron source
  - Tungsten or LaB6 emitte
  - Auto saturation
  - High Voltage range 20 to 120 KV
  - Resolution 1.0 nm
- Vacuum
  - Ultra high vacuum for contamination free observation of the specimen
  - Specimen chamber and gun area with 10 -6 Pa.
- Specimen stage - Compustage
  - X, Y movement 2 mm, specimen size 3 mm
  - High tilt (± 80°) and large field of view.
- Imaging:
  - High contrast, long focal length objective lens (BioTwin)
  - Automated contrast enhancement
  - Rotation free magnification and diffraction series.

Applications:
- Morphology of internal cell structure can be analyzed.
- Observation of particle/molecule in nano size range.

Location:
Lab. No. 306 & 309,
Centre for Research in Nanotechnology and Science

Dielectric Broadband Spectrometer

Broadband dielectric spectroscopy is a tool for investigating a variety of dielectric processes for both electrical and non-electrical applications. It measures electric properties of materials over a wide frequency and temperature range.

Make and Model:
Novocontrol Technologies Germany – Concept 80

Specifications/Features:
- Below 20 MHz working on gain phase measurement method
- From 1 to 3 GHz working on coaxial line reflectometry method.

Technical specifications:
- Temperature range : -150°C to 350°C
- Frequency range :
  1. Novocontrol Alpha A Analyzer : 3μHz to 20 MHz and
  2. Agilent E4991A RF analyzer : 1MHz to 3GHz

Applications:
- Polymers, rubbers, liquid crystals, ferroelectrics, ceramics, Dielectric spectra, molecular relaxation and dynamics, glass transition.
- Pharmaceutical applications, characterization of drugs.
- Structural material properties like phase transitions, phase compositions and crystallization processes

Dielectric Broadband Spectrometer

- Semiconductors, organic crystals: charge transport, activation energy, charge mobility.
- Civil engineering: characterization of concrete.

Location:
Room No. 2, Ground floor,
Department of Metallurgical Engineering and Materials Science

Contact:
Prof. P. Gopalan,
Department of Metallurgical Engineering and Materials Science
clsm@iitb.ac.in

Environmental Scanning Electron Microscope

Environmental Scanning Electron Microscope

Environmental Scanning Electron Microscope is used to study the characterization (composition, surface topography, etc.) of heterogeneous materials and surfaces.

Make and Model:
FEI, Quanta 200 (D 7548)

Specifications / Features:
- Operating voltages : 0.7 - 30 kV
- Resolution :3.0 nm

Applications:
- Materials Science/Metallurgy
- Biological Science
- Nanotechnology
- Ceramics
- Pharmaceuticals
- Semiconductors

Location:
Centre for Research in Nanotechnology and Science

Contact:
The Head,
Centre for Research in Nano technology and Science
esem@iitb.ac.in

Liquid Helium Plant

This produces liquid helium from helium gas.

Make and Model:
Linde Cryogenics USA, Model 1410

Production Capacity:

- 14 litres per hour in pure gas mode
- 30-40 litres per hour with liquid nitrogen pre-cooling.

Applications:
Liquid helium can be used for cooling purposes down to 2 K for doing various experiments at low temperatures. Liquid helium can also be used for cooling superconducting magnets such as the ones used in NMR machines, MRI machines, etc.

Location:
Room No.1, Department of Physics

Liquid Helium Plant

Contact:
Prof. C. V. Tomy,
Department of Physics
tomy@phy.iitb.ac.in

Liquid Nitrogen Plant

Liquid Nitrogen plant

Make and Model:
Stirling Cryogenics

Production Capacity:
- 5 Litres per hour

Location:
Ground floor,
Department of Electrical Engineering
(Annexe)

Contact:
Prof. R. Pinto,
Dept. of Electrical Engineering
ln2@iitb.ac.in

Microcompounder and Mini Injection Moulding

The microcompounder facility consists of conical twin-screw microcompounder and a mini-injection molding machine. The facility offers an option to effectively blend as well as mould smaller quantity of polymeric materials and prepare test specimens for tensile and flexural properties.

Make and Model:
DSM Xplore™ 5 cm^3 twin-screw

Specifications/Features:

- Divisible extruder housing and double, co-rotating detachable extruder screws with an integrated adjustable driving gear.
- Capacity of mixing few grams of polymeric materials (up to 5 ml) during melt-mixing of polymer blends or making polymer nanocomposites.
- Extruded strand (diameter ~ 2 mm)
- Dumb-bell shaped rectangular tensile specimen (ASTM D638, type V)

Applications:
Thermoplastics (with or without fillers or additives) are processed above their melting point (up to 350 °C) in the microcompounder.

During melt-mixing the machine allows for the axial force measurement (torque data can also be calculated) which otherwise indicates the melt-viscosity of the mixture.

Microcompounder and mini injection moulding

Location:
Room No.: B11,
Department of Metallurgical Engineering and Materials Science

Contact:
Prof. Arup R. Bhattacharyya,
Department of Metallurgical Engineering and Materials Science
arupranjan@iitb.ac.in

NanoIndenter

NanoIndenter

Nanoindentation facility is used to study mechanical properties of thin films and small structures. Nanoindentation technique is called a depth-sensing indentation technique.

Make & Model:
Hysitron Inc Minneapolis USA, TI-900

Specifications/Features:

- Load control and displacement control capabilities.
- The tip used for indentation is also used for scanning the sample.
- Load Range :
  low load - upto 10 μN,
  high load - upto 500 mN
- Displacement range :
  Max Z-displacement - 5 μm,
  Max X-displacement - 15 μm
- Load Resolution :
  Indentation 1 nN,
  Scratch 3 μN
- Displacement resolution :
  Z-axis upto 0.04 nm,
  X-axis upto 4 nm
- Heating/Cooling stage:
  Temperature range -10 to 200°C
- Frequency range for DMA:
  1 to 300Hz

Applications:

- Involves forcing a sharp diamond indenter into the surface of the sample, while measuring the force imposed and the corresponding displacement of the indenter.
- The size of the indentation is determined from the measured depth of indentation and the calibrated shape of the indenter.
- Used to study properties of:
  - Bulk Materials
  - Multiphase materials
  - MEMS devices
  - Nanostructured materials
  - Protective Coatings
  - Depth Profiling of layered materials

Location:
Room No.B-14,
Department of Metallurgical Engineering and Materials Science

Contact:
Prof. (Ms.) Prita Pant,
Department of Metallurgical Engineering and Materials Science
nanoindenter@iitb.ac.in

Physical Property Measurement System

Physical Property Measurement System is used for the magnetization measurement of a matter.

Make and Model:
Quantum Design, USA

Specifications / Features:
- Vibrating sample magnetometer for magnetization measurements
- Magnetic Field : ±9 Tesla (or ± 90 kOe)
- Temperature range : 2 - 325 K
- Resolution : 10^{-6} emu
- Sample size (maximum): length ~ 10 mm, breadth ~ 0.5 mm, thickness ~ 0.5 mm

Applications:
- Magnetic moment/Magnetization/ dc susceptibility of a sample can be measured as a function of temperature or magnetic field
- Two types of measurements possible:
  - M vs H: Field is varied at a fixed temperature and magnetization is measured
  - M vs T: Temperature is varied at a fixed field and magnetization is measured

Location:
Room No. 14, Ground floor,
Department of Physics

Physical Property Measurement System

Contact:
Prof. C. V. Tomy,
Department of Physics
tomy@iitb.ac.in

Scanning Probe Microscopy

Scanning Probe Microscopy

Scanning Probe Microscope (SPM) is used to measure properties of surfaces. SPM includes Atomic Force Microscopes (AFM) and Scanning Tunneling Microscopes (STM).

Make and Model:
Veeco Digital Instruments, Multimode Nanoscope IV

Specifications/Features:
Routine modes:

- Contact mode AFM
- Tapping mode AFM

Contact:
Prof. S. S. Major,
Department of Physics
spm@iitb.ac.in

Advanced modes:

- STM with following applications, Low current STM and Scanning Tunneling Spectroscopy (STS)
- Fluid Cell AFM
- Magnetic Force Microscopy (MFM)
- Electric Force Microscopy (EFM)
- Conductive AFM (C-AFM)
- Electrochemical AFM and STM
- Nanoindentation and Nanoscratching

Applications:

- Studies of surface topography/ morphology of thin films of metals, semiconductors, oxides, polymers, and Langmuir-Blodgett multilayers
- Phase imaging of polymers and their nanocomposites
- Particle size distribution of micro/ nanoparticles
- Study of drug nanoparticles and lipids on mica
- Study of semiconductor quantum dots
- Applications of various derivative modes (listed above as advanced modes) for investigating electrically homogeneous/heterogeneous materials, magnetic thin films, ferroelectric thin films, and various nanomaterials/structures deposited on substrate.

Location:
Room No. 14, Ground floor,
Department of Physics

Spectroscopic Ellipsometry

Spectroscopic Ellipsometry is used to characterize thin films and multi-layer structures.

Make and Model:
SE 800

Specifications / Features:
- Spectral range: 240 - 930 nm
- Incident angles: 40 - 90°, 50 steps, generally kept at 70° fixed
- Parameters extracted: thin film thickness, refractive index, uniformity of films and layer stacks
- Substrate: Si substrate or transparent substrate like Glass
- Sample size: minimum 1 x 1 cm, maximum 6 inch wafer
- Thickness: Minimum 1-2 nm, maximum 100 microns

Applications:
- Linearly polarized light is reflected from the surface of a material. The reflected light becomes elliptically polarized, the degree of ellipticity being determined by the optical properties of the solid being probed.
- Film thickness and refractive index of single films and each layer of a multi layer stack can be measured.
- It is a non-destructive and contactless measurement tool for the characterization of thin film.

Spectroscopic Ellipsometry

- An optical model and fitting procedure are used to obtain film thickness and dispersion of the optical constants n and k.

Location:
Department of Electrical engineering

Contact:
Prof. R. Pinto
ellipsometer@iitb.ac.in

OrthoCAD Network Research Cell

OrthoCAD research cell

The OrthoCAD Cell was set up with the initial mission of developing a high-quality low-cost modular knee prosthesis system for young patients affected by bone cancer.

Specifications/Features:

- CAD/CAE/CAM workstations with Solidworks, Hypermesh, Radioss and UG-NX
- Computer-aided surgery system with MIMICS, FreeForm and NDI Polaris Vectra
- Desktop Rapid Prototyping machine (Solid dimension SD300)
- Knee walking simulator machine (indigenous) for fatigue and wear testing
- Stereo microscope (Meiji, 50-100x), weighing balance (Sartorius, 0.1 mg accuracy)
- Universal Testing Machine (Instron) with special attachments for implant testing
- Photo-elastic Stress Analysis system (Vishay) with laser direction and coating kit

Applications:

Using these facilities, a novel rotating-hinge modular total knee prosthesis along with suitable surgical instruments have been developed. A 3D surgery planning software to select, position and visualize the implants in the patient's anatomy reconstructed from CT images has also been developed, and is available for use by orthopaedic surgeons. The next phase of the mission includes taking up other joints and instruments.

Location:

F4 bay, Next to power house

Contact:
Prof B Ravi,
Mechanical Engineering Dept ,
b.ravi@iitb.ac.in

Quadrupole-Time of Flight Tandem Mass Spectrometer

The mass spectroscope is a compact bench-top, fully integrated, high performance Quadrupole-time of flight tandem mass spectrometer that can be configured for a wide range of Liquid Chromatograph Mass Spectrometer (LCMS) and Liquid Chromatography MS/MS applications.

Make and Model:
Q-Tof microTM

Special Features:

- A hybrid system utilizing a high performance research grade analyzer, and an orthogonal acceleration ToF mass spectrometer
- Pre-filter assembly to protect the main analyzer against contaminating deposits
- The hexapole collision cell between the two mass analyzers can be used to induce fragmentation to assist in structural investigations
- Ions emerging from the second analyzer are detected by the microchannel plate detector and ion counting system
- Two techniques are possible using the Micromass Z-spray atmospheric pressure ionization source, namely:
- Atmospheric Pressure Chemical Ionization (APCI)
- Electrospray Ionization

Quadrupole-Time of Flight Tandem Mass Spectrometer

Applications:
This instrument is used for

- Trace gas analysis
- Pharmakinetics
- Protein characterization
- Space exploration
- Respired gas monitor

Location:
Room no: 370,
Department of Chemistry

Contact:
Prof. K. P. Kaliappan,
Department of Chemistry
kpk@chem.iitb.ac.in
Prof. M. Ravikanth,
Department of Chemistry
ravikanth@chem.iitb.ac.in

Rapid Prototyping and Tooling Facility

Prototypes made on the FDM Machine

Rapid Prototyping Unit

Rapid Prototyping is a technology that makes it possible to manufacture objects directly from their CAD models without human intervention, or use of product-specific tools, dies, or fixtures.

