

# PROSPECTUS

## 2020-2021



**INDIAN INSTITUTE OF TECHNOLOGY DELHI**

## VISION

To contribute to India and the World through excellence in scientific and technical education and research; to serve as a valuable resource for industry and society; and remain a source of pride for all Indians.

## MISSION

To generate new knowledge by engaging in cutting-edge research and to promote academic growth by offering state-of-the-art undergraduate, postgraduate and doctoral programmes.

To identify, based on an informed perception of Indian, regional and global needs, areas of specialization upon which the Institute can concentrate.

To undertake collaborative projects which offer opportunities for long-term interaction with academia and industry.

To develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders can emerge in a range of professions.

## VALUES

- Academic integrity and accountability.
- Respect and tolerance for the views of every individual.
- Attention to issues of national relevance as well as of global concern.
- Breadth of understanding, including knowledge of the human sciences.
- Appreciation of intellectual excellence and creativity.
- An unfettered spirit of exploration, rationality and enterprise.

# PROSPECTUS 2020-2021



INDIAN INSTITUTE OF TECHNOLOGY DELHI

This publication is available at the IIT Delhi Website : <http://www.iitd.ac.in>  
Link : <https://home.iitd.ac.in/curriculum.php>

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## 1. INTRODUCTION

Indian Institute of Technology Delhi is one of the Twenty Three IITs created to be Centres of Excellence for training, research and development in science, engineering and technology in India.

Established as College of Engineering in 1961, the Institute was later declared as an Institution of National Importance under the “Institutes of Technology (Amendment) Act, 1963” and was renamed as “Indian Institute of Technology Delhi”. It was then accorded the status of a Deemed University with powers to decide its own academic policy, to conduct its own examinations, and to award its own degrees.



Since its inception, around 52,000 students have graduated from IIT Delhi in various disciplines including Engineering, Physical Sciences, Management and Humanities & Social Sciences. Of these, nearly 6,000 students received Ph.D. degrees. The number of students who graduated with B.Tech. degree is over 17,000. The rest obtained Master's Degree in Engineering, Sciences and Business Administration. These alumni today work as scientists, technologists, business managers and entrepreneurs. There are several alumni who have moved away from their original disciplines and have taken to administrative services, active politics or are with NGOs. In doing so, they have contributed significantly to building of this nation, and to industrialization around the world.



IIT Delhi is situated in Hauz Khas in South Delhi, which is a landmark place in the colourful and chequered history of Delhi. Bounded by the Sri Aurobindo Marg on the east, the Jawaharlal Nehru University Complex on the west, the National Council of Educational Research and Training on the south, and the Outer Ring Road on the north, the Institute campus is flanked by Qutub Minar and the Hauz Khas monuments.



Well connected to the major city centres by open and wide roads, the Institute campus is about 19 k.m. away from the Delhi Main Railway Station, 14 k.m. from the New Delhi Railway Station, 21 k.m. from the Inter-State Bus Terminal (Kashmere Gate) and 10 k.m. from Delhi Airport. Delhi Metro has two gates opening at the Institute Campus.

Campus of the Institute extends to an area of 320 acres. With many topographical features, imaginatively laid out with picturesque landscape, numerous buildings of various nature and stature, and clean and wide roads, the campus presents a spectacle of harmony in architecture and natural beauty.

The campus area is divided into four functional zones : (i) Residential zone for students; (ii) Residential zone for the faculty and other supporting staff; (iii) Academic zone for academic buildings and workshops; and (iv) Cultural-cum-social and recreational zone for students.

The campus also offers amenities like Staff Clubs, Hospital, Shopping Centre, Banks, Post Office, Telecom Centre, Community Centre, Stadium, Playing Fields, etc. The Students Activities Centre provides all facilities for students' extra-curricular activities and physical development.

The central double-storied recreation block with a swimming pool and a gymnasium hall offers amenities such as squash courts, hobbies workshops/seminar rooms, music rooms and other multipurpose rooms for reading and indoor games. The amphitheater with large capacity constructed in modern style is an added amenity to the centre.



IIT Delhi has been extending its boundaries. One extension campus has been established in Sonapat, Haryana over 50 acres of land allocated by Haryana Government. A Technopark filled with high class facilities has been set-up there. Another extension campus will come up in near future in Jhajjar, Haryana over 50 acres of land.



## 1.1 Administration

IIT Delhi is an autonomous statutory organization functioning within the “Institutes of Technology Act” as amended by “The Institutes of Technology (Amendment) Act, 1963”.

The Indian Institutes of Technology are administered centrally by the IIT Council, an apex body established by the Government of India to co-ordinate the activities of these Institutes.

The Hon’ble Minister for Human Resource Development of the Government of India is the Chairman of the IIT Council. Each Indian Institute of Technology has a Board of Governors responsible for its overall administration and control.

**DIRECTOR  
&  
OFFICIATING CHAIRMAN, BOG**



**Prof. V. Ramgopal Rao**

**Prof. V. Ramgopal Rao** is the Director of IIT Delhi. He is also officiating as Chairman, Board of Governors. Before joining IIT Delhi as the Director in April 2016, Dr. Rao served as a P.K. Kelkar Chair Professor for Nanotechnology in the Department of Electrical Engineering and as the Chief Investigator for the Centre of Excellence in Nano-electronics project at IIT Bombay. Dr. Rao has over 450 research publications in the area of nanoscale devices & nanoelectronics and is an inventor on 43 patents and patent applications, which include 15 issued US patents. Eleven of his patents have been licensed to industries for commercialization. Prof. Rao is a co-founder of two deep technology startups at IIT Bombay (Nanosniff.com & Soilsens.com) which are developing products of relevance to the society. Dr. Rao is a Fellow of IEEE, a Fellow of the Indian National Academy of Engineering, the Indian Academy of Sciences, the National Academy of Sciences, and the Indian National Science Academy.

Prof. Rao’s work is recognized with many awards and honors in the country and abroad. He is a recipient of the Shanti Swarup Bhatnagar Prize in Engineering Sciences in 2005 and the Infosys Prize in 2013. Dr. Rao also received the Swarnajayanti Fellowship award from the Department of Science & Technology, IBM Faculty award, Best Research award from the Intel Asia Academic Forum, TechnoMentor award from the Indian Semiconductor Association, DAE-SRC Outstanding Research Investigator award, NASI-Reliance Platinum Jubilee award, J.C. Bose National Fellowship, Prof. C.N.R. Rao National Nanoscience award, VASVIK Award, DRDO Academic Excellence award and the Excellence in Research Award from IIT Bombay. Prof. Rao was an Editor for the IEEE Transactions on Electron Devices during 2003-2012 for the CMOS Devices and Technology area and currently serves on the Editorial boards of other journals. He is a Distinguished Lecturer, IEEE Electron Devices Society and interacts closely with many semiconductor industries in India and abroad.

## **THE SENATE**

The Senate decides the academic policy of the Institute, and approves curriculum, courses and examination results. It appoints committees to look into specific academic matters arising from time to time. The teaching, training and research activities of various departments at the Institute are constantly under review to improve both facilities and standard. The Director of the Institute is the Chairman of the Senate.

## **INSTITUTE COMMITTEES**

Financial advice to the Institute is rendered by the Finance Committee. Similarly, there is a Buildings and Works Committee to advise on matters relating to buildings and works activity. These committees are appointed by the Board of Governors. In addition, there are a number of other committees like the Board of Academic Programmes, Board of Educational Research and Planning, appointed by the Senate to help the administration in the efficient running of the Institute.

## **▶ 2. ACADEMICS**

IIT Delhi provides science-based engineering education with a view to produce quality engineer-scientists. The curriculum provides broad based knowledge and simultaneously builds a temper for the life long process of learning and exploring.

### **▶ 2.1 Academic System**

At the undergraduate level, a student needs to do compulsory foundation courses in the areas of basic sciences, humanities & social sciences and engineering sciences apart from departmental requirements. At postgraduate level, several specializations, in the form of various M.S.(R), M.Tech., M.B.A., M.Des., P.G. D.I.I.T., and M.Sc., are available and the students get an exposure and training in research in their chosen fields. The Institute has strong Ph.D. programmes and the students carry out advanced research under the guidance of the members of the Institute faculty.

The Institute undertakes a major revision of its curriculum periodically. From the academic session 2013-14, a new undergraduate curriculum has been in place and the new postgraduate curriculum has been implemented from the academic session 2015-16.

The Institute follows the semester system. An academic year runs from July through June next year and comprises two semesters. Typically, the 1st semester starts in the last week of July and ends in the 1st week of December; and the 2nd semester starts in the first week of January and ends in the 2nd week of May. Additionally, the summer semester which starts in the 3rd week of May and ends in the 2nd week of July, is utilised in some exceptional cases. Detailed activities are given in the Semester Schedule that is available before the start of every semester.



## 2.2 Academic Structure

The major academic units of the Institute are the Departments, Centres and the Schools. Interdisciplinary research is organized in programmes. The various academic units are listed below, and details are given latter in this document. The activities of Departments include teaching at all levels and research. The Centres focus on interdisciplinary research and some teaching mostly at the postgraduate level.

### DEPARTMENTS

Department of Applied Mechanics  
 Department of Biochemical Engineering and Biotechnology  
 Department of Chemical Engineering  
 Department of Chemistry  
 Department of Civil Engineering  
 Department of Computer Science and Engineering  
 Department of Design  
 Department of Electrical Engineering  
 Department of Humanities and Social Sciences  
 Department of Management Studies  
 Department of Materials Science & Engineering  
 Department of Mathematics  
 Department of Mechanical Engineering  
 Department of Physics  
 Department of Textile and Fibre Engineering

### SCHOOLS

Amar Nath and Shashi Khosla School of Information Technology  
 Bharti School of Telecommunication Technology & Management  
 Kusuma School of Biological Sciences  
 School of Interdisciplinary Research  
 School of Public Policy

### CENTRES

Centre for Applied Research in Electronics  
 Centre for Atmospheric Sciences  
 Centre for Automotive Research and Tribology  
 (formerly ITMMEC)  
 Centre for Biomedical Engineering  
 Centre for Energy Studies  
 National Resource Centre for Value  
 Education in Engineering  
 Centre for Rural Development and Technology  
 Centre for Sensors, Instrumentation and  
 Cyber-Physical Systems Engineering  
 (formerly IDDC)

### INTERDISCIPLINARY RESEARCH PROGRAMMES

Transportation Research and Injury  
 Prevention Programme  
 Opto-Electronics and Optical  
 Communication Research Programme  
 VLSI Design Tool and Technology

### 2.3 Research and Innovation

IIT Delhi places strong emphasis on research and development, and innovation. Faculty members undertake research in the fields of their interest. Many postgraduate students and some undergraduate students are also involved in these activities, as the curriculum provides facilities for the same. While some research is funded by the Institute, majority of research activities/projects are funded by sponsoring agencies and/or industries. All projects funded by government agencies and some industry funded projects are managed through the Institute's Industrial Research and Development (IRD) Unit. Innovative technology development and industrial outreach are also facilitated by the Foundation for Innovation and Technology Transfer (FITT), a non-profit society associated with IIT Delhi and located on the campus.

### 2.4 Collaborations

IIT Delhi is actively involved in collaborative programmes with industry, academia and governments at national and international level to remain at the forefront of scientific and technological developments and also to share knowledge for mutual benefit. The Institute has 110 ongoing International Memorandum of Understanding established with various organization/institutions from countries all over the world. During the period 2019-20 Institute has signed 23 International Memorandum of Understandings which includes Russia, Denmark, Canada, UK, Korean, France, Germany etc.