Make and Model:
STRATASYS - FDM1650

Special Features:
- Cold metal spraying
- Epoxy and Silicone tooling set ups
- Two S.G. INDY 5000 workstations
- Proengineer release 18.

Applications:
- Physical verification of design concepts
- Testing assembly and fit between parts
- Models for market research and tenders
- Artificial limbs for medical applications
- Rapid production of metal prototypes.
- Rapid tooling for casting and moulding.
- Redesign of layout for folding and packaging section and design of bulk - packing for clothes

Location:
Next to F3 shed in central workshop area

Contact:
Prof K P Karunakaran,
Department of Mechanical Engineering
karuna@iitb.ac.in,
The Head,
Department of Mechanical Engineering
head.me@iitb.ac.in

Structural Integrity Testing and Analysis Centre

It is a large-scale component testing facility

Make and Model:
ZWICK

Special Features:

- Loading capacity of 2 x 750 KN(static) and 2 x 650 KN(dynamic)
- Advanced control features
- Data Acquisition Systems
- 10-ton crane attachment for material handling
- Earthquake-resistant features

Applications:

- Testing of large pipes, elbows and other heavy built-up units and components
- Fatigue/fracture studies

Location:
Between S2-S3 bay of Central Workshop

Fatigue Testing Machine

Contact:
Prof A De,
Department of Mechanical Engineering,
amit@iitb.ac.in
The Head,
Department of Mechanical Engineering,
head.me@iitb.ac.in

Thermal Hydraulic Test Facility

Control room of Thermal Hydraulic Test Facility

A scaled model of the primary system of the proposed Advanced Heavy Water Reactor (AHWR) has been built at IIT Bombay.

Specifications/Features:

- Scales chosen are ¼ height scale and 1/3000 power scale
- Has four natural circulation channels
- Model can operate up to a pressure of 70 bar and power of 560 kW
- One forced circulation loop dedicated for CHF studies
- A new forced loop for 54-rod cluster is being set-up

Applications:

- To identify a stable operating zone of the proposed AHWR
- To generate Critical Heat Flux (CHF) data
- To identify a safe starting procedure

Status

- CHF studies at pressures up to 70 bar completed
- Stability domain with single loop fully characterized up to 70 bar.
- Studies on parallel channel stability are being initiated
- Studies on stability of drum level control is being initiated

Location:

Near power house.

Contact:
Prof. Kannan Iyer,
Department of Mechanical Engineering
kiyer@iitb.ac.in,
Prof. R. P. Vedula,
Department of Mechanical Engineering
rpv@iitb.ac.in

VLSI Design Laboratory

The VLSI Design Laboratory was originally set up in 1998 under the project on 'Specialized Manpower Development Program in VLSI Design' to train teachers across the country. Intel Inc., USA has supported this lab for 5 years from November 2003 to till end of 2008. During this period the Lab was rechristened as INTEL VLSI Design laboratory. The laboratory has several latest PCs and SUN workstations.

Specifications/Features:

- CAD tools like MAGIC tools, ALLIANCE tools, Xilinx FPGA tools
- Commercial CAD VLSI design tools for technology nods even in sub 100 nm technologies.
- CAD tools include full set of design tools from Cadence (design possible in all domains: Digital, analog and RF, full set of front end and back end tools from Synopsis, Mentor Graphics, Magma tools, CoWare tools and Xilinx tools.

Applications:

Design tools like circuit simulator-SeQUEL, a timing simulator and a circuit partitioner are available and regularly used by students. Some good number of chip designs have been realized on silicon using commercial foundries abroad.

VLSI Design Laboratory

Location:

5th floor, Department of Electrical Engineering

Contact:
Prof. A. N. Chandorkar,
Department of Electrical Engineering,
anc@iitb.ac.in

X-Ray Diffractometer

Panalytical Xpert Pro Diffractometer

The machine uses a ceramic, long line-focus x-ray tube with a copper target. It is equipped with an "Xcelerator" detector for high-speed measurement of diffraction spectra

Make and Model:
DK Hyper 320485

Specifications/Features:

- Incident beam monochromator to generate a parallel beam (beam divergence < 0.0050) of pure Cu K_1 radiation
- Xcelerator detector for high-speed measurements
- Reflectivity attachment including a flat crystal diffracted beam monochromator
- Programmable divergence slits
- Software for data analysis

Applications:
This powder diffractometer is used for quantitative and qualitative phase analysis of polycrystalline samples, as well as for reflectivity measurements in thin films and multilayers

Location:
Room no: 14 B,
Department of Physics

Contact:
Prof. A.V. Mahajan,
Physics Dept
a.v.mahajan@iitb.ac.in,
The Head, Physics Dept
head.phy@iitb.ac.in

Central Library

Central Library is another great resource at IIT Bombay which strives to keep pace with a global, dynamic, and technology-enabled information environment to meet the expectations of its users. Beside holding an excellent collection of over 400,000 volumes of books, journals, theses, reports, standards, pamphlets, it provides access to over 12000 electronic books, journals and databases in sciences, engineering, technology, humanities, social sciences and management. It offers a range of services including reference and consultation, membership and circulation, document delivery, resource sharing, information alert service, book bank for needy students, and user awareness programmes. Availability of information / knowledge resources to a researcher in IIT Bombay is as good as any where in the world.

The library has its own homepage (http://www.library.iitb.ac.in), provides web-based access to its resources, supports on-line submission of theses and dissertations, and has set up an institutional archive of publications brought out by the IIT Bombay community. Users can search our on-line catalogue (OPAC) to find out the availability of material in the library, accessible 24x7 via library web page.

The library is the hub of all R&D activities of IIT Bombay and plays a significant role in facilitating creation and dissemination of knowledge. It not only acquires, organizes, processes and provides access to all knowledge resources, but also offers an ambiance which all researchers will find extremely attractive and conducive for their work.

Central Library - Reading Room

Contact:
Mr. Daulat Jotwani,
Librarian,
librarian@iitb.ac.in

Additional Resources

Centre for Distance Engineering Education Programme

This center was established to meet the national need for distance education and e-learning.

Aim:

- To disseminate knowledge in various fields of science and engineering using modern technological tools.
- A large number of courses from various disciplines being developed
- Both video and web-based lectures are being made available

Facilities:

- Four dedicated video studios
- Web development laboratory

Activities:

- Facilitates video streaming of IIT Bombay courses using the bandwidth provided by ISRO on EDUSAT
- Video conferencing on the National Knowledge Network (NKN)
- Exploration of e-learning deployment strategies like VCD and multimedia streaming.
- Courses transmitted through live video-multicast using the satellite based VSAT technology to geographically dispersed Remote Centres.

Courses are designed for two main categories of participants:

- Working professionals and other eligible graduates
- Teachers and senior undergraduate students of engineering colleges

Video and web-based lecture room

The center offers courses in four modes with different fee structures:

- Credit mode with IIT Bombay certification
- Credit mode with Remote Centre certification
- Extended live classroom mode
- Offline classroom mode

Contact:
head.cdeep@iitb.ac.in

Centre for Environmental Science and Engineering

Micro-orifice uniform deposit impacter with diffusion drier

Microbiology laboratory

- Aerosol research Laboratory
- Air Monitoring Laboratory
- Biogas Laboratory
- Chemistry Laboratory
- Instrumentation Laboratory
- Microbiology Laboratory
- Computing Facility

Contact:
head.cese@iitb.ac.in
www.cese.iitb.ac.in

Centre for Technology Alternatives for Rural Areas

- Workshop facility for metal and wood working
- Laboratory for post harvesting of food products

Food colour analyser

Power take-off generator

Contact:
head.ctara@iitb.ac.in

Centre of Studies in Resources Engineering

Dual Frequency GPS Systems (Leica 1200 Series) with RTK System

Corner Reflector

YSI V2-2 6600 SONDE

Facilities:

- Networked computation facility with access to Central Server hosting of Image Processing and GIS software.

Laboratories:

- Geomatics Laboratory
- Image Processing Laboratory
- Geo-Spatial Data Analysis Laboratory
- Agroinformatics Laboratory
- Marine and Coastal Research Laboratory
- Geo-Chemical Analysis Laboratory with AAS, XRF etc.

Software:

- ARCGIS
- ERDAS IMAGINE with Leica Photogrammetry Suite
- GEOMATICA Photogrammetry Suite
- ENVI and GAMMA software for microwave data analysis.
- MATLAB Tool kit for Image Processing

Contact:
hod@csre.iitb.ac.in
www.csre.iitb.ac.in

Department of Aerospace Engineering

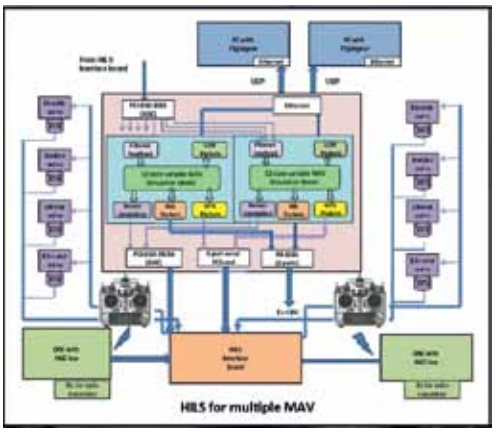
- Aerodynamics Laboratory: Houses Subsonicand supersonic wind tunnels, open jets, water tunnel, and the Laser Doppler Velocimeter (LDV) facility
- Control Laboratory: Experimental setups for control education
- Structures Laboratory: Facilities for FRP fabrication, material and structural testing, strain and motion measurement, drop weight and ballistic impact testing, high strain rate testing, vibration measurement and modal analysis
- Propulsion Laboratory, Turbomachinery Research Laboratory and Combustion Research laboratory: Houses rigs for studying blade cascades, axial flow fan rotor and stage characteristics, turbine exhaust diffusers, mini turbojet engine, nozzle testing facilities, flue gas analyzer, high accuracy mass flow controllers, DSLR camera and high speed camera for flame visualization
- Shock Tunnel Laboratory: Has complete shock tunnel to simulate hypersonic free streams and instrumentation for the following studies:
  - Measurement of forces and moments on hypersonic test models
  - Heat transfer rate measurement techniques
  - Hypersonic flow physics on complex test models through flow visualization and pressure measurement techniques
  - Shock dynamics and shock loading into condensed matter
- MAV Laboratory: has a facility for building flying aircrafts models, antonomous mini and micro aerial vehicles, HILS and OILS for MAVs and co-operative flying
- Associate Centre for Computational fluid dynamics: Provides computational assistance with its servers, workstations, Linux clusters

Shock Tunnel Laboratory

Contact:
head.aero@iitb.ac.in
www.aero.iitb.ac.in

Centre for Aerospace Systems Design and Engineering

Micro Aerial Vehicles



HILS for multiple MAV

Objectives:

- Conducting system level integration studies through design, build, fly philosophy for Mini Aerial Vehicle (MAV) in autonomous mode, including multi-agent co-operative flying
- Research & Development in Multidisciplinary Design Optimization (MDO)
- Systems Engineering Research

Facilities:

- Integrated Modeling and Simulation Laboratory (IMSL)
- Multidisciplinary Design Optimization (MDO) Laboratory
- Applied Mechatronics laboratory
- Facilities for design, fabrication, testing and flying of Micro Aerial Vehicles
- Modelling frameworks for systems design

Contact:
casde@aero.iitb.ac.in
head.aero@iitb.ac.in
www.casde.iitb.ac.in

Department of Biosciences and Bioengineering

- Molecular Biology facilities: Liquid Scintillation Counter, Spectrometer, Spectro-fluorimeter; Thermocycler, Deep freezer (- 80° C), High-speed Centrifuge, Gel documentation, Lyophilizer.
- FPLC / HPLC systems
- Tissue Culture facility, Micromanipulator, Microscope.
- Solid phase peptide synthesizer,
- Computational facility
- Microelectronics Laboratory in Department of Electrical Engineering
- Signal Processing and Artificial Neural Networks Laboratory

FPLC Facility

Lypophilizer

Contact:
head.bio@iitb.ac.in
www.bio.iitb.ac.in

Department of Chemical Engineering

Simultaneous thermal analyzer in the process laboratory

Laboratories

- Automation Laboratory
- Biochemical engineering Laboratory
- Biosystems Engineering Laboratory
- Computer Aided Design Centre
- Cellulose
- Fluid Mechanics Laboratory
- Heat Transfer Laboratory
- Membrane Laboratory
- Processes Engineering Laboratory
- Particle and Aerosol Research Laboratory
- Polymer Laboratory
- Protein Engineering Laboratory
- Reaction Engineering Laboratory
- Silicate Technology Laboratory
- Soft Fluids Technology Laboratory
- Thermodynamics Laboratory

Contact:
head.che@iitb.ac.in
www.che.iitb.ac.in

Facilities:

Biotechnology: Real time PCR, Refrigerated centrifuge, Microarray scanner, Fermentors

Composition Analysis: Gas chromatography, UV spectrophotometer, HPLC, HPTLC, GC-MS

Interfacial Analysis: Surface charge analyzer, Surface profilometer, Ellipsometer, Langmuir Bladgett, Quartz Crystal microbalance, interfacial and contact angle goniometer

Microscopy: Upright, Inverted, Rheo-Microscopy, Stereo zoom, HR-TEM, SEM, Image analyzers, AFM

Softwares: Molecular modeling, Process design, Matlab, Tomlab, COMSOL

Reactions: CSTR, Reactive distillation, Gas absorption, PFR setups, Stopped flow reactor, electrochemical workstation, rotating disc electrode, hanging mercury drop electrode

Rheology: Rheometers

Sample preparation: Air jet atomizer, Autotitrator, Deep freezer, Mini extruder

Size analysis: DLS, Condensation particle counter

Spectroscopy: Small angle x-ray spectrophotometer

Thermodynamic Analysis: Bomb Calorimeter, Microcalorimeter, Othermer-Still, TGA-DTA-DSC instrument

Polymer processing: Reaction injection moulding machine, Single screw extruder, cast films and film blown assemblies, hollow fiber extrusion, electrospinning of fibers

Prototype plants: Supercritical fluid extractor, bio-diesel

Advanced inverted Fluorescent Microscope

Department of Chemistry

Quadropole Time of flight Tandem mass spectrometer

Gas Chromatograph with Molecular Spectrometer

Facilities:

- FTIR and UV-VIS-NIR Spectrophotometers.
- Computer laboratories with high-end workstations and GAUSSIAN, SPARTAN, HYPERCHEM, GAMESS and GROMOS software packages
- C, H, N, S Analyzer, Spectropolarimeters, GCMS, HPLC, Spectrofluorimeters, TGA/DTA, Cyclic Voltameters, Faraday Magnetic Susceptibility Balance
- Powder XRD facility
- Single Crystal X-Ray Diffractometer
- 400 MHz NMR Spectrometer
- Liquid Nitrogen plant
- Surface and porosity analyser
- Q-ToF Tandem Mass Spectrometer
- Peptide Sequencer
- Nano second / pico second time resolved ultra fast setup

Contact:
head.chem@iitb.ac.in
www.chem.iitb.ac.in

Department of Civil Engineering

- Structural Engineering Laboratories
  - Concrete technology Laboratory
  - Experimental mechanics Laboratory
  - Heavy structures Laboratory

- Remote sensing Laboratories
  - Geodesy Laboratory
  - Global positioning systems Laboratory
  - Photogrammetry and remote sensing Laboratory

- Geotechnical Engineering Laboratories
  - Environmental Geotechnical Laboratory
  - Geo-textiles and Geo-synthetics Laboratory
  - National geotechnical centrifuge facility
  - Soil mechanics Laboratory

- Water resources engineering Laboratory
  - Hydraulics engineering and fluid mechanics Laboratory

- Transportation systems engineering Laboratories
  - Highway material testing Laboratory
  - Traffic engineering Laboratory
  - Transport planning Laboratory

Scanning of RCC slab using Ground Penetrating Radar

- Computational Laboratories
  - Artificial intelligence Laboratory
  - Post-graduate Laboratory
  - Under-graduate Laboratory

Contact:
head@civil.iitb.ac.in
www.civil.iitb.ac.in

Department of Computer Science and Engineering

Intel laboratory

- AI and machine intelligence Laboratory
- Centre for formal design and verification of systems
- Centre for Indian language technologies
- Database and information systems Laboratory
- Digital and microcomputing Laboratory
- Embedded and real-time systems Laboratory
- Gcc resource centre
- Geospatial information science & engineering Laboratory
- Gigabit networking Laboratory
- Laboratory for intelligent internet research
- Operating systems and compilers Laboratory
- Software Laboratory
- Systems and networks research group
- Vision, graphics and imaging Laboratory

Contact:
head@cse.iitb.ac.in
www.cse.iitb.ac.in

Centre for Formal Design and Verification of Software

The Objective is to carry out R&D activities in the area of quality software and hardware development with special focus on formal verification techniques for safety-critical applications.

Facilities:
Current software resources include a number of public domain tools for:

- Formal specification and verification
- Advanced static analysis tools
- Dynamic analysis and testing tools (test-beds)
- Modeling languages and related environments for real-time software supporting simulations and verification
- Hazard analysis tools
- CASE tools and general programming environments

Centre for formal design and Verification of Software

Contact:
head@cfdvs.iitb.ac.in
www.cfdvs.iitb.ac.in

Department of Earth Sciences

Section Preparation Laboratory

Geochemical Analysis Laboratory

Facilities:

- Inductively Coupled Plasma Atomic Emission Spectrometer and Atomic Absorption Spectrometer for major and trace element analysis including rare earth elements.
- Cathodo-luminescence imaging for growth fabrics of minerals, and digenetic microtextures of sedimentary rocks.
- Scanning Electron Microscope for high magnification digital imaging,
- Energy Dispersive X-Ray Spectrometer for microanalysis of solid samples
- X-Ray Diffraction for phase identification.
- Heating and freezing stage for fluid inclusion studies in minerals.
- Optical systems for transmitted and incident light microscopy
- Engineering geological test equipment
- Experimental Petrology setup for high temperature and pressure studies
- Magnetic Susceptibility Measurement Systems and Magnetometers
- Digital Seismograph
- Vehicle for geological field investigations
- ^{40}Ar-^{39}Ar mass spectrometer
- Laser-Raman spectrometer
- Magneto-telluric unit

Contact:
head.geos@iitb.ac.in
www.geos.iitb.ac.in

Department of Electrical Engineering

Facilities:

- Bharti Centre for Communication
- Antennas and Microwave Laboratory
- Communications Laboratory
- Digital Audio Processing Laboratory
- Fiber Optic Communications Laboratory
- Information Networks Laboratory
- Multimedia Signal Processing Laboratory
- Networking Laboratory
- SPANN Laboratory
- L. R. Gadre Wireless Complex
- DSP Laboratory
- Vision and Image Processing Laboratory
- Control and Computation Laboratory
- Field Computation Laboratory
- Electrical Machines Laboratory
- Power Electronics Laboratories
- PowerAnser Laboratory
- Power System Laboratory
- Insulation Diagnostics Laboratory
- Fabrication Clean Room
- VLSI Laboratory
- Microelectronics Characterization, Simulation and Computation Laboratories
- Applied Materials Nano-manufacturing Laboratory
- Wadhwani Electronics Laboratory
- Signal Processing and Instrumentation Laboratory
- Texas Instruments Digital Signal Processing Laboratory
- Printed Circuit Board Laboratory

Electrical Machines Laboratory

Optical Spectrum Analyser

Contact:
head.ee@iitb.ac.in
www.ee.iitb.ac.in

- Center for Excellence in Nanoelectronics
  - Deposition, Growth and Annealing systems
    - Dielectric Sputter System
    - Chemical Vapor Deposition of CNT
    - Electron Beam Evaporation (Aluminum)
    - Electroplating System
    - AMAT ENDURA PVD system
    - Four-target Electron Beam Evaporator
    - AMAT Gate Stack Centura
    - Thermal Evaporator
    - Hot Wire CVD
    - Inductively coupled plasma CVD
    - Metal Sputtering System
    - Plasma Immersion Ion Implantation
    - Pulsed LASER Deposition
    - Polymer evaporation system
    - Rapid Thermal Processing
    - Silanization Set-up
    - Thermal Evaporation System (Chrome-Gold)
    - Ultech Furnaces
  - Electrical characterization
    - Fully Shielded Probe Station with Triax Chuck
    - Fully Shielded Probe Station with Triax Thermo Chuck
    - Mercury Probe
    - Unshielded Probe Station with BNC chuck
    - Unshielded Probe Station with Thermo Chuck
  - Material and structural characterisation
    - Atomic Force Microscope
    - Spectroscopic Ellipsometry
    - Flurescene Microscope
    - Contact Angle Measurement
    - Olympus Industrial Microscope
    - Potentiostat
    - Scanning Electrochemical Microscope
    - Spectrum 100 Optica FT-IR System
    - Surface Profilometer
    - Four Probe system
    - UV-VIS-NIR spectrophotometer
  - Reactive Ion Etch
    - AMAT Etch Centura
    - Inductively Coupled Plasma RIE System
    - STS RIE 320 PC
  - Lithography
    - Double Side Aligner-EVG 620
    - JOEL SEM 6400 with Lithography Attachment
    - MJB-3 mask aligner
    - LASER Writer
    - Raith 150 - Lithography
  - Bonding tools
    - Wafer Bonder
    - Wire Bonder

Department of Energy Science and Engineering

- Biomass and Bio-Fuel Laboratory
- Cummins Engine Research facility
- Electrochemical Energy Laboratory
- Electrical & Electronics Laboratory
- Energy Systems Laboratory
- Fuel cell & Hydrogen Storage Laboratory
- Gasifier Laboratory
- ONGC-UCG Laboratory
- Power engineering Laboratory
- Power Electronics Laboratory
- Short circuit Laboratory
- Solar Cell Characterisation Laboratory and Energy Materials Laboratory
- Solar Thermal Laboratory
- Thermography Laboratory
- Urja Computational Laboratory
- Wet Chemistry Laboratory

Evacuated Tube Solar Collector System

Flate -plate solar Collector System

Contact:
head.ese@iitb.ac.in
www.ese.iitb.ac.in

Department of Humanities and Social Sciences

Bio-feedback Experimentation at the Psychology Laboratory

Multipurpose Computer Laboratory

Facilities:

- Full-fledged language laboratory and a psychology laboratory having Tandberg education system for a variety of functions such as recording, high speed copying, test preparation intercom, student monitoring, teacher/student call, group conferencing etc.
- Psychology laboratory

Contact:
head.hss@iitb.ac.in
www.hss.iitb.ac.in

Department of Mathematics

- Advanced Computing Laboratory
- Industrial Mathematics Group Laboratory
- Network of 80 workstation nodes with powerful Sun Servers, Linux servers
- Many commonly used software development platforms

Advanced Computing Laboratory

Contact:
head.math@iitb.ac.in
www.math.iitb.ac.in

Department of Mechanical Engineering

IC Engines Room

Micromap & MicroPIV system

Facilities for:

- Computer Aided Manufacturing
- Computer Graphics
- Excimer Laser Micromachining
- Fluid Power
- Fracture Mechanics
- Heat Transfer and Thermodynamics
- IC Engines
- Instrumentation
- Machining
- Machine Design
- Machine Tools
- Mechatronics
- Metal Forming, Casting & Welding
- Metrology and measurement
- Microstereolithography
- Nuclear Engineering
- Refrigeration
- Robotics
- Steam Power
- Strength of Materials
- Textile Machinery
- Vibration

Contact:
head.me@iitb.ac.in
www.me.iitb.ac.in

Department of Metallurgical Engineering and Materials Science

- **Characterization Facilities**
  - Gas Chromatography
  - Hardness tester
  - Image Analyzer
  - Impedance Analyzer
  - Particle Analyzer
  - Potentiostat
  - Scanning Electron Microscope
  - Testing Machine
  - Thermal Analyzer
  - UV-VIS Spectrometer
  - XRD, Zeta meter