### 2.5 Student Exchange Programmes

IIT Delhi promotes exchange of students with premier institutions in India and abroad at UG, PG and Ph.D. levels. At the international level, the exchange programme has been established with institutions like INSA Toulouse France, INSA Lyon France, KTH Sweden, City University Hong Kong, Chalmers University of Technology, Concordia University, IMT, Loughborough University, UK, Macquaire University, University of Waterloo, University Taipei, ILDP-Hiroshima University and UBC Canada, Korea Advance Institute of Science & Technology, POSTECH. Apart from these, IIT Delhi is also one of the partner institutions under (i) the ERASMUS project of European Commission under which active faculty/student/staff exchange is undertaken with European partner institutions and (ii) International Linkage Degree Programme (ILDP), Hiroshima.



## 2.6 Academic Programmes

IIT Delhi offers a variety of academic programmes for students with a wide range of backgrounds leading to the degrees listed below:

### Doctor of Philosophy (Ph.D.) :

All Departments, Centres and Schools offer Ph.D. programmes.

### Master of Technology (M.Tech.) :

- » M.Tech. in Engineering Analysis and Design
- » M.Tech. in Chemical Engineering
- » M.Tech. in Molecular Engineering : Chemical Synthesis & Analysis
- » M.Tech. in Geotechnical and Geoenvironmental Engg.
- » M.Tech. in Rock Engg. and Underground Structures
- » M.Tech. in Structural Engineering
- » M.Tech. in Water Resources Engineering
- » M.Tech. in Construction Engineering and Management
- » M.Tech. in Construction Technology and Management
- » M.Tech. in Environmental Engineering and Mgmt.
- » M.Tech. in Transportation Engineering
- » M.Tech. in Computer Science and Engineering
- » M.Tech. in Communications Engineering
- » M.Tech. in Computer Technology
- » M.Tech. in Control and Automation
- » M.Tech. in Integrated Electronics and Circuits
- » M.Tech. in Power Electronics, Electrical Machines and Drives
- » M.Tech. in Power Systems
- » M.Tech. in Mechanical Design
- » M.Tech. in Industrial Engineering
- » M.Tech. in Production Engineering
- » M.Tech. in Thermal Engineering
- » M.Tech. in Polymer Science and Technology
- » M.Tech. in Materials Engineering
- » M.Tech. in Applied Optics
- » M.Tech. in Solid State Materials
- » M.Tech. in Fibre Science & Technology
- » M.Tech. in Textile Engineering
- » M.Tech. in Textile Chemical Processing
- » M.Tech. in Radio Frequency Design and Technology
- » M.Tech. in Atmospheric-Oceanic Science & Technology
- » M.Tech. in Biomedical Engineering
- » M.Tech. in Energy Studies
- » M.Tech. in Energy & Environment Technologies and Management
- » M.Tech. in Renewable Energy Technologies and Mgmt.
- » M.Tech. in Industrial Tribology and Maintenance Engg.
- » M.Tech. in Instrument Technology
- » M.Tech. in Optoelectronics and Optical Communication
- » M.Tech. in Telecommunication Technology and Mgmt.
- » M.Tech. in VLSI Design Tools and Technology

### **Master of Science (Research) (M.S.(R)) :**

- » M.S. (R) in Amar Nath and Shashi Khosla School of Information Technology
- » M.S. (R) in Applied Mechanics
- » M.S. (R) in Automotive Research and Tribology
- » M.S. (R) in Bharti School of Telecommunication Technology and Management
- » M.S. (R) in Biochemical Engineering and Biotechnology
- » M.S. (R) in Chemical Engineering
- » M.S. (R) in Civil Engineering
- » M.S. (R) in Computer Science and Engineering
- » M.S. (R) in Electrical Engineering
- » M.S. (R) in Mechanical Engineering
- » M.S. (R) in Materials Science and Engineering
- » M.S. (R) in Kusuma School of Biological Sciences
- » M.S. (R) in VLSI Design Tools & Technology
- » M.S. (R) in Sensors, Instrumentation and Cyber-Physical Systems Engineering

### **Masters of Business Administration (M.B.A) :**

- » M.B.A.
- » M.B.A. (with focus on Telecommunication Systems Management)
- » M.B.A. (with focus on Technology Management), (part-time evening programme)

### **Master of Design (M.Des.) :**

- » M.Des. in Industrial Design

### **Masters of Science (M.Sc.) :**

- » M.Sc. in Chemistry
- » M.Sc. in Cognitive Science
- » M.Sc. in Economics
- » M.Sc. in Mathematics
- » M.Sc. in Physics



**Postgraduate Diploma**

- » P.G. D.I.I.T (Naval Construction)  
(for candidates sponsored by the Indian Navy)

**Dual Degree (B.Tech. and M.Tech.) :**

- » B.Tech. & M.Tech in Chemical Engineering
- » B.Tech. & M.Tech in Computer Science and Engineering
- » B.Tech. & M.Tech. in Mathematics and Computing

**Bachelor of Technology (B.Tech.) :**

- » B.Tech. in Biochemical Engineering and Biotechnology
- » B.Tech. in Chemical Engineering
- » B.Tech. in Computer Science and Engineering
- » B.Tech. in Civil Engineering
- » B.Tech. in Electrical Engineering
- » B.Tech. in Electrical Engineering (Power and Automation)
- » B.Tech. in Engineering and Computational Mechanics
- » B.Tech. in Material Engineering
- » B.Tech. in Mathematics and Computing
- » B.Tech. in Mechanical Engineering
- » B.Tech. in Production and Industrial Engineering
- » B.Tech. in Engineering Physics
- » B.Tech. in Textile Technology

The details of these programmes are given under specific Departments, Centers and Schools in this Prospectus as well as in the Courses of Study 2020-2021.

### ▶ 3. ADMISSIONS

Admission to IIT Delhi is possible through various entrance examinations, like the Joint Entrance Examination (JEE), Graduate Aptitude Test in Engineering (GATE), Common Entrance Examination for Design (CEED), Common Admission Test (CAT) and Joint Admission Test in M.Sc. (JAM), for its various degrees and programmes.

#### ▶ 3.1 Undergraduate Programmes

Admission to all Undergraduate Programmes listed in Chapter 2 are made through the Joint Entrance Examination (JEE) (Main and Advanced). For further information, please visit JEE website: <http://jee.iitd.ac.in/>

##### **Visiting Studentship**

A student, who is registered for an Engineering / Technology degree in a recognized Institute / University in India or abroad, is eligible for being considered as a visiting student at IIT Delhi, for a maximum period of 6 months / one semester. More details can be obtained from the Academic Section of the Institute.

##### **Summer Research Fellowship**

In order to expose students from other Engineering Colleges / Institutes to the ongoing research activities at IIT Delhi, Institute has introduced Summer Research Fellowship programme for undergraduate students from other engineering Institutes. IIT Delhi will offer fellowship or interns can also be supported from budget of sponsored / consultancy projects, through an outside fellowship (eg. KVPY, INSA, INAE, etc.) or institutional MoUs. Further details can be obtained from the Academic Section of the Institute.

##### **Admission of UG students to PG programmes with advance standing**

UG students of IIT Delhi with advance standing are eligible for admission to PG programmes at IIT Delhi. Details are given in the Courses of Study booklet.

#### ▶ 3.2 Postgraduate Programmes

**Procedure for admission:** Applications are invited from candidates by advertising the programmes in March/ October every year. Subsequently, the candidates have to apply online as specified in the advertisements.

Admission are done through the Graduate Aptitude Test in Engineering (GATE) for M.Tech. programmes, Common Entrance Examination for Design (CEED) for M.Des., Common Admission Test (CAT) for M.B.A. and, Joint Admission Test (JAM) for M.Sc. programmes.

Admission to Ph.D./M.S. (Research) programme is also possible any time during the year through Department Research Committee (DRC) / Centre Research Committee (CRC) / School Research Committee (SRC) with the approval of Dean, Academics. For further information / details, please visit the Institute website - [www.iitd.ac.in](http://www.iitd.ac.in)

IIT DELHI FOLLOWS RESERVATIONS IN ADMISSIONS (BOTH UG AND PG) AND CHARGES FEES AS PRESCRIBED BY GOVERNMENT OF INDIA FROM TIME TO TIME.

### Migration from one PG Programme to another PG Programme of the Institute

Provision exists for the PG students of the Institute to move from (i) M.Tech./ M.S. (R) to Ph.D., (ii) M.Tech. to M.S. (R), and (iii) M.S.(R) to M.Tech. The details of the provisions are available on the Institute website.

### ADMISSION OF FOREIGN NATIONALS

- **International Ph.D. Fellowship Programme (IPFP)** : IIT Delhi has announced the International Ph.D. Fellowship Programme (IPFP), as an effort to attract talented young minds globally. Under this programme, fellowships to international Ph.D. students are given at par with Indian students. (For more details and application process, please visit: <http://intladm.iitd.ac.in>)
- **Applicants under Cultural Exchange Fellowship Programme**: The foreign nationals desiring admission to a post-graduate programme (M.Sc./M.Des./M.Tech./MBA / M.S. (Research)/Ph.D.) at IIT Delhi under this Fellowship programme, are required to apply to the Indian High Commissions/Embassies, in their respective countries. After examining the case of the applicants, they will recommend/ sponsor the names to the Indian Council for Cultural Relations (ICCR), New Delhi, which in turn, will recommend the applicants to this Institute.
- **Self-Financing Foreign Nationals**: Applications from foreign nationals for admission to the various postgraduate programmes (M.Sc./M.Tech./M.S. (Research)/M.Des./M.B.A./Ph.D.) at the Institute are received directly by the Institute. The details of such admissions are available on the Institute Website.
- **Students under Memorandum of Understanding**: Admission of foreign nationals to the various postgraduate programmes (M.Sc./M.Tech./M.S. (Research)/M.Des./M.B.A./Ph.D.) at the Institute will be made in accordance with the terms and conditions of the MoU agreed to between IIT Delhi and the Country/ University/ Institution concerned.

### 3.3 Joint Degree Programmes

IIT Delhi is actively pursuing Joint Degree Programmes at the doctoral level with the following internationally acclaimed institutions:

- IIT Delhi and University of Queensland (UQ) have launched a joint Ph.D. programme recently. Under the programme, Ph.D. students (from India, Australia and elsewhere) will be admitted. IITD/QU faculty will jointly formulate projects and Students will be jointly selected against these projects Students in this academy will spend 3 years at the parent institution and at least 1 year at the partner. Students who successfully complete all the requirements of the programme will be awarded a joint degree by both institutions. (For more details, please visit: <https://www.uqidar.org>)
- IIT Delhi and National Chiao Tung University (NCTU), Taiwan have initiated an Industry funded Joint Doctoral Degree Programme (JDP). An academic and student exchange will be developed through the JDP whereby students who successfully complete all the requirements of the programme will be awarded a joint degree by both institutions. Students will be admitted at both institutions, at the time of joining or after they join the regular Ph.D. Programme. More details on this may be found on the IIT Delhi website.

## 3.4 Scholarships

### UNDERGRADUATE PROGRAMMES

#### **Institute Merit-cum-Means (MCM) Scholarships**

The Institute offers Merit-cum-Means scholarships to under-graduate students in engineering and technology. These scholarships are offered to about 25% of the students. The present value of Merit-cum-Means scholarship is ₹1000/- per month for General/OBC/EWS students and the recipient is exempted from paying tuition fee.