- **Processing Facilities**
  - Centrifuge
  - Furnace
  - Humidity Chamber
  - Hydraulic Press Mill
  - Polisher
  - Press
  - Sol-Gel Reactor
  - Salt Spray Unit
  - Thin Film Making Instrument
  - Ultrasonic Cleaner
  - Vapor Deposition Technique
  - Welding Machine

State-of-the-art Hot-Wire Chemical Vapor Deposition Tool in the Semiconductor Thin Films and Plasma Processing Laboratory

High Resolution Dielectric Analyser

Contact:
head.met@iitb.ac.in
www.met.iitb.ac.in

Department of Physics

Langmuir-Blodgett Trough

Liquid Nitrogen Facility

- Various modern techniques of thin films deposition such as CVD, Pulse Laser Deposition, Langmuir-Blodgett Trough, High Power Sputtering Unit
- Electrical, Magnetic, structural and thermal characterization of films and multi-layers
- Ultra-fast laser pulses for studying the swift processes (femto second time scale) in semiconductors, polymers and molecules
- Low temperature facilities to study the electrical properties of the films and bulk materials
- High temperature furnaces (Including vacuum arc) to design and synthesize new materials, alloys and exotic phases
- X-ray diffraction apparatus for studying the bulk and thin films material

Contact:
head.phy@iitb.ac.in
www.phy.iitb.ac.in

Industrial Design Centre

Facilities:

- Workshop facilities in the areas of ceramics, plastics, wood and metal processing
- Multimedia studios for Visual Communication, Animation and Interactive Product Design
- Professional Sound recording and editing studio
- Research laboratory for Product Ergonomics, Eye Movement Research and Peoples behavioral study

Metal Studio

Shenoy Innovation Studio(SIS) :
To come up with innovative products by leveraging the design capabilities of IDC, other department of IIT Bombay and industry.

The core philosophy of SIS is innovation by humanizing technology.
SIS is an innovation studio aimed to aid industries in innovating continuously by designing methodologies tailored to their specific conditions and needs and create a balance between design and management thinking. Flexible Collaborative Model of Innovation, developed by Prof. B. K. Chakravarthy, forms the backbone of this innovation methodology.

Ergonomics Laboratory

Contact:
head.idc@iitb.ac.in
www.idc.iitb.ac.in

Interdisciplinary Programme in Industrial Engineering and Operations Research

PhD Student Room

- A range of commercial and in-house optimization and simulation software tools are availble for modeling and solving complex decision models
- Post-graduate computational Laboratory
- Dedicated workspace for Research Scholars

Contact:
head.ieor@iitb.ac.in
www.ieor.iitb.ac.in

Interdisciplinary Programme in Systems and Control Engineering

Facilities:
Experimental testbeds of representative models in mechanical, chemical and electrical engineering, for carrying out control experiments and control-algorithm implementation.

- Embedded control systems laboratory
- Mobile robot platform
- Industrial plant emulator
- Induction motor
- Gyroscope
- Magnetic levitation
- Engine speed control
- 3D crane
- Gas turbine
- Hybrid two tanks setup
- Inverted pendulum
- Coupled tank
- Brushless DC motors
- Allen Bradfly PLC
- Mitsubishi PLC
- ISaGRAF control software
- InduSoft web studio
- Softwares
  - RSLogix 5000 enterprise series
  - LabVIEW
  - Handel-C
- Xilinx embedded development kit
- AspenONE v.7.0 application suite
- UniSim design suit R380 process modeling

Piezo Actuation and Sensing system: Syscon Laboratory

3D Underactuated Manipulator: Compcon Laboratory

Contact:
head.syscon@iitb.ac.in
www.sc.iitb.ac.in

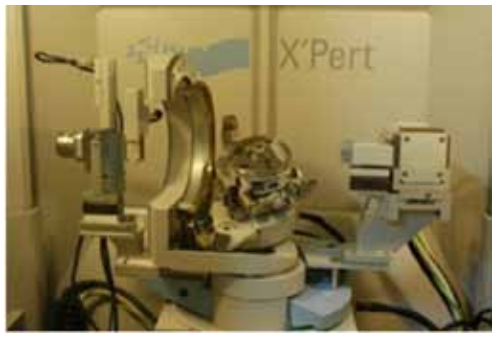
Shailesh J. Mehta School of Management

SOM Library

Classroom

- State-of-the-art academic, computing and information facilities
- Classrooms in the School are specially designed and equipped with latest audio visual aids and internet connectivity, to enhance group discussion and learning activities
- In addition to the resources of the Central Library of the Institute, the School has its own library with over 5500 books, 70+ periodicals and other audio-visual instructional material
- Access to full-text electronic databases such as ABI/Inform and data resources from CMIE (Prowess) and Capital Line

Contact:
head.som@iitb.ac.in
www.som.iitb.ac.in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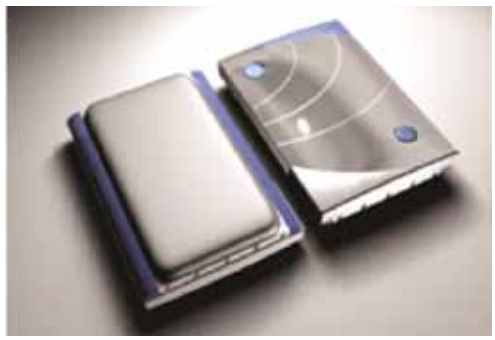

Agreement Templates

1 Standard Terms and Conditions

Standard Terms And Conditions applicable for all Projects

1. Declaration: All work undertaken by IIT Bombay as part of the project will be in good faith and based on material / data / other relevant information given by the Client requesting for the work.

2. Confidentiality: Due care will be taken by IIT Bombay to maintain confidentiality and discretion regarding confidential information received from the Client, including but not limited to results, reports and identity of the client.

3. Reports: Any test or other consultancy report given by IIT Bombay will be based on work performed according to available standards and / or open domain literature. In any event, this report may not be construed as a legal document, certificate or endorsement and may not be used for marketing of the products or processes, without prior consent from IIT Bombay. The institute reserves the right to retain one copy of the report and use the results of the project for its internal teaching and research purposes.

4. Work Performance: Every effort will be made to complete the specified work according to the planned time schedule. However, IIT Bombay will not be held responsible for delays caused beyond its reasonable control.

5. Conflict Of Interest: IIT Bombay may take up work for other clients also in the same area, provided, to the best of the institutes knowledge, there is no conflict of interest in undertaking such projects.

6. Payment: The payment of consultation charges to IIT Bombay are to be made in advance and in full before the start of the project, through a demand draft / crossed valid cheque, drawn in favour of The Registrar, IIT Bombay and sent to the Consultant or the address overleaf. The standard terms & conditions are routinely printed on the backside of the letter head that IITBombay uses to communicate with the client. The charges will also include any applicable tax as prescribed by the Government of India from time to time.

7. Termination: The project work may be terminated by either party by giving the other party a notice period of 30 days. However, both parties will meet any residual obligations in connection with the project.

8. Liability: IIT Bombay shall not be held liable for any loss, damage, delay or failure of performance, resulting directly or indirectly from any cause, which is beyond its reasonable control (Force majeure). The liability of IIT Bombay shall be limited to the funds received for the project.

9. Intellectual Property Rights: All rights pertaining to any intellectual property generated / created / invented in the due course of the project, will be the joint property of IIT Bombay and the Client. Terms and conditions regarding transferring / assigning / selling these rights to the client shall be governed by a separate written and agreed to document if required.

10. Resolution Of Disputes: Any disputes arising out of the project shall be amicably settled by both the organizations. Any unsettled disputes may be subject to resolution as per the Indian Arbitration and Conciliation Act 1996.

11. Disclaimer: The report on the consultancy project is the technical opinion of the individual faculty member, based on his expertise in the particular area of research and NOT the views of IIT Bombay.

These terms and conditions will apply to all projects taken up by IIT Bombay, unless otherwise mutually agreed to in a separate document.

2 Research Agreement

This Agreement is made and entered into as of dd/mm/yyyy by and between name of the company a Company incorporated under the Companies Act 1956 and having its office at (adress) _____, hereinafter referred to as "COMPANY", of the FIRST PART,

AND

Indian Institute of Technology, Bombay, a research and educational institution in science, technology and engineering disciplines established by a special act of Parliament of Republic of India having its office at Powai, Mumbai-400 076, India, hereinafter referred to as 'IITB', of the SECOND PART.

Company and IITB are collectively referred to herein as 'Parties'.

Whereas Company is engaged in the business of _____.

Whereas IITB is among the premier research and development (R&D) institutions in India and a centre of excellence in higher learning, research and development.

Whereas both Parties hereto have agreed to jointly work on Projects in topics of mutual interest as defined below and develop Products under terms and conditions mutually agreed upon by the Parties and

Whereas the Parties desire to record the broad terms and conditions that are jointly accepted and agreed to in this Agreement as contained hereunder.

1. DEFINITION

a. 'Projects' shall mean and include the individual Projects under the Agreement, the terms and conditions for execution of each of which shall be jointly agreed upon, in writing.

b. 'COMPANY know-how' shall mean and include all know-how of methods, material, software, designs, patterns, formats, proprietary technical literature, and information developed, owned and provided by COMPANY, which are required for the Projects.

c. 'IITB know-how' shall mean and include all know-how of methods, material, software, designs, patterns, formats, proprietary technical literature, and information developed, published or otherwise owned and provided by IITB, which are required for the Projects.

d. 'COMPANY Personnel' shall mean the personnel or research and development engineers of the Company deputed for the Projects.

e. 'IITB Personnel' shall mean the faculty members and / or scientists and / or students and / or staff of IITB deputed for the Projects.

f. 'Principal Investigator' shall mean the individual, employee of IITB, having the responsibility of conducting and supervising the Project(s) under this agreement.

g. 'Co-Investigator' shall mean the individual(s) participating in the Project(s) under the supervision of Principal Investigator, including, but not limited to, students, employees, representatives, and agents.

h. 'Project Investigator Team' shall comprise the Principal Investigator and the Co -Investigators participating in the Project(s) under this agreement.

i. 'Products' shall mean the results, software, hardware or other deliverable generated as a result of work carried out to meet the objectives of the Projects funded by COMPANY.

j. 'COMPANY-IITB Research Programme' shall mean the activities envisaged under this Agreement.

2. ITEMS OF COLLABORATION

The parties agree to collaborate in the following said items:

(a) _____ (b) _____

(c) _____ (d) _____

3. SCOPE OF AGREEMENT

COMPANY and IITB shall work jointly to carry out Projects in the abovesaid items for developing Products and with specific objectives, terms & conditions to be jointly agreed under the Agreement.

4. ACTIVITIES AND OBLIGATIONS OF COMPANY

a. COMPANY shall be responsible for providing the funds required for the Projects, as identified in each Project. COMPANY may depute appropriate COMPANY personnel to participate in the Projects, as per mutual agreement.

b. COMPANY will provide COMPANY know-how, which may be deemed necessary for the Projects.

c. COMPANY shall take reasonable steps to prevent IITB know-how, which are meant only for the purpose of conducting the Projects, from unauthorised usage or falling into unauthorised hands. COMPANY shall ensure that COMPANY personnel working on projects sign appropriate non-disclosure agreements to prevent unauthorised usage or disclosure of materials or information received under this Agreement.

5. ACTIVITIES AND OBLIGATIONS OF IITB

a. IITB shall complete the activities in the said items and deliver the Products to COMPANY as per the individual Project objectives and schedules as agreed upon.

b. IITB shall take reasonable steps to prevent COMPANY know-how, which are meant only for the purpose of conducting the Project(s), from unauthorised usage or falling into unauthorised hands. IITB shall ensure that IITB personnel and the Project Investigator Team working on Projects sign appropriate non-disclosure agreements.

6. FINANCIAL AND OTHER ARRANGEMENTS

The consideration payable to IITB for individual Project cost and the schedule of payment would be as mutually agreed upon for each Project. Any other Project related payment will be as per mutual agreement. Financial arrangements related to Intellectual Property Rights sharing will be as spelt in clause 11.

7. ASSIGNMENT

The Parties hereto shall not transfer or assign any of their rights and obligations under this Agreement to any other party without obtaining prior consent in writing from other Parties hereto.

8. TERM / DURATION

This Agreement shall be initially valid for a period of two years from the date of signing of this agreement. The Parties may extend the term of this Agreement for additional periods as desired under mutually agreeable terms and conditions which shall be reduced to writing and signed by the Parties.

9. TERMINATION

Any of the Parties may terminate this Agreement by serving a written notice on the other Parties six months prior to the intended date of termination provided that the termination by either of the parties shall not relieve that party of its obligations accrued prior to such termination, under a specific Project.

10. NOTICES

All communications by COMPANY involving financial, administrative and other matters shall be sent to Dean R&D, IIT Bombay. All information of scientific and technical nature may be exchanged directly between the Project Investigator from IIT Bombay and appropriate COMPANY personnel as identified in writing, for the Project concerned.

11. INTELLECTUAL PROPERTY AND COMMERCIAL RIGHTS

a. Title to all inventions, discoveries or developments made solely by IITB inventors resulting from the Research Programme shall reside in IITB; title to all inventions, discoveries and developments made solely by COMPANY inventors resulting from the Research Programme shall reside in COMPANY; title to all inventions, discovery, development or other intellectual property including but not limited to copyrights, patents and industrial designs made jointly by IITB and COMPANY resulting from the Research Programme shall reside jointly in IITB and COMPANY.

b. COMPANY will be given the first right to commercially exploit any development, for a period of one year from the date of completion of the Project, resulting out of the research conducted under this agreement. Benefits arising out of such commercialization shall be shared between IITB and COMPANY under mutually agreed terms. In the event that COMPANY is unable to commercially exploit the said development within this specific time period of one year, then IITB will be free to assign the development, know-how to any other third parties. The benefits accruing from such assignments will be shared between IITB and COMPANY under mutually agreed terms.

c. In the case of joint Intellectual Property between IITB and COMPANY, neither party may assign any rights to any third parties without the consent of the other party, which shall however not be unreasonably withheld.

d. Any benefits accruing from assignment of rights to third parties will be shared between IITB and COMPANY under mutually agreed terms.

e. The sharing of benefits between IITB and COMPANY as spelt in Clause 11 b to d is for the Intellectual Property, arising from the results of the Projects undertaken under this Agreement, being commercialised and exploited in India only. Any commercialisation of results and Intellectual Property arising out of the Projects under this Agreement outside of India, by the COMPANY shall be done with explicit consent of IITB and the benefit accrued from such commercialisation shall be shared between IITB and COMPANY under mutually agreed terms.

f. Any modification / further development of the Results obtained from the Projects under this agreement, by the COMPANY shall be done with the explicit written consent of IITB.

12. CONFIDENTIALITY

a. It may be necessary for IITB and COMPANY to disclose to or exchange with each other proprietary information relating to IITB know-how and COMPANY know-how, which are confidential and proprietary. The disclosing party shall advise authorised personnel of the receiving party appropriately regarding the confidential nature of the information disclosed. The Party receiving such confidential or proprietary information shall not, unless specifically permitted in writing by the Party providing the said information, disclose in whole or part any such confidential or proprietary information or divulge any information thereon to any person other than its Personnel for fulfilling the purpose of this Agreement. The disclosure to any such Personnel as aforesaid, of any such confidential or proprietary information, shall be in confidence and only to the extent necessary for carrying out the obligations herein.

b. The obligations of confidentiality set forth above shall be applicable for two years from the termination of the relevant Agreement

c. The obligations of confidentiality however shall not apply to information that:

i. is not disclosed in writing or reduced to writing and marked with appropriate confidentiality legend within thirty (30) days after disclosure;
ii. is already in the recipient party's possession at the time of disclosure;
iii. is or later becomes part of the public domain through no fault of the recipient party;
iv. is received from a third party having no obligations of confidentiality to the disclosing party;
v. is independently developed by the recipient party; or
vi. is required by law or regulation to be disclosed.

13. ARBITRATION, APPLICABLE LAW AND JURISDICTION

a. Any disputes between the parties shall be resolved by mutual discussions. Unresolved disputes, if any, shall be subject to resolution by a panel consisting of the Dean R&D, IITB, who shall represent IITB, and Chairman / Managing Director, COMPANY, who shall represent COMPANY. If the dispute cannot be resolved by the said panel, the matter shall be resolved by arbitration in accordance with the Arbitration and Conciliation Act, 1996. The venue of arbitration shall be Mumbai. The decision of the arbitrator shall be binding on both parties

b. This agreement shall be governed by the Laws of India and subject to the jurisdiction of Courts in Mumbai.

14. GENERAL

a. The terms and Conditions for publication of the research results in journals / conferences, and / or patenting or copyrighting the Products shall be mutually agreed upon.

b. Any addition, deletion and / or alteration to this Agreement may be effected with a written agreement of all the Parties to this Agreement concerning the amendments. A document containing the additions, deletions and/or alterations, and signed by all Parties hereto, shall form an annexure to and be deemed to be a part of this Agreement.

c. The headings of various clauses herein are inserted for convenience of reference and are not deemed to affect the meaning or construction of relative provisions.

d. IITB will have the right to continue to utilise the intellectual property generated as part of the R&D work carried out under this project for its research and for teaching purposes.

e. This Agreement and its Appendices constitute the entire agreement among the Parties and supersede all other representations, understandings or communication whether written or verbal, with respect to the subject matter hereof.

15. FORCE MAJEURE

Neither party shall be held responsible for non-fulfillment of their respective obligations under this Agreement due to the exigency of one or more of the force majeure events such as but not limited to acts of God, War, Flood, Earthquakes, Strikes not confined to the premises of the party, Lockouts beyond the control of the party claiming force majeure, Epidemics, Riots, Civil Commotions, etc. provided on the occurrence and cessation of any such event the party affected thereby shall give a notice in writing to the other party within one month of such occurrence or cessation. If the force majeure conditions continue beyond six months, the parties shall jointly decide about the future course of action.

IN WITNESS WHEREOF, the Parties hereto have set and subscribed their respect hands and seal on the day, month and year first herein above mentioned.

FOR AND ON BEHALF OF IITB

IN THE PRESENCE OF
WITNESS

FOR AND ON BEHALF OF COMPANY

IN THE PRESENCE OF
WITNESS

3 Non-Disclosure Agreement

This non-disclosure agreement ('Agreement') is by and between The Indian Institute of Technology Bombay (herein after referred to as 'IITB') having its address at Powai, Mumbai 400076 and _____(hereinafter referred to as 'Company'), a corporation having a business address at _____ on this dd/mm/yyyy being the date when this agreement comes into force.

I. RECITALS

Company and IITB wish to exchange certain information pertaining to _____. This exchange includes all communication of information between the parties in any form whatsoever, including oral, written and machine-readable form, pertaining to the above which is indicated as confidential.

A. IITB and Company wish to exchange the information for the sole purpose of _____ and each party regards certain parts of the Information it possesses to be secret and desires to protect those parts from unauthorized disclosure or use (such secret parts being hereafter collectively referred to as 'Information').
B. IITB and Company are willing to disclose Information (as 'Disclosing Party') and receive Information(as 'Receiving Party') as the case maybe, on the terms and conditions set forth herein.

II. AGREEMENT

In furtherance to the above mentioned, IITB and Company agree to the following:

1. The Receiving Party will:

a. Not disclose Information of Disclosing Party to any other person and use at least the same degree of care to maintain the Information confidential as Receiving Party uses in maintaining as confidential its own confidential Information, but always at least a reasonable degree of care; due diligence will be taken by both parties in maintenance of confidential information.

b. Use the Information only for the above mentioned purpose;

c. Restrict disclosure of the Information of the Disclosing Party solely to those employees of Receiving Party having a need to know such Information in order to accomplish the purpose stated above;

d. Advise each such employee, before he or she receives access to the Information, of the obligations of Receiving Party under this Agreement, and require each such employee to agree to maintain those obligations.

e. Within fifteen (15) days of notice furnished by either party, the party receiving such notice shall return to the other Party all documentation, copies, notes, diagrams, computer memory media and other materials containing any portion of the Information, or confirm to the other Party, in writing, the destruction of such materials.

2. This Agreement imposes no obligation on Receiving Party with respect to any portion of the Information received from Disclosing Party which

a. was known to Receiving Party prior to disclosure by Disclosing Party,

b. is lawfully obtained by Receiving Party from a third party under no obligation of confidentiality,

c. is or becomes generally known or publicly available other than by unauthorized disclosure,

d. is independently developed by Receiving Party or

e. is disclosed by Disclosing Party to a third party without a duty of confidentiality on the third party.

f. is required by law or decree.

3.The Information shall remain the sole property of Disclosing Party.

4.Neither Disclosing party makes any representation with respect to and does not warrant any information provided under this agreement, but shall furnish such in good faith. Without restricting the generality of the foregoing, neither Disclosing party makes any representations or warranties, whether written or oral, statutory, express or implied with respect to the information which may be provided hereunder, including without limitation, any warranty of merchantability or of fitness for a particular purpose. Neither Disclosing party shall be liable for any special, incidental or consequential damages of any nature whatsoever resulting from receipt or use of the information by the receiving party.

5. Neither the execution of this Agreement nor the furnishing of any Information hereunder shall be construed as granting either expressly or by implication, any license under or title to any invention, patent, copyright, trademark or trade name now or hereafter owned by or controlled by the party furnishing the Information.

6. The Receiving Party will not export, directly or indirectly, any technical data acquired from Disclosing Party or any product utilizing any such data to any third party, without first obtaining approval of the Disclosing Party.

7. The rights and obligations of the parties under this Agreement may not be sold, assigned or otherwise transferred (subject to contract).

8. The obligation of this Agreement shall be continuing for a period of _____ years after the disclosure has been made. However, IITB is free to use the Information solely for the purpose of teaching after a period of _____ years.

9. This Agreement can be terminated on thirty (30) days written notice by either party. However, Receiving Party's obligations of confidentiality and restrictions on use of the Information disclosed by Disclosing Party shall survive termination of this Agreement.

This agreement will be construed and governed in accordance with the laws of India. Any dispute arising out or in connection with the agreement shall be settled within the jurisdiction of Mumbai courts.

IN WITNESS WHEREOF, the parties have executed this agreement effective as of the date first written above.

For Indian Institute of Technology Bombay	For Company
Name : Date :	Name : Date :
Witness :	Witness :

Areas of Expertise

Centre for Distance Engineering Education Programme

Faculty	Areas of Specialisation
Murthy, Sahana (Ms) sahana@iitb.ac.in	Educational Technology
Tembe, Bhalachandra L. bltembe@iitb.ac.in	Chemical dynamics, Statistical mechanics, Instructional design

Centre for Environmental Science and Engineering

Faculty	Areas of Specialisation
Asolekar, Shyam R. asolekar@iitb.ac.in	Development and modelling of reactors for treatment of domestic sewage and industrial wastewater for pollution control and reuse. Hazardous, solid, and biomedical waste management. Preventive environmental management and sustainable development. Application of remotely sensed data for monitoring and modelling of environmental systems. Environmental planning, policy and law
Chaudhari, Sanjeev sanjeev@iitb.ac.in	Water and wastewater treatment Arsenic and fluoride removal from groundwater Zero-valent iron based technology for wastewater treatment Biological nutrient removal from water and wastewater
Dikshit, Anil K. dikshit@iitb.ac.in	Environmental and water technologies. Sustainable management of urban solid waste and industrial residues. Mathematical modelling of environmental systems. Geo-informatics for environmental systems
Garg, Anurag a.garg@iitb.ac.in	Treatment of industrial wastewater and leachate using physico-chemical processes Nutrient removal by biological treatment processes Municipal solid waste treatment and final disposal Energy from solid waste residues
Karmakar, Subhankar skarmakar@iitb.ac.in	Water resources and environmental systems Floodplain planning and management Solid waste management Uncertainty modeling in environmental systems - probabilistic approach, Fuzzy sets theory and interval optimization Water conveyance systems and hydraulic designs