#### **Institute Merit Prizes and Certificates**

The Institute offers Merit prizes and Certificates to the top 7% of the students of each 4-year B.Tech., and 5-year Dual Degree programmes each semester up to the 8th / 10th Semester. The value of merit prize is ₹2500/-.

#### **Institute Free Studentship-U.G.**

The Institute offers free studentship to 10% of the students on the basis of means alone.

**Scholarship provision for SC, ST & PD students:** Tuition fee exemption is admissible to all SC / ST / PD students irrespective of their parents' / guardians' income. Institute offers several other benefits to students from these categories.

**Donor Scholarships:** There are several other scholarships in operation at the Institute. These scholarships have been established by grants from individuals, trusts and organizations.

### POST GRADUATE PROGRAMMES

#### **M.Sc. Programmes**

Merit-cum-Means scholarship of ₹1,000/- per month and tuition fee waiver are permissible to M.Sc. students to the extent of 25% of the sanctioned strength as per Institute rules. Only those students are eligible whose parents' gross income is upto ₹ 4.5 lac per annum for all categories of students / as per govt. orders as applicable .

**M.Tech., M.S. (Research) and M.Des. Students:** The Institute does not award any scholarship to the students of M.Tech., M.S. (Research), and M.Des. programmes. However, a scheme for financial assistance is in operation. Apart from the teaching / research assistantships, there are a number of fellowships and scholarships Instituted by industries and individuals for such students.

**Ph.D. Students:** Although the Institute does not award any scholarship, a scheme for the award of Teaching / Research Assistantship for providing financial assistance to the students exists. Under this scheme, those students, who are admitted on full-time basis, are offered Teaching/Research Assistantship, provided they are not getting any other equivalent fellowship.

### 3.5 Admission to Post Graduate Programmes

Degree	Status	Minimum Eligibility for Admission*	Selection basis
M.Sc.	Full Time	<p>At least 55% aggregate marks or 5.5 CGPA/CPI out of 10 without rounding-off (taking into account all subjects including languages and subsidiaries, all years combined) for General/OBC (Non Creamy Layer)/EWS category candidates (taking into account all subjects, including languages and subsidiaries, all years combined) in the qualifying degree. For Candidates with letter grades / CGPA on other scales, the equivalence will be decided by the Institute.</p> <p>For M.Sc. (Chemistry), Bachelor's degree with Chemistry as a subject for three years/six semesters and Mathematics at (10+2) level. For M.Sc. (Mathematics), Bachelor's degree with Mathematics as a subject for at least two years/four semesters. For M.Sc. (Physics), Bachelor's degree with Physics as a subject for two years / four semesters and Mathematics for at least one year/two semesters.</p> <p>For M.Sc. (Cognitive Science), Qualifying Degree: B.A./B.Sc./B.Com./B.M.S./B.Tech./B.E./B.Stat./B.Math. or equivalent</p> <p>For M.Sc. (Economics), Qualifying Degree: B.A./B.Sc./B.Com./B.Tech./B.E./B.Stat./B.Math. or equivalent</p>	<p>JAM (for Maths, Chemistry, Physics)</p> <p>COGJET/GATE/ JAM/NET &amp; interview (for Cognitive Science)</p> <p>All India Entrance Test &amp; interview (for Economics)</p>
M.Tech.	Full Time	B.E./B.Tech./M.Sc. or equivalent with (a) CGPA 6.00 on a 10 point scale or 60% marks in aggregate for General/OBC (Non Creamy Layer)/EWS Category with valid GATE score. *B.Tech. from IITs with CGPA of 8.00 without GATE are also eligible for admission. AMIE / Grad. IETE are eligible, subject to condition at Note 7.	GATE
	Part Time	B.E./B.Tech./M.Sc. or equivalent in relevant field with (a) CGPA 6.00 on a 10 point scale or 60% marks in aggregate for General/OBC (Non Creamy Layer)/EWS Category and minimum experience (as per table 3.4.1). Must submit No Objection Certificate from employer (as per Note 4) Organisation should be located within 50km. of IIT Delhi. Also see Note. 6.	Written test and/or interview
	Sponsored Full Time	Same as for M.Tech. part time requirements and Sponsorship Certificate from the employer as per Notes 4 and 5 respectively.	-Do-
M.Des.	Full Time	B.E./B.Tech./B.Des./B.Arch. or equivalent in relevant field with CGPA 6.00 on 10 point scale or 60% marks in aggregate and a valid CEED score.	CEED
M.B.A.	Full Time (Generic)	Bachelor's degree or equivalent (Minimum 3 years after 10+2) with CGPA of 6.00 on 10 point scale or 60% marks in aggregate for General/OBC (Non Creamy Layer)/EWS Category.	CAT
	Full Time (with focus on Telecommunication Systems Mgmt.)	Bachelor's degree in Engg./Technology/Architecture/Pharmacy/B.Sc. Agri. Engg. (Minimum 4 year after 10+2) or Bachelor's degree in any branch of Physical/Chemical/Mathematical Sciences like Physics/Chemistry/Mathematics Statistics/Computer Application/Electronics Sciences/Environmental Science or Computational/Information science/Agriculture or Bachelor's degree in Commerce/Economics/CA/ICWA with CGPA of 6.00 on 10 point scale or 60% marks in aggregate for General/OBC (Non Creamy Layer)/EWS Category.	CAT
	Part Time (evening) (with focus on Technology Mgmt.)	Same as M.B.A. full-time (Telecommunication Systems Mgmt.) requirements and two-years experience.	Selection on Performance (SoP) and interview



Degree	Status	Minimum Eligibility for Admission	Selection basis
M.S. (R)	Full Time/ Part Time Sponsored Full Time/ Part Time	<p>Same as the corresponding M.Tech. requirements</p> <ul style="list-style-type: none"> <li>For the currently registered students in Centrally Funded Technical Institutes (CFTIs) having CGPA of 8.0 or above (on a 10 point scale) at the end of 6th semester or later, in B.Tech./B.E./Integrated M.Tech./ Integrated M.Sc. programmes (or any other programme of minimum four years duration, admission to which is on the basis of JEE), the requirement of GATE/National Examination is waived for consideration of admission the M.S.(R) programme in IIT Delhi. Moreover, such students must have obtained CGPA of 8.0 or above at the time of graduation (and before they formally register for the M.S.(R) programme).</li> <li>The requirement of GATE/ National Examination is waived for consideration for admission to the M.S.(R) programme for all graduated of CFTIs with a B.Tech./B.E./Integrated M.Sc. (or any other programme of minimum four years duration, admission to which is on the basis of JEE) with CGPA of 8.0 or above at the time of graduation.</li> <li>The Requirement of GATE/ National Examination is also waived for M.A. or M.Sc. graduated from IITs with CGPA 8.0 or above.</li> </ul> <p>However, if a candidate admitted to M.S.(R) programme following the above criterion wanted to convert to M.Tech. programme, he/she should also meet the shortlisting criteria of the M.Tech. programme, in addition to the conversion criteria (including requirement, if any, of a valid examination in GATE/ National Examination).</p>	Same as the corresponding M.Tech. requirements.
Ph.D.	Full Time	<p>Master degree in Engineering/Technology or master degree in Science/Humanities or equivalent in relevant discipline with CGPA 6.00 on 10 point scale or 60% marks in aggregate for General/OBC/EWS category. Full time students who do not possess M.Tech. or equivalent degree are required to have a valid GATE/CEED* Score or UGC/CSIR/DBT/ICMR/INSPIRE fellowship examination for Sciences/Humanities and Social Sciences disciplines. OR B.Tech. or equivalent with CGPA of 7.0 on a 10 point scale or 70% aggregate marks and qualified GATE or UGC/CSIR/DBT/ICMR/INSPIRE fellowship examination for Biomedical Engg., candidates having M.B.B.S. with 60% marks or more are eligible provided they have qualified ICMR. The Candidates having Postgraduate degree of Doctor of Medicine (MD) / Master in Surgery (MS) with 60% marks or more after MBBS will also be eligible for admission to Ph.D. Programme in CBME.</p> <ul style="list-style-type: none"> <li>For the currently registered students in Centrally Funded Technical Institutes (CFTIs) having CGPA of 8.0 or above (on a 10 point scale) at the end of 6th semester or later, in B.Tech./B.E./ Integrated M.Tech./ Integrated M.Sc. programmes (or any other programme of minimum four years duration, admission to which is on the basis of JEE), the requirement of GATE/National Examination is waived for consideration of admission the Ph.D. programme in IIT Delhi. Moreover, such students must have obtained CGPA of 8.0 or above at the time of graduation (and before they formally register for the Ph.D. programme).</li> <li>The requirement of GATE/ National Examination is waived for consideration for admission to the Ph.D. programme for all graduates of CFTIs with a B.Tech./B.E./Integrated M.Sc. (or any other programme of minimum four years duration, admission to which is on the basis of JEE) with CGPA of 8.0 or above at the time of graduation.</li> <li>The Requirement of GATE/ National Examination is also waived for MA or M.Sc. graduated from IITs with CGPA 8.0 or above.</li> </ul>	Written test and/or interview
	Part Time	Same as for Ph.D. full time and minimum experience (as per table 3.4-1) and No Objection from the employer.	Written test and/or interview
	Sponsored Full Time or Part Time	Same as for Ph.D. full time and Certificate from employer (as per Note 8.) No GATE/National examination required (Note.11)	-Do-

\*CEED score is only for the Department of Design

Part Time Foreign National Posted in Delhi	Same as for full-time Subject to conditions stipulated in Note 12.	-Do-
PMRF	Under the Prime Minister's Research Fellowship (PMRF) Scheme, certain number of fellowship are allocated to the Institute. While PMRF fellows are governed by the same academic rules as any other research scholar, the selection of PMRF fellows is through a centralized process across all IITs/ IISc. (For more details, please visit: <a href="https://pmrf.in">https://pmrf.in</a> )	-Do-
IITD - QU Joint Ph.D.	For admission in QU and IITD joint Ph.D. programme. (please visit: <a href="https://www.uqidar.org">https://www.uqidar.org</a> )	-Do-
IITD - NCTU Joint Ph.D.	Under this programme, each Institute would admit students to its HOME Institute as per their own criteria. Students would have to apply for admission to the HOST Institute when they have identified Co-Supervisor. HOST Institute will select as per its own criterion. It is proposed that students apply to the Host Institute for admission within 12 months of their admission to the HOME Institute.	-Do-

**NOTES:**

- 15% seats are reserved for SC candidates, 7.5% for ST candidates, 27% for OBC (non-creamy layer) candidates and 10% for EWS candidates.
- For SC, ST and PD candidates, relaxation of 5% marks or 0.5 CGPA (on ten point scale) in the qualifying degree will be provided. Relaxation in CGPA to 5.50 or in marks to 55% in the minimum qualifying criteria may be permitted to those General / OBC / EWS candidates who possess M.A. Degree in English for admission to Ph.D. programme in the Department of Humanities & Social Sciences.
- 5% of the seats allocated for full-time students, excluding sponsored students, students drawing assistantship from other sources and foreign students are reserved for Persons with Disability (PD) for admission to various Postgraduate Programmes. The candidates selected against the quota for PD be placed in the appropriate category viz. SC / ST / OBC / EWS / General Candidates depending upon the category to which they belong.
- No Objection Certificate should state that the candidate is permitted to pursue studies on part time basis and he / she will not be transferred to any other place during the period of study.
- Sponsorship letter (on letterhead of the sponsoring organization) should state that period of study will be treated as on duty with usual salary / allowances and he / she would be fully relieved and granted study leave for the period of studies.
- For part-time MBA programme, the classes are held in the evening.
- Candidates with AMIE/grad. IETE fulfilling the minimum eligibility criteria can be considered for admission as visiting students for completing 24 earned credits of undergraduate courses as prescribed by the respective programme after which they have to appear for GATE and apply afresh for admission to M.Tech. programme.
- The letter should state that he / she is permitted to pursue studies on part time basis and that
  - his / her official duties will permit sufficient time for research,

- (ii) facilities for research are available at the place of work,
- (iii) he / she will be permitted to reside at the Institute for at least 6 months\* during his/her registration for the degree (not applicable if organization is within 50 km of IIT Delhi).