Mukherji, Suparna (Ms) mitras@iitb.ac.in	Water & wastewater treatment Biodegradation and bioremediation of hazardous organic pollutants Toxicity evaluation of complex mixtures and wastewater using microorganism based tests Environmental Application of Nanomaterials Sorption Phenomena Sampling and Analysis of Bioaerosols
Patil, Rashmi S. (Ms) rspatil@iitb.ac.in	Air pollution dispersion and receptor modelling Indoor air quality and exposure assessment Air quality monitoring and management Environmental impact assessment
Sethi, Virendra vsethi@iitb.ac.in	Aerosol science and engineering Air quality Hot gas clean-up (thermal gasification of biomass) Nano-powder synthesis Satellite remote sensing for air quality management
Suresh, Sumathi (Ms) sumathis@iitb.ac.in	Remediation of chlorinated organic compounds (pesticides), Textile dyes, Heavy metals using bimetallic systems, Immobilized metals and zero-valent metals, Microbiological processes for treatment of industrial pollutants and pesticides, Application of biological processes (whole cell and enzyme based) for developing cleaner technologies (such as production of cellulose by bacteria), Microbial toxicity testing assays for monitoring micro-pollutants (such as endocrine disrupting chemicals), Enzyme catalyzed bioremediation

Centre for Research in Nanotechnology and Science

Faculty	Areas of Specialisation
Aiyar, Ramnath P. R. C. aiyar@iitb.ac.in	Electronic ceramic materials (synthesis, characterisation) growth Characterisation of thin film electronic materials, Numerical methods for electromagnetic fields, Structure property correlation in nanocrystalline thin films
Gandhi, Mayuri N. (Ms) mngandhi@iitb.ac.in	Nanophosphors, Analytical Environmental engineering Separation science, Food engineering
Harendranath, C. S. cshnath@iitb.ac.in	Environment engineering, Advanced imaging and image analysis techniques, Electron microscopy/microanalysis, Waste water treatment and management, Structure-property correlations, Failure analysis
Mombasawala, L. S. laiqsm@iitb.ac.in	Instrumentation, Analytical techniques, Electronics, Noble gas mass spectrometry
Mukherji, Soumyo mukherji@iitb.ac.in	Biosensors, bioinstrumentation, cardiac electrophysiology
Vijayalakshmi, S. (Ms) vlakshmi@iitb.ac.in	Analytical techniques, Separation science, Catalysis, Hollow gas microspheres, Hydrogen storage

Centre for Technology Alternatives in Rural Areas

Faculty	Areas of Specialisation
Date, Anil W. awdate@iitb.ac.in	Heat transfer, Thermodynamics and energy conversion, Energy systems, Appropriate technology
Gaitonde, Uday N. gaitonde@iitb.ac.in	Heat transfer, Thermal management, Computational heat transfer and fluid mechanics, Energy systems
Modak, Prasad pmodak@vsnl.com	Environmental policy, Environmental impact assessment, Environmental management, environmental modeling
Narayanan, N. C. ncn@iitb.ac.in	Development theory, Community-based natural resource management, Environment and development, Water governance, Water Conflicts
Rao, Anand B. a.b.rao@iitb.ac.in	Environmental impacts of energy utilization, Climate change, Carbon capture and sequestration, Energy from biomass
Rao, Bakul (Ms) bakulrao@iitb.ac.in	Environmental impact assessment framework for rural areas, State of environmental studies, Field assessments & remediation, Matrix characterization, Climate change
Shah, Narendra G. nshah@iitb.ac.in	Biomass processing (food and fuel), and Agro-based industry
Wagle, Subhodh M. subodh@prayaspune.org	Sustainable livelihoods, Energy, environment & development policy, Development governance, Technology, environment and society, Political economy

Centre of Studies in Resources Engineering

Adinarayana, J. adi@iitb.ac.in	Rural development, Geo-ICT and Wireless sensor network in precision agriculture
Gedam, Shirish. S. shirish@iitb.ac.in	Stereo image processing and analysis, GPS signal analysis for tropospheric and ionospheric modelling, GPS based geo-location and land surface deformation analysis, Surface hydrology, Urban landuse and infrastructure planning
Inamdar, Arun B. abi@iitb.ac.in	Application of remote sensing and GIS to marine and coastal environment, Natural resources exploration and management, Impact assessment due to cyclones/tsunami
Khire, M. V. mvk@iitb.ac.in	Application of remote sensing to terrain evaluation, Watershed development, Landuse/landcover mapping and Natural hazard zonation
Krishna Mohan, B. bkmohan@iitb.ac.in	Digital image analysis, Machine learning algorithms, GIS, Educational content development
Mukherjee, Shyamalee shyamali@iitb.ac.in	Computational methods, Computer vision
Murti, M. V. R. mvr@iitb.ac.in	Satellite based atmospheric trace gases studies and global ozone monitoring, Spectroscopic analysis of planetary materials, geochemical analysis & chemical instrumentation, X-Ray satellite studies of compounds and X-Ray fluorescence analysis
Nagarajan, R. rn@iitb.ac.in	Application of remote sensing and GIS to environmental impact assessment, Natural hazard assessment, Water and mineral resources, Village information systems
Porwal, Alok alok@iitb.ac.in	GIS and remote sensing applications to mineral systems studies and resources exploration, Remote sensing of hydrothermal systems on the Mars
Rao, Y. S. ysrao@iitb.ac.in	Active and passive microwave remote sensing for land based applications (soil moisture, crop classification, interferometry, differential interferometry, polarimetry, flood mapping, software development)
Venkatachalam, P. (Ms.) pvenk@iitb.ac.in	GIS Theory, Modeling, Software and Applications
Venkataraman, G. gv@iitb.ac.in	Snow and ice studies, Microwave remote sensing applications, Remote Sensing and GIS applications to mineral exploration

Department of Aerospace Engineering

Faculty	Areas of Specialisation
Arya, Hemendra arya@iitb.ac.in	Design and development of mini/micro, fixed wing aerial vehicles, Hardware in loop simulation for system testing and integration, Co-operative mission in mini/micro aerial vehicles. Systems thinking, systems engineering, Design education
Chatterjee, Avijit avijit@iitb.ac.in	Computational fluid dynamics, Aerodynamics, Computational electromagnetics
Joshi, Ashok ashokj@iitb.ac.in	Dynamics & control of flight vehicle structure, Aeroelasticity
Hablani, Hari B. hbhablani@iitb.ac.in	Spacecraft dynamics and control, Space flight mechanics, Satellite-based navigation, Exoatmospheric interceptor guidance, Spacecraft rendezvous navigation and guidance
Kumar, Sudarshan sudar@iitb.ac.in	Combustion, Emission reduction from combustion system, Modeling of combustion systems, Experimental combustion, Heat transfer, Propulstion, Gas turbine combustors, Computational fluid dynamics
Mahulikar, Shripad P. spm@iitb.ac.in	Laminar micro-convective flows, Infrared signatures of aerospace vehicles, Aerothermal studies in hypersonics, Thermodynamics of self-organisation
Mandal, J. C. mandal @iitb.ac.in	Computational fluid dynamics
Menezes, Viren viren@iitb.ac.in	Hypersonic aerothermodynamics, Hypersonic ground testing facilities and related experimental techniques, Shock waves, Medical and Industrial applications of shock waves
Mitra, Mira mira@iitb.ac.in	Structural dynamics, Wave propagation, Structural control, Health monitoring, Composite structures, Nano-composites.
Mujumdar, Prasanna M. mujumdar@iitb.ac.in	Aersospace structures, Vibrations & structural dynamics, Computational aeroelasticity & aeroservoelasticity, Multidisciplinary design optimization, Structural health monitoring
Naik, Niranjan K. nknaik@iitb.ac.in	Polymer matrix composites, Textile composites, Ballistic impact & High strain rate behavior, 3D composite materials
Pant, Rajkumar K. rkpant@iitb.ac.in	Lighter-than-air systems, Aircraft design, Air transportation
Pradeep, A. M. ampradeep@iitb.ac.in	Aerospace propulsion, Active and passive flow control, Aerodynamics design and analysis of turbomachinery, Instabilities and their control in axial flow compressors/fans, Experimental techniques and flow visualization.
Ramachandran, Prabhu prabhu@iitb.ac.in	Vortex methods, Particle methods, Scientific computing, Computational fluid dynamics
Roy, Bhaskar aeroyia@iitb.ac.in	Aircraft gas turbine engines; Axial flow compressors & turbines - design and analysis

Sharma, Shailendrakumar D. sds@iitb.ac.in	Experimental techniques in fluid mechanics & aerodynamics, Control of coherent structures in free shear flow, Turbulent mixing of coaxial ducted jets, Vortex flow, Pulsatile flow
Shevare, Gopal R. shevare@iitb.ac.in	Computational fluid dynamics, Multi-scale methods, Multi-disciplinary analysis
Shimpi, Rameshchandra P. rpshimpi@iitb.ac.in	Theory of plates, Finite element method, Optimization techniques (Genetic algorithms, simulated annealing), Material testing, Experimental stress analysis, Ultrasonic testing
Sinha, Krishnendu krish@iitb.ac.in	High-speed flows, Computational fluid dynamics, Turbulence modeling, Shock-boundary layer interaction, Hypersonic aero-thermodynamics, Parallel computing.
Sudhakar, K. sudhakar@iitb.ac.in	Design optimisation, Multidisciplinary design optimisation, Flight mechanics, Systems engineering

Department of Biosciences and Bioengineering

Faculty	Areas of Specialisation
Balaji, Petety V. balaji@iitb.ac.in	Protein & macromolecular structure & design, Computational biology, Bioinformatics
Banerjee, Rinti rinti@iitb.ac.in	Nanomedicine, Drug delivery, Biomaterials
Bhat, Jayadeva P. jayadeva@iitb.ac.in	Yeast gene regulation, geneties and metabolism
Ghosh, Santanu K. santanughosh@iitb.ac.in	Cell biology & microbiology
Kondabagil, Kiran kirankondabagil@iitb.ac.in	Molecularvirology, Molcular and structural biologyd
Kumar, Ashutosh ashutoshk@iitb.ac.in	Structural biology, NMR Spectroscopy of biomolecules, Biophysics
Manchanda, Rohit manch@iitb.ac.in	Biomaterials, Artificial organs & medical devices - Bioinstrumentation & sensors, Physiology & pathology (Neuro, Cardiac etc.)
Maji, Samir K. samirmaji@iitb.ac.in	Protein and macromolecular structure & design
Mukherji, Soumyo mukherji@iitb.ac.in	Bioinstrumentation & sensors, Physiology & pathology (Neuro, Cardiac, etc.)
Panda, Dulal panda@iitb.ac.in	Protein & macromolecular structure & design, Cell biology & microbiology
Padinhateeri, Ranjith ranjith@iitb.ac.in	Protein & macromolecular structure & design, Systems & Computational biology
Patankar, Swati patankar@iitb.ac.in	Cell biology & microbiology
Phale, Prashant S. pphale@iitb.ac.in	Cell biology & microbiololgy, Genetics & Immunology
Punekar, Narayan S. nsp@iitb.ac.in	Microbial biochemistry and molecular enzymology (majorfields) Microbial metabolic regulation, Understanding metabolism through biochemical & recombinant DNA techniques, Fungal molecular genetics and its applications to metabolic engineering
Rao, K. Krishnamurthy kkr@iitb.ac.in	Cell biology & microbiology, Genetics & Immunology
Sen, Shamik shamiks@iitb.ac.in	Cellular mechanics
Srivastava, Rohit rsrivasta@iitb.ac.in	Bioinstrumentation & sensors, Drug design & delivery
Srivastava, Sanjeeva sanjeeva@iitb.ac.in	Proteomics
Subrahmanyam, G. gsm@iitb.ac.in	Cell biology & microbiology, Genetics & Immunology