\*If the course credit requirement recommended by a Deptt. / Centre / School is more than 12, then the residency requirement for part time Ph.D. Candidates holding degrees from other Institutes / Universities and working in organisations outside Delhi will be 12 months.

9. Full-time applicants coming on study leave must show proof of at least 3 years (2 years in the case of M.Tech. degree holders) study leave when appearing for the interview.
10. CGPA is Cumulative Grade Point Average. For the purpose of admission at IIT Delhi, the conversion factor of 10 would be used for converting percentage to CGPA (divide by 10). However, this conversion to CGPA will only be applied in case of the primary method of evaluation followed in the graduating institution of the candidate seeking admission is percentage marks.

For CGPA with scales of other points, a linear interpolation will be used i.e.

$$G = G_x * 10 / X$$

where G is the GPA on 10 points scale and  $G_x$  is the GPA on 'x' point scale. Conversions worked out using the above formula for some scales are given in the following table:

%	CGPA 10	CGPA 9	CGPA 6	CGPA 4
50	5	4.5	3	2
55	5.5	4.95	3.3	2.2
60	6	5.4	3.6	2.4
70	7	6.3	4.2	2.8
75	7.5	6.75	4.5	3
80	8	7.2	4.8	3.2
90	9	8.1	5.4	3.6

The minimum prescribed 60/55/50% marks in aggregate (of all the years/Semesters of the qualifying examinations) is calculated by IIT Delhi as per the following example:-

	1st semester	%	2nd semester	%
1st year	250/400	62.50	290/400	72.50
2nd year	205/400	51.25	280/400	70.00
3rd year	210/400	52.50	350/400	87.50
4th year	240/400	60.00	150/400	75.00
<b>Total</b>	<b>905/1600</b>		<b>1070/1400</b>	

- Aggregate (%) (of all the years/semesters)  $1975 / 3000 = 65.83\%$

11. Sponsored (Full-time)/Part-time candidates are not required to possess GATE/CEED score for admission to postgraduate / Ph.D. programmes.
12. The registration of foreign nationals, posted in Delhi, to Ph.D. Programme on part-time basis can be made on the terms and conditions as under :-
  - (i) The admission will be subject to production of Research Visa for study at IIT Delhi.
  - (ii) The candidate should satisfy all the requirement as applicable to part-time scholars.

**Table 3.5.1 :** Experience required for admission to part-time Ph.D. / M.Tech. / M.S.(R) Programmes.

For admission to part-time programme	Qualifications	Work Experience (Post Qualification)
Ph.D.	M.E./M.Tech./M.S.(R)/M.D. or Equivalent	Nil
Ph.D.	B.E./B.Tech./M.Sc./M.A./M.B.A./MBBS or equivalent, from CFTIs/Central Universities	1 Year
Ph.D.	B.E./B.Tech./M.Sc./M.A./M.B.A./MBBS or equivalent, and working in IIT Delhi* (Project or Regular) *Through proper channel	1 Year
Ph.D.	B.E./B.Tech./M.Sc./M.A./M.B.A./MBBS or equivalent, from institutions other than CFTIs/Central Universities	2 Years
M.Tech./M.S.(R)	B.E./B.Tech./M.Sc. or equivalent, from CFTIs/Central Universities	6 Months
M.Tech./M.S.(R)	B.E./B.Tech./M.Sc. or equivalent, and working in IIT Delhi* (Project or Regular) *Through proper channel	6 Months
M.Tech./M.S.(R)	B.E./B.Tech./M.Sc. or equivalent from institutions other than CFTIs/Central Universities	1 Year

### 3.6 Medals and Prizes

IIT Delhi also awards numerous medals and prizes to the students on the basis of examination/project and all-round performance in sports, co-curricular activities, etc. At present there are around ninety such medals and awards in operation.

## 4. FEES

The fees payable by 2020 entry year students are given in Table below

### 4.1 Fees Payable by Students of the Entry Year 2020

Tuition Fees (per Semester)		
Programme		Tuition Fee
B.Tech. / Dual degree <sup>#</sup>		₹ 1,00,000**
M.Sc.		₹ 5,000
M.Tech., M.S.(R), M.Des. (Receiving Institute / Project Assistantship or Teaching position holders)		₹ 10,000
M.Tech. / M.S.(R) / M.Des. / DIIT (Sponsored, FT / PT & Non-teaching position holders)		₹ 50,000
Ph.D. (Full Time )		₹ 5,000
Ph.D. (Part Time)		₹ 10,000
M.B.A. Self-financing	Full Time	₹ 2,40,000
	Part Time	₹ 1,80,000
Foreign National <sup>@</sup>	SAARC Countries	US\$ 1,000
	Non SAARC Countries	US\$ 2,000
B.Tech./Dual Degree		

<sup>@</sup>The fee for the foreign nationals joining PG/Ph.D. programme will be at par with Indian students.

### Other charges (to be paid every semester alongwith Tuition Fee)

A	Institute Fees			
	Examination fees			₹ 1,000
	Registration / Enrolment fees			₹ 500
	Gymkhana			₹ 1,000
	Medical fees			₹ 500*
	Internet and computer access fee			₹ 750
	Transport charges			₹ 100*
	<b>Total</b>			<b>₹ 3,850</b>
B	Hostel Fees	B.Tech./Dual Degree	MBA/M.Sc.	Ph.D./M.Tech./M.Des./M.S.(R)/P.G. D.I.I.T.
	Hostel seat rent	₹ 7,500	₹ 7,500	₹ 10,000
	Amenity charges	₹ 500	₹ 500	₹ 500
	<b>Total</b>	<b>₹ 8,000</b>	<b>₹ 8,000</b>	<b>₹ 10,500</b>



<b>C</b>	<b>Other Payments</b>	
	Student Distress Fund Scheme (each semester)	₹ 300
	Insurance Scheme (yearly)	₹ 500
	<b>Total</b>	<b>₹ 800</b>

**D. One Time payment to be paid at the time of admission**

	<b>Non Refundable</b>	
	Admission fees	₹ 1,500
	Student welfare fund	₹ 500
	Modernization fees	₹ 1,000
	Benevolent fund	₹ 300
	Alumni fees	₹ 1,500
	Training and Placement charges	₹ 1,000
	<b>Total</b>	<b>₹ 5,800</b>
<b>E</b>	<b>Refundable</b>	
	Institution security deposit	₹ 3,000
	Library security deposit	₹ 3,000
	<b>Total fees payable at the time of admission</b>	<b>₹ 6,000</b>

1. Total other charges payable for B.Tech., Dual Degree, M.Sc. and MBA (with hostel) ₹24,450, without hostel ₹16,450.
2. Total other charges payable for Ph.D./M.Tech./M.S.(R)/P.G. D.I.I.T./M.Des. (with hostel) ₹26,950, without hostel ₹16,450.

**NOTE :**

1. #The tuition fee in 9th semesters and later will be ₹5,000/- per semester for Dual-degree programmes.
2. \*Medical fee and transport charges are applicable to full time students only.
3. \*\*1/3<sup>rd</sup> of tuition fee for student with family income between ₹1 lac to ₹5 lac per annum. Other students (other than SC, ST & PD) whose family income is less than ₹1 lac per annum will get 100% tuition fee exemption.
4. Thesis fee for M.S.(R) and Ph.D. is ₹500/- and ₹1,000/- respectively and shall be payable at the time of submission of thesis.
5. All SC, ST, PD students will get 100 % tuition fee exemption.
6. Hostel is available only to full time students subject to availability.
7. Messing and electricity charges will be calculated on completion of each semester and will be notified separately.

## ▶ 4.2 Foreign National Visiting Students

Following are the tuition fees per semester, chargeable from Self-financing foreign National Students including those seeking admission as visiting students :

- I) US \$ 1,000 for SAARC Countries.
- ii) US \$ 2,000 for other Countries.

## ▶ 4.3 Mode of Payment

### (a) Institute dues:

All Institute dues are to be paid through State Bank of India I-collect facility.

Payment by challan slip is allowed only to the following:

- (i) students who have taken loan from a bank (for educational purposes), or
- (ii) students who are holders of a scholarship from outside sources who directly send cheque(s) for fees in the name of the Institute.

### (b) Mess dues: Payment Portal for payment of Hostel Mess Fees:-

Please click on the following URL - <https://ecampus.iitd.ac.in/scorner>

## ▶ 4.4 Deadlines for Payment

### (a) Institute dues:

- (i) All Institute dues are to be paid in full before the last date for Late Registration (this is typically one week after the first day of classes)
- (ii) Students who do not pay the required amount by this date, or those who make partial payments, shall have their registration cancelled. Registration will be restored on payment of fees and a fine as stipulated in the Institute rules.
- (iii) In case of new entrants, the fees are to be paid on the day of registration at the time of joining the Institute.

### (b) Mess dues: All Mess dues are to be paid on or before the allotment of hostels.

## ▶ 4.5 Refund of Fees

The whole amount of fees/other charges deposited by the students will be refundable after deduction of ₹1,000/, if the students do not join the programme after paying the dues and leave the Institute by applying for refund on or before the date of registration. No refund of fees will be permissible to students who have registered for the programme but leave immediately thereafter. In such cases, only caution money will be refunded.



## 5. STUDENT LIFE ON CAMPUS

The ambience of student life and activities on the campus is to provide an invigorating and creative environment which promotes independent thinking and introspection and leads the young students to become more aware of the consequence of their own actions.

Excellent facilities for accommodation to a large number of students, co-curricular activities, sports and games recreation, shopping, etc., are provided to the students on campus. Special efforts are also made to promote and strengthen student-teacher interaction. Students Counselling Service has been set up to assist and morally support students in their initial adjustment, and also to deal with any difficulties, they may have during their stay at the Institute.

## 5.1 Board for Hostel Management

1. The Board for Hostel Management (hereinafter called the BHM) is a constituent body of the Student Affairs Council (S.A.C.), as recognized under Article III-A2 of the S.A.C. Constitution.
2. The Board for Hostel Management shall be responsible for policy formulation, co-ordination and review of all matters relating to management of the Halls of Residence.
3. The Board shall be subject to all decisions, rules and regulations which may be laid down from time to time by the Student Affairs Council and the Authorities of the Institute.

### Halls of Residence

There are eleven boys' hostels and two girls' hostels. The boys' hostels are Nilgiri, Karakoram, Aravali, Jwalamukhi, Satpura, Zanskar, Kumaon, Vindyachal, Shivalik, Girnar and Udaigiri. Kailiash and Himadri Hostels are for girls. Each Hostel is self-contained with amenities such as a reading room, an indoor games room, a lounge and a dining hall with mess, a computer room and TV in common room. All rooms have been provided with Internet facilities.

## 5.2 Student Affairs Council (SAC)

The Student Affairs Council is a joint student-faculty Senate committee to deal with overall policy formulation, coordination and review of student affairs, which are of non-academic nature.

The SAC co-ordinates the activities of the various student organizations, viz., Boards for Recreational and Creative Activities, Sports, Hostel Management, Students Publications and Student Welfare. It also works to promote the student interests and endeavors to create healthy traditions in campus life.

## 5.3 Co-curricular and Academic Interaction Council (CAIC)

The Co-curricular and Academic Interaction Council (CAIC) and its constituent bodies aim at maximal interaction between students and faculty, a good academic atmosphere and an efficient decision making process based on consultation; and through these it aims to promote an overall development of students for the maximum realization of their potential. The council is a joint committee of undergraduate students, postgraduate students and faculty that provides feedback to the Board of Academic Programmes on all academic and allied matters. CAIC has following constituent clubs:

### Robotics Club

The Club strives to stimulate interest in robotics among the students of the institute. Besides making a serious endeavour to spread knowledge on Robotics and its diverse applications, it also stands by the subtle acronym of TEAM - 'Together Everyone Achieves More'.

### **Axlr8r Club**

Axlr8r Formula Racing is a group of undergraduate students from different departments who design and fabricate open wheel electric formula race cars. So far, the club has designed 3 electric vehicles and 5 combustion vehicles. It aims to promote e-mobility in India and strive to revolutionize the future of electric mobility in India.

### **Aeromodelling Club**

The Club is a group of aeromodelling and aviation enthusiasts with an innate desire for flying. Aeromodelling is a work of art where engineering and creativity synergize in developing sophisticated flying systems.

### **Physics and Astronomy Club**

This Club is a group of Physics and Astronomy enthusiasts who organise lecture sessions, discussions and observation sessions and competitive events throughout the year.

### **Devclub**

DevClub strives to spread applied computer science culture among the students of the Institute. Club combines the likes of coding, web development, android app development and much more to come up with new and innovative, out-of-the-box solutions.

### **Economics Club**

The vision of the Economics club is to promote knowledge on economics & financial education, training & imparting practical skills, and introducing people to economic, in a way that gets them interested to pursue the area further.

### **iGem Club**

The International Genetically Engineered Machine (iGEM) club aims to solve real-world challenges by building genetically engineered biological systems to advance research in synthetic biology..

## ▶ **5.4 Co-curricular Activities**

IIT Delhi provides a full measure of opportunity to its students for co-curricular pursuits. Through several students directed activities a student participates actively in the many-sided life of the Institute community. He / She pursues his / her intellectual and aesthetic horizons far beyond the realm of the classroom experience, and he / she expands his / her interests and forms new relationships.

## ▶ **5.5 The Students' Activity Centre**

The Students' Activity Centre is the nerve centre of all student activities on the Campus. With a moat on one side



and a high stone wall on the other, the Students' Activity Centre recalls to the visitors memories of an ancient fort. The Centre comprising a Club Building, Gymnasium Hall, Swimming Pool, Amphitheater, Music Rooms, Robotics Room, and Hobbies Workshop, caters to various hobbies of the Students. They have a place to paint, to sculpt or to tinker with the radio.

There are committee rooms where they can hold formal or informal meetings and a large marble-floored hall for exhibitions. On the first floor of the Centre, students have facility to play billiards, table tennis etc.

### ▶ **5.6 Students' Canteens**

There are canteens for the students in the Hostel area just opposite to Aravali Hostel, in Himadri Hostel and adjacent Kumaon Hostel and the others located in front of Library across the road. The Hostel area canteen is open normally from 4 p.m. till midnight. The other canteens run during the Institute working hours. Working of these canteens is looked after by the Canteen Cell of the Board of Hostel Management. There are Coffee and Cold drinks kiosks also in the Institute.

### ▶ **5.7 Stationery Shop/Telephone Booths**

For the benefit of the student community, there is a stationery shop situated in the academic area. A number of Photocopy facilities and STD/ISD/PCO facilities are available in all the Hostels.

### ▶ **5.8 Board for Sports Activities (BSA)**

Sports, being the practical way of education, inculcates discipline and dedication in general life. In addition, it facilitates recreation and fosters social harmony. Board for Sports Activities (BSA) of IIT Delhi has been looking after this important component for the development of sports environment in the campus. Board for Sports Activities (BSA) is a constituent body of the Student Affairs Council and is responsible for the coordination of the various sports activities in the Institute. It ensures that adequate sports facilities are available to the community and provides a forum for the students and staff to discuss and formulate policy towards the betterment of sports activities in the campus.

Our facilities include, a cricket field with four turf wickets, four flood-lit cricket practice pitches, flood-lit hockey and football grounds, four flood-lit volleyball and two basketball courts, eight flood-lit tennis courts (four synthetic and four clay courts), tennis practice wall, two squash courts, one badminton hall, two table tennis halls with synthetic flooring, one weight-lifting hall, Olympic size swimming pool, kid's pool, two multi-gyms, a flood-lit stadium with 400 meters athletics track, flood-lit jogging track and ancillary arrangements for all the games. Construction of a new multipurpose hall (indoor sports complex) with facilities for badminton, table tennis and squash courts

is in full swing and will be available by the end of this year. A team comprised of Sports officer, Physical training instructors (PTI), part-time coaches and ground staff, President (BSA), Vice President (BSA) and Games Presidents help the students in their regular sporting activities ensuring that all facilities are being properly maintained and utilized.

The Institute lays considerable emphasis on student's participation in various outdoor and indoor games. Such activities take place almost throughout the year. BSA is also responsible for conducting the NSO programme for the incoming students (BTech) who are thereby exposed to the different sporting activities that our institute has to offer. The students are encouraged to take part in the Fresher's events conducted for incoming first year students, friendly matches with the local colleges, inter-hostel events, the annual IIT Delhi Inter-Collegiate event 'Sportech' and the annual Inter-IIT Sports Meet held every year in the month of December. In the just concluded 54th Inter IIT Sports Meet (December-2019) meet held at IIT Kharagpur & IIT Bhubaneswar, IIT Delhi was declared Runners Up in overall championship. To summarise, IIT Delhi has a very vibrant sporting atmosphere contributed to, not only by students but staff and faculty alike.

## ▶ 5.9 Board for Recreational and Creative Activities (BRCA)

The BRCA is the one-stop destination to get away with college stress and indulge in various recreational and creative activities. It gives a platform to nurture and showcase one's talent in co-curricular hobbies. The Showstopper is Rendezvous, our own cultural fest (one of the largest cultural festival in India) which sees glamorous pronites and competitions on a national level.

The board has a plethora of clubs serving the needs of the diverse IIT Delhi community. A few of them are briefed below:

### **Literary Club**

The Literary Club aims to promote the growth of knowledge and encourage the IITD family to read together, for reading is knowledge and knowledge is power. The present team aims to take the Reading Circle to newer heights, and organise events for people to bond over.

### **Hindi Samiti**

The importance of local languages is diminishing in urban areas. To nurture this culture, Hindi Samiti at IIT Delhi brings to you the different verticals, where participants can contribute, like Hindi Debates, Hindi Quizzes, Poetry and Stand-up Comedy and much more.

### **SPIC MACAY**

Society for Promotion of Indian Classical Music and Culture Amongst Youth or SPIC MACAY is founded with an aim

to introduce Indian culture and its beautiful art forms to the students. VIRASAT- the annual fest of SPIC MACAY sprawls over 3 weeks and comprises of performances and workshops in arts and crafts, theatre, films and yoga.

### **Wellness Club**

Wellness Club aims at achieving holistic wellness of students by providing a supportive environment for the yoga, meditation and other wellness activities to develop an integration between the physical, social and emotional well-being of students. We motivate and empower students to fight against major challenges such as stress, use of harmful substances and loss of integrity, to become the best version of themselves.

### **5.10 Board for Students Publications (BSP)**

Board for Student Publications is the electronic and print media body of the college, run almost entirely by students. It is involved in bringing out various publications and organizing events for nurturing the literary talent of the IITD community and carrying out journalistic activities.

At the beginning of the academic year, BSP releases a magazine called "Inception" which provides the incoming freshers with a glimpse of IITD life and gives them information about various avenues and opportunities. Apart from this, BSP's "Muse" is a magazine which provides an excellent forum for creative expression. The Board's annual technical magazine, "Elemental", is a technical compendium of interesting research ongoing in IIT or around the world. A new magazine called "Impulse", a collection of short fiction written by students, was launched this year.

Apart from its creative publications, the Board's key area of focus remains its journalistic activities and bi-annual newsletter "Inquirer". With interviews, detailed surveys and in-depth analyses of issues affecting the student community, the Board keeps track of all ongoing activities on campus and provides an interactive space for students, faculty and administration to debate relevant issues through its social media platforms and newly restructured website.

The BSP also organizes an annual literary festival, "Literati" which is recognized and appreciated as one of the best literary college festivals in North India. With workshops, competitive events and panel discussions featuring renowned authors and journalists, the Board aims to develop and sharpen the creative and media skills of the entire student community.

### **5.11 Board for Students Welfare (BSW)**

The Board for Student Welfare, IIT Delhi is a student body set up with an intention to look after the Welfare of the Student Community. BSW has always been dedicated towards helping the Student Community in every aspect of life in IIT Delhi. The Board adheres to a principle of making itself the organisation of the Students, for the Students, and by the Students. The constituent bodies of BSW have to permanent committees viz., Operations Committee and Mentorship Committee.

The Operations Committee executes welfare activities in the institute to benefit the student community. It also provides assistance (financial and in-kind) to the students in need. The various activities include smooth induction of the Orientation process, setting up of various camps such as cycle camp, book camp etc., conducting informative sessions on Foreign exchange, Minor degree, MBA etc., and other activities throughout the year.

The Mentorship Committee of BSW executes & monitors all mentorship initiatives for IIT Delhi students. These include Mentorship of freshmen students, Alumni Mentorship, Academic Mentorship, Language Mentorship etc. On the commencement of one's IITD life, every individual is provided with a mentor who is a trained & experienced senior student and is responsible for making the freshmen capable of making informed decisions in academic, extra-curricular & personal fronts by sharing unbiased knowledge & experiences.

BSW organises the very popular, socio-welfare fest of IIT Delhi, Speranza. Each year Speranza welcomes a huge crowd of students with great enthusiasm and is the first college festival to be organised in a new academic year. From Talk shows, workshops, to fun games and competitive events, Speranza has a wide spectrum of events taking place making them few of the most memorable days of IITD life.

BSW also runs a Student Cooperation Society (SCOOPS) which runs on a no profit-loss philosophy. Located near Block I, its duty is to provide students access to buy good-quality subsidised stationary items, notebooks and related services.

Student Teacher Interaction Council (STIC) Dinner is another welfare activity carried on by BSW, to strengthen the Student-Teacher interaction, the foundation pillar of any Educational Institution.

Student Counselling Service (SCS) under BSW provides a confidential environment where a student can explore and express aspects of one's self that may be painful or uncomfortable. The counsellor helps the students in gaining their own insights and making and acting on their own choices, thereby enabling them to resolve issues. BSW has also collaborated with YourDOST, which provides free online counselling services to all the IITD students.