Department of Chemical Engineering

Faculty	Areas of Specialisation
Adhikari, Jhumpa adhikari@iitb.ac.in	Materials engineering
Bandyopadhyaya, Rajdip rajdip@iitb.ac.in	Transport, colloids and interfaces group, Materials engineering
Bellare, Jayesh R. jb@iitb.ac.in	Transport, colloids and interfaces Group, Materials engineering
Bhartiya, Sharad bhartiya@iitb.ac.in	Process systems engineering, Biotech & Biosystems engineering
Bhushan, Mani mbhushan@iitb.ac.in	Process Systems engineering, Optimisation
Ganeshan, S. sganeshan@iitb.ac.in	Transport, colloids and interfaces group
Rao Govardhana, V. vgr@iitb.ac.in	Transport, colloids and interfaces group
Gudi, Ravindra D. ravigudi@iitb.ac.in	Biotechnology & biosystem engineering, Process systems engineering, Optimization
Juvekar, Vinay A. vaj@iitb.ac.in	Transport, colloids and interfaces group, Catalysis & reaction engineering, Materials engineering
Jadhav, Sameer R. rrjadhav@iitb.ac.in	Biotechnology & biosystem engineering, Transport, colloids and interfaces group, Materials engineering
Khakhar, Devang V. khakhar@iitb.ac.in	Transport, Colloids and interfaces group, Catalysis & reaction engineering, Materials engineering
Mahajani, Sanjay M. sanjaym@iitb.ac.in	Transport, Colloids and interfaces group, Catalysis & reaction engineering, Energy and environment
Malik, Ranjan K. rkmalik@iitb.ac.in	Transport, colloids and interfaces group, Systems engineering, Energy and environment
Mehra, Anurag mehra@iitb.ac.in	Biotechnology & Biosystem engineering, Transport, colloids and interfaces group catalysis & reaction engineering, materials engineering
Mehra, Sarika (Ms) sarika@iitb.ac.in	Biotechnology & Biosystem engineering
Moharir, Arun S. amoharir@iitb.ac.in	Transport, colloids and interfaces group, Catalysis & Reaction engineering, Materials engineering, Systems engineering
Moudgalya, Kannan kannan@iitb.ac.in	Process systems engineering, Energy & Environment

Nanavati, Hemant hnanavati@iitb.ac.in	Materials engineering, Energy & environment
Noronha, Santosh noronha@iitb.ac.in	Biotechnology & biosystem engineering, Energy & environment
Patwardhan, Sachin C. sachinp@iitb.ac.in	Process systems engineering, Optimization & control
Roy, Sandip sr@iitb.ac.in	Transport, colloids and interfaces group, Materials engineering, systems engineering
Shankar, Hariharan S. hss@iitb.ac.in	Biotechnology & biosystem engineering, Energy & environment
Suresh, Akkihebbal K. aksuresh@iitb.ac.in	Biotechnology & biosystem engineering, Transport, colloids and interfaces group, Catalysis & reaction engineering, Materials engineering
Sunthar, P. sunthar@iitb.ac.in	Transport, colloids and interfaces group, Materials engineering
Thaokar, Rochish M. rochish@iitb.ac.in	Transport, colloids and interfaces group, Materials engineering
Tirumkudulu, Mahesh mahesh@iitb.ac.in	Transport, colloids and Interfaces group, Materials engineering
Venkataraman, Chandra (Ms) chandra@iitb.ac.in	Transport, colloids and interfaces group, Materials engineering
Venkatesh, K. V. venks@iitb.ac.in	Biotechnology & Biosystem engineering, Materials engineering
Vinjamur, Madhu madhu@iitb.ac.in	Transport, colloids and interfaces group, Materials engineering, Energy & environment
Viswanathan, Ganesh A. ganeshav@iitb.ac.in	Biotechnology & biosystems engineering, Catalysis & Reaction engineering
Wangikar, Pramod pramodw@iitb.ac.in	Biotechnology & Biosystem engineering, Materials engineering

Department of Chemistry

Faculty	Areas of Specialisation
Anand, Ruchi (Ms) ruchi@iitb.ac.in	Peptide synthesis enzyme mechanism, Biophysical chemistry, Macromolecular crystallography
Balakrishna, Maravanji S. krishna@iitb.ac.in	Main group chemistry, Transition metals, Homogeneous/ Heterogeneous catalysis, Bio-inorganic chemistry
Chowdhury, Arindham arindam@iitb.ac.in	Single molecule spectroscopy
Contractor, Aliasgar Q. aqcontractor@iitb.ac.in	Electrochemistry/ Conducting polymers, Chemical & Biosensors
Datta, Sambhu N. sndatta @iitb.ac.in	Theoretical/Computational chemistry, Biophysical chemistry Photochemistry/Photobiology, Magnetic materials
Durani, Susheel sdurani@iitb.ac.in	Peptide synthesis enzyme mechanism
Dutta, Anindya anindya@iitb.ac.in	Ultra fast spectroscopy
Fernandes, Rodney A. rfernand@iitb.ac.in	Organic synthesis
Gopalan, Rajaraman rajaraman@iitb.ac.in	Theoretical/Computational chemistry, Magnetic materials
Ghosh, Prasenjit pghosh@iitb.ac.in	Transition metals, Organometallics, Homogeneous/Heterogeneous catalysis
Kaliappan, Krishna P. kpk @iitb.ac.in	Organic synthesis
Kotha, Sambasivarao srk@iitb.ac.in	Organic synthesis
Kulkarni, Suvarn S. suvarn@iitb.ac.in	Organic synthesis, Bioorganic chemistry, Glyco chemistry
Kumar, Anil anilkumar@iitb.ac.in	Electrochemistry, Conducting polymers, Chemical & Biosensors
Lahiri, Gautam K. lahiri@iitb.ac.in	Transition metals, Organometallics, Physical inorganic chemistry
Mathur, Pradeep mathur@iitb.ac.in	Organometallics
Maiti, Debabrata dmaiti@iitb.ac.in	Synthetic catalysis
Mishra, Manoj K. mmishra@iitb.ac.in	Theoretical/Computational chemistry

Murugavel, R. rmv@iitb.ac.in	Main group chemistry, Transition metals, Organometallics, supramolecular chemistry
Namboothiri, Irishi N. N. irishi @iitb.ac.in	Organic synthesis, Physical Organic Chemistry
Nand, Kishore nandk@iitb.ac.in	Biophysical chemistry, Protein folding, Thermodynamics
Patwari, Naresh G. naresh@iitb.ac.in	Chemical dynamics
Pradeepkumar, P. I. pradeep@chem.iitb.ac.in	Nucleic acids chemistry: chemically modified interfering RNAs, DNA enzymes and quadruplex forming nucleic acids
Pulla, Rao C. cprao@iitb.ac.in	Theoretical/Computational chemistry, Transition metals Biophysical chemistry, Physical Inorganic Chemistry, Supramolecular chemistry, Bio inorganic chemistry, Organic nanoscience
Ravikanth, M. ravikanth@iitb.ac.in	Supramolecular chemistry
Sasidhar, Y. U. sasidhar@iitb.ac.in	Theoretical/Computational chemistry, Biophysical chemistry, Protein folding and Dynamics
Shanmugam, Maheswaran eswar@chem.iitb.ac.in	Inorganic chemistry, Co-ordination chemistry, Molecular nano-magnets and magnetic materials, Molecular qubits for quantum computing, small molecule activation
Singh, Anil K. retinal@iitb.ac.in	Ultra fast spectroscopy, Organometallics, Organic synthesis, Biophysical chemistry, Photochemistry/Photobiology, Bio organic chemistry, Organic nanoscience, Physical organic chemistry
Singh, Harkesh B. chhbsia@iitb.ac.in	Main group chemistry, Transition Metals, Organometallics
Singh, Vishwakarma vks@iitb.ac.in	Organ synthesis, Photochemistry/Photobiology
Sunoj, Raghavan B. sunoj@iitb.ac.in	Theoretical/Computational Chemistry, Physical/Theoretical Organic Chemistry
Tembe, Bhalachandra L. bltembe@iitb.ac.in	Theoretical/Computational chemistry, Chemical dynamics, Statistical mechanics

Department of Civil Engineering

Faculty	Areas of Specialisation
Bajoria, K M kmb@iitb.ac.in	Structural engineering, Computer aided design, Non-linear analysis, Nuclear structures
Balaji, Ramakrishnan rbalaji@iitb.ac.in	Design of coastal structures, Wave-structure interaction, Physical modelling, coastal engineering, Numerical modeling of coastal processes, Tidal hydrodynamics
Banerji, Pradipta pbanerji@iitb.ac.in	Structural engineering, Earthquake analysis, Risk assessment, Artificial neural networks, Nuclear structures
Banerjee, Sauvik sauvik@iitb.ac.in	Structural engineering, Structural and solid mechanics, Ultrasonic wave propagation in solids, Non-destructive quality evaluation of composites, Structural health monitoring, Dislocation mechanics, Multiscale materials modeling
Chandiramani, Naresh K. naresh@iitb.ac.in	Active vibration control, Nonlinear dynamics, Stability, computational mechanics, Solid mechanics
Choudhury, Deepankar dchoudhury@iitb.ac.in	Geotechnical engineering, Geotechnical earthquake engineering, Foundation engineering, Soil dynamics, Soil-structure interactions, GIS, Numerical, analytical and centrifuge modeling
Deo, M. C. mcdeo@iitb.ac.in	Coastal & Ocean Engineering & Hydrology: Analysis of data using soft computing & statistical methods, Climate change effects, coastal and offshore structures
Desai, Yogesh M. desai@iitb.ac.in	Structural engineering, Wind induced vibrations, computational mechanics, Nonlinear analysis, Finite elements, Parallel computing, Fiber reinforced polymer composites, Composites in construction
Dewaikar D. M. dmde@iitb.ac.in	Geotechnical engineering, Offshore foundations, Ground improvement, Seepage
Dhingra, S. L. dhingra@iitb.ac.in	Transportation systems engineering, Modeling, simulation, Economics, Environmental impact assessment, GIS, Expert systems, Artificial intelligence, Genetic algorithms, Fuzzy set theory
Eldho, T. I . eldho@iitb.ac.in	Water resources & environmental engineering, Groundwater flow, Fluid dynamics, Experimental & numerical analyses of fluid flow, Watershed management
Gopal Rao, K. kgr@iitb.ac.in	Remote sensing, Digital image processing (DIP) of multispectral, thermal and microwave data, Digital elevation modeling (DEM), Geographic information systems (GIS), Artificial neural networks (ANN), Applications of RS.GIS, DEM and ANN in hydrology
Ghosh, Siddhartha sghosh@iitb.ac.in	Structural engineering, Performance-based seismic design, Reliability based seismic design, Plastic design of steel structures, Analysis and design of special plate shear walls
Subimal, Ghosh subimal@iitb.ac.in	Water resources engineering, Uncertainity modeling, Water resources systems, Hydroclimatology

Goyal, A agoyal@iitb.ac.in	Structural engineering, Base isolation systems and energy absorbing devices, Earthquake analysis and design, Liquid storage tanks, Bridges, Vibration control of structures, Service life assessment of buildings
Gupta, Kapil kgupta@iitb.ac.in	Urban hydrology and water infrastructure management, Urban drainage, Flood protection structures, Airport drainage, Urban flood disaster management
Inamdar, Mandar minamdar@iitb.ac.in	Structural engineering, Solid mechanics, Cellular adhesion and motility, Mechanics of soft materials, Dissipation in structural and mechanical systems
Jangid, R. S. rsjangid@iitb.ac.in	Structural earthquake engineering, Base isolation, Non-classically damped system and Vibration control using tuned mass dampers, semi-active & active dampers
Jothiprakash, V. vprakash@iitb.ac.in	Water resources engineering, Water resources systems analysis, Reservoir operation, Policy issues, Multi-objective analysis, Stochastic hydrological modeling, Irrigation water management
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Bellur, Umesh umesh@iitb.ac.in	Distributed systems, Adaptive computing
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Sheshadri, Sreedhara sreedhara.s@iitb.ac.in	Power plant & I.C Engine, Alternate fuels, Fluid mechanics Thermodynamics and heat transfer
Sridharan, Arunkumar arunsri@iitb.ac.in	Thermodynamics and heat transfer, Fluid mechanics, CFD, MEMS Machine design and dynamics, Solid mechanics, Stress analysis, fracture mechanics, FEM