### ▶ **5.12 National Service Scheme (NSS)**

Launched in the Mahatma Gandhi Birth Centenary year 1969, as a student youth service programme, National Service Scheme (NSS) aims at arousing social consciousness of the youth with an overall objective of personality development of students through community service. The motto of NSS is "NOT ME, BUT YOU".

### ▶ **5.13 National Cadet Corps (NCC)**

The National Cadet Corps is an organization aiming at the development of leadership, character, comradeship, spirit of sportsmanship and the ideal of service, among the youth in educational institutions. The motto of NCC is "Unity and Discipline".

### ▶ **5.14 National Sports Organization (NSO)**

The National Sports organisation is a classification in the scheme of education formulated in furtherance of setting a climate of sports consciousness and improvement of physique among the youth during their period of education. Sports is included in the curriculum at IITD.

### ▶ **5.15 Student Counseling Service (SCS)**

The Student Counseling Service under the aegis of Board for Student Welfare at the Institute aims at assisting students in sorting out their difficulties and dilemmas in an environment where they can talk freely in confidence about any matter which is troubling them. Students seek counseling for a variety of reasons, such as difficulties in adjusting to campus life, problems in relationship, being shy, feeling lonely, anxious, depressed, confused, demotivated, low self-esteem, difficulties in coping with academic pressures and competition, worries about the future and low self-confidence.

### ▶ **5.16 Entrepreneurship Development Cell (EDC)**

Entrepreneurship Development Cell is a student-run body working with an aim to promote, foster and nurture entrepreneurship amongst the student community at IIT Delhi. It works as a primary student body of the institute which helps the young aspiring minds to explore and open the doors of the promising and exciting world of entrepreneurship. The initiatives and activities of the cell are not just aimed at promoting and creating awareness about entrepreneurship as a career choice, they also aim to nurture entrepreneurial skills through different events, workshops and competitions, and provide all kinds of support to budding student entrepreneurs, ranging from mentorship and skill-development to facilitating the process of incubation-related activities. EDC IIT Delhi continuously works towards facilitating entrepreneurship education and developing a comprehensive resource pool.

In this pursuit, it organizes a plethora of events and initiatives, which includes the following:

- Exclusive Townhall Sessions with top entrepreneurs of the world
- Workshops, Guest Lectures and Bootcamps on entrepreneurship
- Mentorship Sessions with experienced entrepreneurs
- Annual Business and Entrepreneurship Conclave
- Facilitate Student - led startups in Legal Services
- Investor Meet-ups and Pitching Sessions



- Online Entrepreneurship Resource Portal
- Facilitate in Incubation Related Activities
- Business Plan Competitions

As an institute, IIT Delhi has always been at the forefront to support entrepreneurship and is proud to be the alma mater of a large number of Indian Unicorn founders, with many luminary alumni who have made their mark in the entrepreneurial sphere. eDC IIT Delhi provides a myriad of opportunities to all the interested students to interact with various entrepreneurs and top industry leaders, while providing them with a great platform to learn, network and gain exposure to the entrepreneurial world. Working along with FITT IIT Delhi, eDC IIT Delhi ensures a smooth support to the budding entrepreneurs, ready to transform their ideas into reality.

### ▶ 5.17 Departmental Professional Societies

Most of the Departments / Centres / Schools have professional societies managed by the faculty and students to promote academic and professional interests. These societies also facilitate student-teacher interaction outside the classroom.

### ▶ 5.18 Medical Facilities

The Institute has a 14 bedded hospital centrally located in the campus, providing facilities for OPD treatment and admission for general ailments. The Hospital is managed by a team of full time 10 allopathic doctors, 1 homeopathic doctor, 1 dental doctor and 4 doctors on contract basis from Apollo life for night and evening duties on weekdays and weekends to give 24X7 availability of doctors in the emergency.

The Hospital is also visited by part time specialists from All India Institute of Medical Science (AIIMS) in the field of Cardiology, ENT, Endocrinology, Orthopaedics, Ophthalmology, Psychiatry, Neurology and Ayurvedic specialist from All India Institute of Ayurveda, Delhi. The doctors are assisted by efficient group of Pharmacists, Nurses, Physiotherapist and other Paramedical staff. The Hospital is well equipped to take care of primary emergencies and serious patients are referred to All India Institute of Medical Science (AIIMS), Safdarjung Hospital (SJH) and IIT empanelled hospitals in an Ambulance which is available 24x7 on all days.

IIT Delhi Hospital is the recognized centre for pulse polio immunization. The Hospital provides medical aid during Sports meet, Rendezvous, Annual Convocation, other Cultural functions and events. First aid and CPR demonstration are organized by the hospital for students and staff of the institute. Free educative and health check-up camps are also provided for the IIT community. The group A employees get yearly check-up facility at well equipped medical centre.

## 5.19 Student-Teacher Interaction

The Institute encourages students to come in close contact with teacher. The Student-Teachers Interaction Committee (STIC) facilitates and promotes contact between teachers and students.

### **Student-Teacher Interaction Committee (STIC)**

STIC encourages healthy and informal interaction of students with their teachers outside the boundaries of classrooms environment. Teacher can take their students to trip, for get-together and can have informal interaction. Dinners are organized in the hostel every semester where students can invite their teachers in their hostels. STIC also organizes dinners exclusively for all freshers with their teachers who were teaching in 1st semester of academic year and also with their teachers of the department. Departmental professional societies are encouraged to organize informal activities in their departments and STIC Partially supports monetarily.

### **Class Committees and Course Committees**

In order to bring about greater contact between students and teachers, Course Committees and Class Committees are constituted, comprising of both, students and faculty. These committees discuss academic matters relating to the course or class concerned.

### **Student Advisors**

A student advisor is appointed by the Department for a group of 10-12 students in the B.Tech., and dual-degree (B.Tech. and M.Tech.) programmes. Student are encouraged to keep in constant touch with his/her adviser regarding all academic affairs. The advisor, in turn, will provide the student with suitable advice regarding courses, academic load, and rules and regulations, etc. governing his/her academic programme. Student's registration each semester is carried out through the office of his/her advisor. The student advisor is also expected to keep in touch with the student's general performance and welfare both formally, as well as through informal channels.

### **Programme Coordinators**

The administration of all postgraduate programmes is facilitated by a faculty member designated as the Programme Coordinator. The Programme Coordinator helps students regarding all registration and course related matters.

## 5.20 Alumni Association

The IIT Delhi Alumni Association (IITDAA) was established in 1966. Today, IITDAA has a membership of around 52,000. The Association has multiple chapters spread over the entire globe. The Indian chapters are in the cities of Ahmedabad, Bangalore, Chandigarh, Chennai, Dehradun, Hyderabad, Kolkata, Jaipur, Mumbai, NCR East and South and Pune. We have international chapters in Australia, UK, Qatar, Germany, Italy, Denmark, USA and South Arabia among other nations.

Some goals of the Association are:

- To promote and foster mutually beneficial interaction between the alumni and the current students of the institution,
- To encourage the alumni to take an active and abiding interest in the work and progress of the Institute,
- To organize and establish Benevolent and Scholarship Funds to help the needy and deserving students,
- To institute prizes and awards for outstanding project work, research papers or other professional activities by the students of the Institute,
- To raise public awareness of the role of technology in the economic and social development of the nation.

The Association celebrates Alumni day in the month of December and organizes various events such as the Annual Leadership Conclave and Reunions. Our members also participate in events organized on Industry Day, Open House and Rendezvous. The alumni and current students also interact through lectures, workshops and seminars. The Association has also been a key contributor in fund-raising for various awards, scholarships, fellowships and chair positions, some of which are:

- IITDAA Professor Dogra Chair
- IITDAA Scholarship
- Alumni Gift Fund
- Batch of 1966 Contribution
- Batch 1986 – Innovation Centre
- Batch of 1986 – Shikhar Abhiyan Scholarship
- Class of '89 Innovation Award
- Jwala Batch of 1984 Scholarship
- Kumaon '87 Batch Outstanding Young Faculty Fellowships
- Nilgiri 1990 Batch Scholarship

### 5.21 Conduct and Discipline

A student shall conform to a high standard of discipline and shall conduct himself, within and outside the precincts of the Institute, in a manner befitting the students of an Institution of national importance. He/she shall have the seriousness of purpose and shall in every way, train himself to lead a life of earnest endeavor and co-operation. He/she must follow strict ethical standards. Under no circumstances he/she will adopt unfair means for completing any component of evaluation in a course. He shall show due courtesy and consideration to the employees of the

Institute and Halls of Residence, good neighbourliness to his fellow students, respect to the Wardens of the Halls of Residence and the teachers of the Institute and pay due attention and courtesy to visitors.

### ▶ **5.22 Honour Code**

In order to promote ethical behaviour, the Institute requires every student to agree to abide by the Honour Code. At the time of admission, every student has to sign the Honour Code and submit a copy to the respective academic section. Violations of this Code are taken very seriously and may result in suspension or expulsion. The Honour Code is given on the inside back cover of this document.

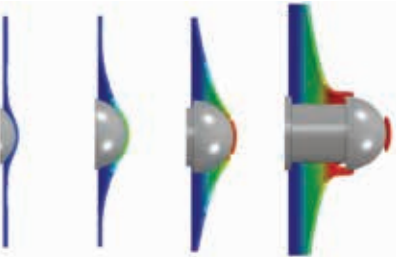
### ▶ **5.23 Institute Policy on Ragging**

Ragging is banned in the Institute. If a student is found to have indulged in ragging in the past, or if it is noticed later that he / she has indulged in ragging, then he / she may be expelled from the Institute.

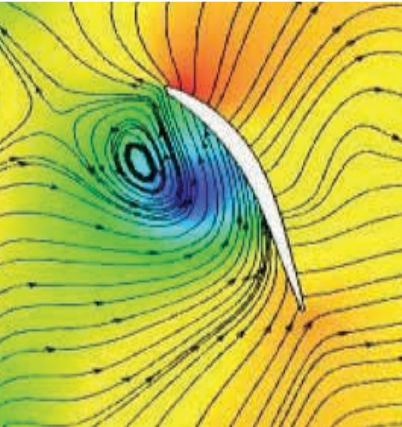
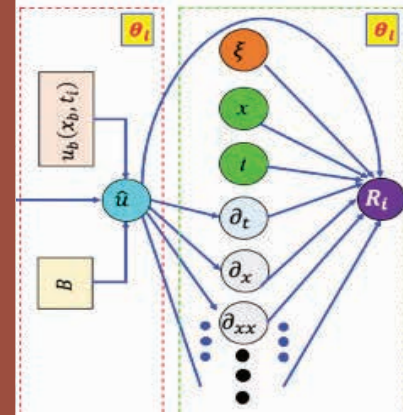
### ▶ **5.24 Policy against Sexual Harassment**

Institute has a policy against sexual harassment and is committed to providing an environment free from sexual harassment of women at the workplace.

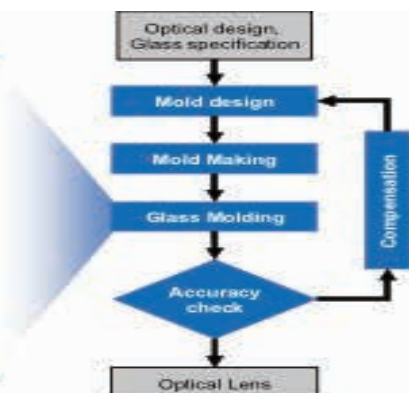
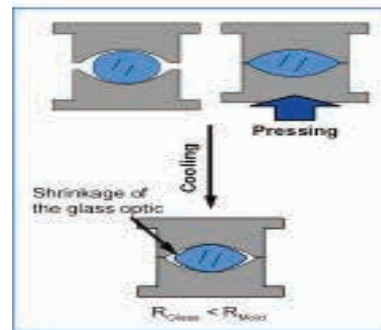
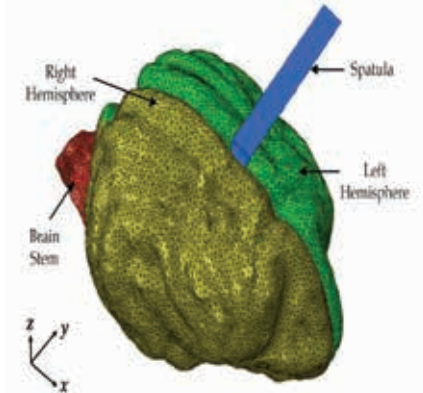
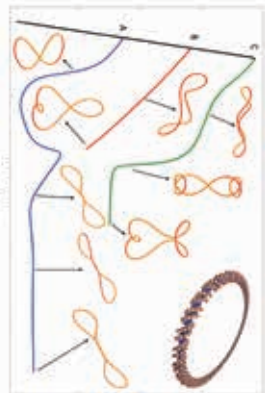
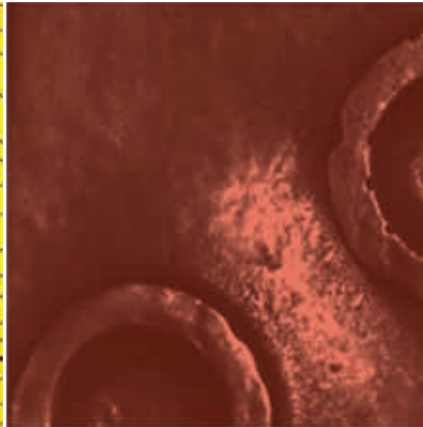
# 6. ACADEMIC UNITS



DEPARTMENT OF



APPLIED MECHANICS





**Puneet Mahajan, Ph.D. (Montana State Univ.)**  
*Professor*

Composites: Homogenization and Mechanical Properties, Low and High Velocity Impact of Composites, Precision Glass Molding, Helmets, Snow Mechanics, Finite Element Applications.

## HEAD OF THE DEPARTMENT



**Amitabh Bhattacharya, Ph.D. (UIUC)**  
*Associate Professor*

Fluid Mechanics, Fluid Structure Interaction  
Multi-Phase Flows, Turbulence.



**Vamsi K. Chalamalla, Ph.D. (UC San Diego)**  
*Assistant Professor*

Computational Fluid Dynamics, Ocean Modeling,  
Stratified Turbulence, Ocean Engineering.



**Souvik Chakraborty, Ph.D. (IITR)**  
*Assistant Professor*

Deep Learning, Digital Twin, Stochastic Mechanics,  
Stochastic Dynamics, Reliability Analysis, Design Under  
Uncertainty, Multi-scale Systems, Inverse Problems.



**Murali R. Cholevari, Ph.D. (IISc., Bangalore)**  
*Associate Professor*

Turbulent Flows, Optical Flow Measurement,  
Applied Fluid Mechanics.



**Anupam Dewan, Ph.D. (IISc., Bangalore)**  
*Professor*

Computational Fluid Dynamics and Heat Transfer, LES, RANS,  
Partially-averaged Navier-stokes (PANS) Approach, Turbulent Jet  
Impingement Heat Transfer, Turbulent Plume, Heat Transfer Over a  
Square Cylinder, Heat Transfer Enhancement in Microchannel, Binary  
Alloy Solidification and Solar Distillation.



**Sriram Hegde, Ph.D. (IIT Delhi)**  
*Senior System Programmer/Manager*

Computer Aided Design (CAD), Design Optimization,  
Hydrodynamic Stability and Transition Delay, Finite  
Element Applications, Heat Transfer.

**Santosh Kapuria, Ph.D. (IIT Delhi)**

*Professor*

Smart Composite and Sandwich Structure,  
Structures Health Monitoring, Active Vibration  
Control, Functionally Graded and Structures,  
Elasticity.

**Ajeet Kumar, Ph.D. (Cornell Univ.)**

*Associate Professor*

Theory of Rods, Plates and Shells,  
Crystal Elasticity, Computational Materials  
Science, Multi-objective Optimization  
Nano-Mechanics, Numerical Analysis.

**B.P. Patel, Ph.D. (MNNIT, Allahabad)**

*Professor*

Nonlinear Static/Dynamic analysis of Shells,  
Composite Structures, Functionally Graded Structures,  
Bimodular Composite Structures, Continuum Damage  
Mechanics, Multiscale Modelling of Nano-Structures.

**Sitikantha Roy, Ph.D. (Utah State Univ.)**

*Associate Professor*

Soft Robotics, Biomechanics, Computational  
Mechanics, Smart Structures, Mechanics of  
multi-functional Polymer, Surgical simulation,  
Medical Device, Data driven Mechanics, Machine  
Learning.

**Pradyumna S., Ph.D. (IIT Kharagpur)**

*Associate Professor*

Functionally Graded Materials, Structural  
Dynamics, Stability, Composite Structures,  
Smart Structures, Plates and Shells.

**Sanjeev Sanghi, Ph.D. (City Univ.)**

*Professor*

Numerical and Analytical Studies of Turbulent Flows,  
Chaos and Dynamical Systems, Computational Fluid  
Dynamics, Educational Software.





**Sushma Santapuri**, Ph.D. (Ohio State)

*Assistant Professor*

Mathematical Modeling of Functional/Smart Advanced Materials, Electrodynamics of Continua, Asymptotic Theories for Smart Composite Structures, Thermodynamics of Functional Materials, Rod and Plate Theories, Multiferroic Materials and their Applications.



**Arghya Samanta**, Ph.D. (UPMC, France)

*Assistant Professor*

Falling Film Intability, Multi-Layer Channel Flow, Flow Transport Through Porous Media. Modal and Non-modal Stability, Oscillatory Flow Instability.



**Arjun Sharma**, Ph.D. (Stanford University)

*Assistant Professor*

Compressible Flows, Numerical Simulations, Large-eddy Simulation, Turbulent Flows and Acoustics.



**Gaurav Singh**, Ph.D. (Imperial College)

*Assistant Professor*

Fracture Mechanics, Composites.



**M.K. Singha**, Ph.D. (IIT Kharagpur)

*Professor*

Stability and Dynamics of Beams, Plates, Shells and Lightweight Structures, Composite, Functionally Graded and Sandwich Panels, Behaviour of Materials and Structures at Different Loading Rates.



**Sawan Suman Sinha**, Ph.D. (Texas A & M)

*Associate Professor*

Turbulence Theory and Modelling, Hypersonic Flows, Bridging Method of Turbulence, Boltzmann Equation-based Solvers.



**Vikrant Tiwari**, Ph.D. (South Carolina Univ.)

*Assistant Professor*

Digital Image Correlation, Impact Mechanics, Dynamic Fracture Mechanics, Product Design & Analysis, Fuel Cell.

**S.V. Veeravalli**, Ph.D. (Cornell Univ.)

*Professor*

Experimental Investigation of Turbulent Flows, Stability Theory, Design Method for Sustainable Development.



**Suhail Ahmad**, Ph.D. (IIT Delhi)

*Emeritus Professor*

Structural Dynamics, Off-shore Structures, Reliability Engineering, Computational Mechanics, Low and High Velocity Impact, Composites, Probabilistic Mechanics, Finite Element Applications.



**S.N. Singh**, Ph. D. (IIT Delhi)

*Emeritus Professor*

Fluid Mechanics, Internal and External flows, Computational Fluid Dynamics, Two-phase flows, Flow Instrumentation, Wind Energy.



**Lt. Cdr. R.V. Shashank Shankar**, M.Tech.

(IIT Madras), DIIT (IIT Delhi)

*Adjunct Faculty*

Marine Hydrodynamics, AUV Design, Underwater Gliders.



**Lt. Cdr. D. Venkata Aditya**, M.Tech.

(IIT Bombay), DIIT (IIT Delhi)

*Adjunct Faculty*

Marine Corrosion Management, Operational Management.



**Cdr. M.P. Mathew**, M.Tech.

(IIT Kharagpur), DIIT (IITD)

*Adjunct Faculty*

Naval Architecture, Ocean Engineering.



## ▶ INTRODUCTION

The Departmental activities in teaching and research can be broadly classified under the headings of Solid Mechanics, Fluid Mechanics and Design Engineering.

## ▶ ACADEMIC PROGRAMMES

### UNDERGRADUATE

The Department offers basic courses in Mechanics, Experimental Methods and Analysis, and Design Engineering, that are part of the undergraduate core curriculum. Students can also obtain minor degree in Applied Mechanics with specialization in Computational Mechanics. Faculties are also involved in guiding undergraduate students of various programs in their mini and major projects.

### POSTGRADUATE

The Department offers Masters of Technology programmes in – (i) Engineering Analysis, & Design. Students admitted to the M.Tech. programme in Engineering Mechanics can opt for specialization in either (a) Engineering Mechanics (b) Product Design. Within Engineering Mechanics students can choose to work in Solid Mechanics or Fluid Mechanics. A masters of Science (Research) programme is also offered with specialization in Applied Mechanics. A Postgraduate Diploma course in Naval Construction is also offered, in collaboration with the Indian Navy, to officers sponsored by Indian Navy. The course is of one and a half years duration.

## ▶ RESEARCH AREAS

The Department has been involved in the following broad areas of research:

- Elasticity, Plasticity, Large Deformations, Manufacturing Analysis, Impact and Crash worthiness, Composite Materials, Composite Plates and Shells, Off-shore Structures, Smart Structures, Snow Mechanics, Computational Methods for Stress Analysis and Structures, Structural Optimization, Finite Element Method, Seismic analysis of Tall structures, Parallel Computing, Non-linear Dynamics and Chaos, Stability and bifurcation theory, Nano-mechanics, Bio-mechanics, Impact mechanics, Continuum Damage mechanics, Probabilistic Mechanics, Structural Health Monitoring and Fracture Mechanics.
- Hydrodynamic Stability Theory and Turbulence, (Theory Computation and Experimental), Low Dimensional Modelling, Computational Fluid Dynamics; Compressible flows; Industrial Aerodynamics and Pollution Dispersion, wind effects on structures, Diffusers, Impellers, Combustors, Hypersonic Flows, Renewable Energy.
- Computer Aided Design, Design Engineering, Reliability Engineering.

Besides, the Department also organizes seminars, symposia, short-term courses and advanced summer schools for faculty of engineering institutes and engineers from industry. It also undertakes industrial consultancy work and has in hand both short and long-term projects sponsored by the government agencies and private industrial organizations.

**Doctoral research is currently being carried out in:**

Large Deformations, Impact Mechanics, Plasticity, Analysis of Manufacturing Processes, Composite Materials, Composite Plates and Shells, Non-linear Dynamics and Chaos, Off-shore Structures, Smart Structures, Snow Mechanics, Stress analysis and finite element application, Damage mechanics, Computational Methods for Fluid Flows, Pollution dispersion, Flow through Fluid Machines, Pipeline Engineering, Wind Engineering, Hydrodynamic Stability, Transition, Turbulence, Bio-fluid Dynamics, Computer Aided Design, Design Engineering, Reliability Engineering, Availability and Maintainability Engineering, Metal Foams, Nanocomposites, Friction Stir Welding, Pattern Formation in Granular Materials, Fracture Mechanics, Fatigue Crack Propagation, Environmental Cracking, Failure analysis and Mechanical Properties of Solids, Nano-mechanics etc.