Srirangarajan, H. R. hrs@iitb.ac.in	Machine design and dynamics, solid mechanics, Stress analysis, Dynamics & vibrations
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Subash Babu, A. subash@iitb.ac.in	Manufacturing processes
Suryanarayanan, S. shashisn@iitb.ac.in	Machine design and dynamics, Systems & control
Tewari, Asim asim.tewari@iitb.ac.in	Microstructural-mechanics modeling, Structure-property linkage during thermo mechanical processing of crystalline alloys, three-dimensional charactesization & rendering of materials micro structure, stereology, applied image analysis
Ukadgaonkar, Vijay G. vgu@iitb.ac.in	Machine design and dynamics, solid mechanics, stress analysis, fracture mechanics, FEM
Vedula, R. P. rpv@iitb.ac.in	Thermodynamics and heat transfer, Fluid mechanics, CFD, Power plant & I. C. Engine

Department of Metallurgical Engineering and Materials Science

Faculty	Areas of Specialisation
Bahadur, Dhirendra dhiren@iitb.ac.in	Magnetic materials, Electronic ceramics, Nano structured materials for magnetic, bio and optical applications
Ballal, N. B. nbb@iitb.ac.in	Process modeling, Process analysis, Iron and steel making, Transport phenomenon, Thermodynamics
Bhargava, Parag pbhargava@iitb.ac.in	Powder processing, Near net shape forming of advanced ceramics, Indentation fracture of ceramics, Gel casting, Rheology of ceramic suspensions, Fabrication and properties of ceramic foams, Synthesis of oxide nanoparticles, Consolidation of nanoparticles, Fabrication of ceramics for prosthodontic applications, Plastic forming of ceramics, Materials for dye sensitized solar cells
Bhattacharya, Arup R. arupranjan@iitb.ac.in	Polymers blends, polymer composites/carbon nano tubes, Polymer crystallization
Dusane, Rajiv O. rodusane@iitb.ac.in	Devices of thin film elemental semi-conductors and alloy systems, Surface passivation and semiconductor processing, Surface treatment/modification, Hard coatings
Gopalan, Prakash pgopalan@iitb.ac.in	Ferroelectric materials and films, Cationic conductors, Oxygen ion conductors for SOFC
Gururajan, Mogadalai P. guru.mp@iitb.ac.in	Phase transformations, modeling of micro structural evolution, Phase field modeling materials mechanics, materials thermodynamics
Kashyap, Bhagwati P. bpk@iitb.ac.in	Deformation behavior and microstructural evolution
Khanna, Anand S. khanna@iitb.ac.in	High temperature corrosion, High temperature coatings, Paint coatings, Rebar and concrete coatings, Oil and gas corrosion
Khosla, Nirdosh K. n.khosla@iitb.ac.in	Process instrumentation and control, Mineral processing, Extractive metallurgy, Materials preparation and characterization
Kulkarni, Ajit R. ajit.kulkarni@iitb.ac.in	Ionic ally conducting materials, Dielectric and multilayers, Glass and glass ceramics, Impedance spectroscopy, Electrical composites
Mallick, Sudhanshu mallick@iitb.ac.in	High temperature piezoelectric ceramics, Powder metallurgy, Dielectrics
Mishra, Saurabh saurabh.mishra@iitb.ac.in	Welding, Transport phenomena, Microstructure modeling, Optimization
Narasimhan, K. nara@iitb.ac.in	Mechanical behaviour, Metal forming, Simulation and validation
Om, Prakash prakasho@iitb.ac.in	Electronic ceramics and nano powders, Design, Processing and characterization
Panwar, Ajay S. panwar@iitb.ac.in	Computational materials science, Molecular simulations, Soft nano-structured materials

Prabhu, Nithyanand nprabhu@iitb.ac.in	Physical metallurgy, Phase transformations, Electron microscopy, Structure-property relationships
Prabhugaonkar, Gajanana V. gvprabhu@iitb.ac.in	Fracture mechanics, Design, Processing and selection of materials, Corrosion prevention, Non-destructive testing and evaluation, Nano-structured composites, Synthesis and applications of CNTs, Failure analysis and RLA
Prasad, R. C. rcp@iitb.ac.in	Fatigue environmental assisted cracking fracture mechanics and Failure analysis of materials and their composites
Prasanna, T. R. S. prasanna@iitb.ac.in	Materials for energy generation and storage, Oxide ion and cation solid electrolytes
Prita, Pant (Ms) pritapant@iitb.ac.in	Mechanical behavior of thin films, Dislocation dynamics simulations, Modelling and experiments to study novel shape memory materials
Raja, Vangaranahalli S. vsraja@iitb.ac.in	Aqueous corrosion, Failure analysis, Protective coatings, Metallurgy of corrosion
Raman, Ramalingam raman@iitb.ac.in	Welding, Thermal spray coating, Corrosion, Metal finishing, Fractal approach to metallurgical & corrosion processes
Raman, Srinivasa S. rss@iitb.ac.in	Nanostructured materials, thin films
Samajdar, Indradev indra@iitb.ac.in	Thermomechanical processing, Texture analysis, Microscopy
Tiwari, Achyut N. ant@iitb.ac.in	Composite materials, Mechanical alloying, wear, Heat treatment
Prasad R. C. rcp@iitb.ac.in	Fatigue environmental assisted cracking fracture mechanics and Failure analysis of materials and their composites
Venkataramani, N. ramani@iitb.ac.in	Magnetic materials, thin films, Structure property correlations in nanocrystalline systems, Magneto electric composites
Viswanathan, Nurni N. vichu@iitb.ac.in	Process metallurgy, Modelling, Transport phenomena, Blast furnace, Steel making
Vitta, Satish satish.vitta@iitb.ac.in	Electronic materials, Biomaterials, Thin films/semiconductors, Nanomaterials, Phase transformation, Microstructures, Texture/ Electron microscopy, Metal joining/solidification, Surface engineering/corrosion

Faculty	Areas of Specialisation
Aslam, Mohammed aslam@iitb.ac.in	Nanomaterials (semiconductors/carbon based materials), magnetism & magnetic materials, Nano scale physics
Das, Dibyendu dibyendu@iitb.ac.in	Statistical physics, Non-equilibrium physics
Das Gupta, Kantimay kdasgupta@phy.iitb.ac.in	Semiconductor heterostructures and bilayers, Low temperature physics and instrumentation, Nanofabrication, Josephson junctions and vortex phases
Das, Pragya (Ms) pragya@iitb.ac.in	Experimental nuclear physics
Dhar, Subhabrata dhar@iitb.ac.in	Nanomaterials (semiconductors/carbon based materials), Magnetism & magnetic materials, Thin films & multilayers-Experimental, Laser physics & spectroscopy
Ghosh, Dipan K. dkg@iitb.ac.in	Theoretical condensed matter physics
Jha, Sudhanshu S. ssjha@iitb.ac.in	Theoretical condensed matter physics
Kundu, Tapanendu tkundu@iitb.ac.in	Experimental, Laser physics & spectroscopy, Non-linear optics
Major, Syed S. syed@iitb.ac.in	Nanomaterials (semiconductors/carbon based materials), Nano scale physics, Thin films & multilayers
Mahajan, Avinash V. mahajan@iitb.ac.in	Magnetism & magnetic materials, Superconductivity & low temp physics
Misra, S. D. nirdesh@iitb.ac.in	Nanomaterials (semiconductors/carbon based materials), Nano scale physics, Thin films & multilayers
Mukherjee, Asmita (Ms) asmita@iitb.ac.in	Theoretical high energy physics
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Punit, Parmananda punit@iitb.ac.in	Non-linear dynamics, Non-equilibrium physics
Prasad, Shiva shivap@iitb.ac.in	Magnetism & magnetic materials, Nano scale physics, Thin films & multilayers

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Singh, Prabhakar P. ppsingh@iitb.ac.in	Theoretical condensed matter physics
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Tomy, C. V. tomy@iitb.ac.in	Magnetism & magnetic materials, Superconductivity & low temp physics
Tulsi, Tathagat A.	Quantum computing
Umasankar, S. uma@iitb.ac.in	Theoretical high energy physics
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Vijaya, R. (Ms) rvijaya@iitb.ac.in	Experimental laser physics & spectroscopy, Non-linear optics
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Industrial Design Centre

Faculty	Areas of Specialisation
Athavankar U. A. uaa@iitb.ac.in	Basic design, Product design, Product semantics, Cognition and imagery, Environment design, Furniture design, Exhibition design
Balan, Sudesh sudesh@iitb.ac.in	Film making, Digital photography, Democratization of digital media
Bapat P. V. bapat@iitb.ac.in	Basic Design, Product Design
Chakravarthy, K.B. chakku@iitb.ac.in	Product styling and perception, Creativity, New product innovation, Design strategy, Humanizing technology, Collaborative innovation methodology
Joshi, Anirudha N. anirudha@iitb.ac.in	Design for development, interaction design, integration of human-computer interaction and software engineering, user studies, active people watching, usability evaluations, field studies, text input in Indian languages, design for low-literate users
Joshi, Purba (Ms) Purba_joshi@iitb.ac.in	Product design, Computer aided design, Form design
Khambete, Pramod Pramod.khambete@iitb.ac.in	Interactions design, Human computer interaction , User experience of service touch points, Service experience design
Mohanty, Raja rajam@iitb.ac.in	Visual arts, Visual communications, Art and design pedagogy, Narratives and storytelling, Basic design
Munshi, K. munshi@iitb.ac.in	Product design, New product development, Design management, Management of design process, Mobility and vehicle design, Design integration, Design pedagogy
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Sadhu, Nachiketa sadhu@iitb.ac.in	Workstation identity ergonomics, Automobile and product ergonomics, Workstation ergonomics, and Product ergonomics
Sandesh, M.R. sandesh.idc@iitb.ac.in	Product Design: Context based industrial/product design, Basic form and form abstraction and expression, Craft practices and traditional vocation based livelihood opportunities, Design based study of traditional craft communities and craft practices
Sharma, Nishant nishantsharma@iitb.ac.in	Vehicle design & styling, Product form & aesthetics, Computer aided industrial design, Class a surfacing, Computational aesthetics. Participatory design/innovation, Human powered mobility
Sreekumar, G. V. gvsree@iitb.ac.in	Typography, Font design, Publication design, Information graphics
Trivedi, Kirti K. kirti@iitb.ac.in	Graphic design, Exhibition design, Indian design tradition

Interdisciplinary Programme in Industrial Engineering and Operations Research

Faculty	Areas of Specialisation
Hemachandra, N. nh@iitb.ac.in	Optimization, Stochastic Models & Applications, Game theory, Logistics and Supply Chain management, Inventory Systems and Scheduling, Simulation and Systems Dynamics, Communication Networks, Financial Engineering, Service Management, Pricing and Revenue Management, Transportation Systems
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Rangaraj, Narayan Narayan.rangaraj@iitb.ac.in	Optimization, Logistics and Supply Chain management, Inventory Systems and Scheduling, Communication Networks, Pricing and Revenue Management, Transportation Systems
Narayanan, Vishnu Vishnu@iitb.ac.in	Optimization, Communication Networks, Transportation Systems
Venkateswaran, Jayendran jayendran@iitb.ac.in	Logistics and Supply Chain management, Inventory Systems and Scheduling, Simulation and Systems Dynamics

Faculty	Areas of Specialisation
Banavar, Ravi N. banavar@iitb.ac.in	Nonlinear control, Optimal control and geometric mechanics with applications to electrical (Power system networks), Mechanical (Robotics, Micro/Nano Particles, Formation) and aerospace (Satellites, Launch vehicles) problem.
Bandyopadhyay, Bijnan bijnan@iitb.ac.in	Variable structure and sliding mode control, Large scale systems, system reduction, Nuclear reactor control, Power systems, Space launch vehicles, Flexible manipulators
Nataraj, Paluri S. V. nataraj@iitb.ac.in	Constraint programming, Fractional-order modeling and control, Gas turbine control, Global optimization, Process control, Robust stability and control, Reliable computing
Sinha, Arpita (Ms) asinha@iitb.ac.in	Cooperative control of multi-agent systems, Guidance of missiles, consensus strategies for dynamical systems, Path planning of autonomous vehicles, Resource allocation, Team theory, Game theory
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Mukherjee, Indrajit Indrajitmukherjee@iitb.ac.in	Operations management, Manufacturing, Quality management
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Patwardhan, Anand anand@iitb.ac.in	Climate change science and policy, Science, technology and innovation policy; Technology management
Rao, Sapar N. snrao@iitb.ac.in	Finance
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Sonar, Rajendra M. rm_sonar@iitb.ac.in	Information systems/technology, Business intelligence, Hybrid intelligence systems

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