## LABORATORY FACILITIES

The Department has well-equipped laboratories, workshop and library facilities. The laboratories and their major facilities are as follows:

- **Computation Laboratory:** Graphics Workstations with engineering software such as ANSYS, ABAQUS, COMSOL.
- **Design Optimization Laboratory:** Workstations, Dual Processor–Softwares such as IDEA, ABAQUS, FLUENT, MATLAB, MATHCAD.
- **Fluid Mechanics Laboratory:** Pilot plant test loop for slurry transportation, pilot plant for flow rate measurement up to 8 cusecs, Bohlin viscometer, Weissenberg Rheogoniometer.
- **Gas Dynamics Laboratory:** Industrial wind tunnel (1.6m x 1.6m x 10m test section closed loop), Environmental wind tunnel (2m x 2m x10m suction type; is currently being renovated and may qualify for a central facility to be used by Civil Engg Dept., Mechanical Engg. Dept. and Atmospheric Sciences) and low turbulence wind tunnels, Wide angle diffuser rigs. Instruments: PIV(2D/3D), LDV, Hot wire Ancomometry, Pressure and Strain Scanners.
- **Instruments:** PIV (2D/3D), LDV, Hot wire Ancomometry, Pressure and Stain Scanners.
- **Impact Mechanics Laboratory:** SSplit Hopkinson Bar apparatus (tension and compression), High velocity projectile launch system, Dynamic three point bend test facility, Ultra high speed cameras, High speed data acq. system.

- **MTS Laboratory:** 250 kN and 25 kN & MTS machine with facilities for mechanical testing, fracture mechanics testing and fatigue testing.
- **Strength of Materials Laboratory:** 25 T Computerized Universal Testing machine (Zwick), 50 T Instron m/c, 10T and 100 T hydraulically operated Universal Testing m/c, Avery machines for hardness, impact, torsion and fatigue testing, Drop hammer facility (Instron 9250 HV) modified for Helmets.
- **Biomechanics/Soft Material Lab:** 5kN UTM, AFM, Inverted Microscope Optical Bench, Sample preparation facility.
- **Stress Analysis Laboratory:** Photo-elastic bench, Reflection polariscobe, Moire fringe equipment, Digital strain meters, Super data loggers, Stress freezing ovens, etc.
- **Workshop:** The departmental workshop has a number of machines that include Lathe machines, vertical milling machines, shaping machine, drilling machines, bench grinders, high temperature furnace, welding sets etc.
- **Composites Lab:** Vacuum Assisted Resin Infusion Moulding, Fixtures for testing composites and micro CT scanner.







**DEPARTMENT OF BIOCHEMICAL  
ENGINEERING AND BIOTECHNOLOGY**





**D. Sundar**, Ph.D. (Pondicherry Univ.)  
*Professor*  
Bioinformatics, Computational Genomics, Genome Engineering, Synthetic Biology.

## HEAD OF THE DEPARTMENT



**Shaikh Ziauddin Ahammad**, Ph.D. (IIT Delhi)  
*Associate Professor*  
Wastewater Treatment-Physico-Chemical and Biological, Anaerobic Wastewater Treatment.

**Ritu Kulshreshtra**, Ph.D. (Delhi Univ.)  
*Associate Professor*

RNAi Technology, MicroRNAs in Cancer Biology, Cancer/Disease Biomarkers, Hypoxia Research.



**Lucinda Elizabeth Doyle**, Ph.D.  
(Nanyang Technological University, Singapore)  
*Assistant Professor*  
Electromicrobiology, Microbial electrochemistry, Electrochemically-active microorganisms.

**Ashish Misra**, Ph.D. (Rutgers The State University of New Jersey, New Brunswick)

*Assistant Professor*  
Metabolic Analysis and Engineering, Clinical Diagnostics, Bioprocessing.



**Ravikrishnan Elangovan**, Ph.D. (Florence Univ.)  
*Associate Professor*  
Single Molecule Biophysics, Fluorescence Spectroscopy, Molecular Motors, Skeletal Muscle Mechanics.

**Prashant Mishra**, Ph.D. (JNU)  
*Professor*

Enzyme Science and Engineering, Pharmaceutical Proteins, Bio-nano-technology, Drug Delivery.



**Ishaan Gupta**, Ph.D. (EMBL Heidelberg)  
*Assistant Professor*  
Biostatistics and Functional Genomics, RNA Biology, Aging, Neurodegeneration and Organ degeneration, Parasitology.

**Saroj Mishra**, Ph.D. (New York City Univ.)  
*Professor*

Molecular Enzymology and Applications of Hydrolytic Enzymes, Yeast Expression Systems, Enzyme Mediated Bioremediation.



**Rohan Jain**, Ph.D. (Univ. of Paris-Est Marne-la-Vallee)  
*Assistant Professor*  
Industrial Wastewater Treatment, Adsorption, Complexation, Resource Recovery, Critical Metal Recovery, Bio-ligands, Scale-up, Spin-off.

**Atul Narang**, Ph.D. (Purdue Univ.)  
*Professor*  
Systems Biology of Microbial Gene Regulation.







**Sunil Nath**, *Dr. Ing. (Braunschweig Univ.)*

*Professor*

Bioseparation, Mechanism and Thermodynamics of ATP-based Molecular Machines, Molecular Systems Biology/Engineering.



**Shilpi Sharma**, *Ph.D. (Ludwig-Maximilians-Univ.)*

*Associate Professor*

Functional Microbial Ecology.



**T.R. Srekrishnan**, *Ph.D. (IIT Delhi)*

*Professor*

Waste Engineering, Environmental Biotechnology.



**Preeti Srivastava**, *Ph.D. (IIT Delhi)*

*Associate Professor*  
Microbial Genetics.



**A.K. Srivastava**, *Ph.D. (McGill Univ.)*

*Professor*

Biochemical Engineering, Modelling, Optimisation and Control of Bioprocesses, Plant Cell Biotechnology.



**G.P. Agarwal**, *Ph.D. (Rice Univ.)*

*Emeritus Professor*

Bioprocess Engineering, Membrane Based Protein Separation, Bioinformatics, Membranes for Heavy Metal Ions Removal and Waste Treatment.

## ▶ **INTRODUCTION**

The Department offers a unique blend of scientific expertise in applied biological sciences, chemical and biochemical engineering. It strives for application of this expertise to evolve various biotechnological products, processes and services through:

- Generation of highly trained human resource capable of quantitative analysis of biological systems to facilitate their role in manning modern bioprocess industries and to provide an integrated approach to research and development in biotechnology.
- Evolving research and development programmes to develop products and provide services in bio energy, environment and therapeutics.
- Leading global innovations in Bioprocess Technology, Applied Biological Sciences and facilitate participation in industrial consulting and sponsored research.
- Dissemination of knowledge generated through short term courses, workshops and conferences.

## ▶ **ACADEMIC PROGRAMMES**

### **UNDERGRADUATE**

The Department offers a four year B.Tech. Programme.

### **POSTGRADUATE**

At postgraduate level the department offers a M.S. (Research) Programme.

## ▶ **RESEARCH AREAS**

Some of the focal areas of research of the department are:

- Bioprocess Engineering
- Cell and Molecular Biotechnology
- Downstream Processing
- Systems and Computational Biology
- Bionanotechnology
- Environmental Biotechnology
- Functional Genomics

**Doctoral research is being carried out in the following areas:**

Microbial physiology and biochemistry, Metabolic engineering, Recombinant DNA technology, Enzyme science and engineering, Animal and plant cell fermentations, Bioreactor design and analysis, Bioseparation and downstream processing systems, Biological waste treatment, Biological molecular machines, Biosensors, Drug delivery systems and Protein-DNA recognition and Bionanotechnology.

**LABORATORY FACILITIES**

The Department is well equipped for the teaching and research programs and the equipment and facilities are regularly modernized as per requirements. Major equipment and facilities are:

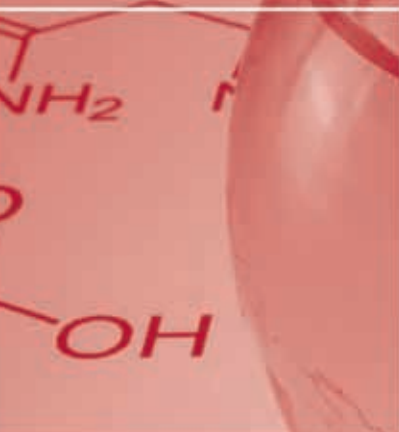
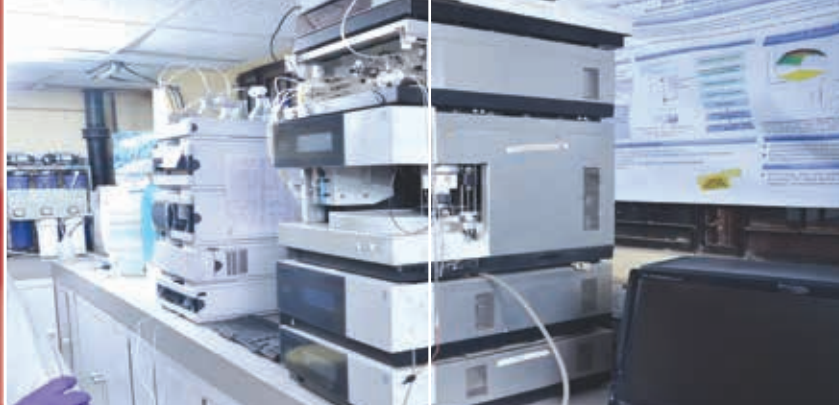
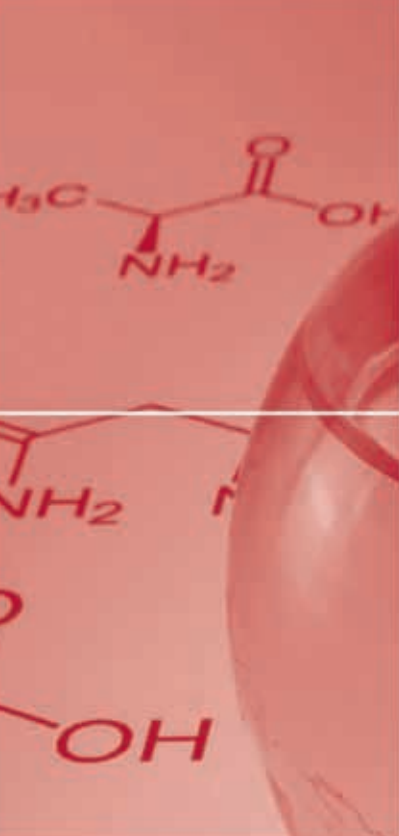
- **Bioreactors:** Several bioreactors with capacities ranging from 0.5 to 300 litres, equipped with instruments for monitoring and control pH, temperature, dissolved oxygen, and gaseous O<sub>2</sub>/CO<sub>2</sub> levels. A pilot plant facility is available for transferring laboratory scale data to industrial scale.



- **Bioseparation:** Ultra-filtration unit, ultracentrifuge, ultrasonic disintegrator.
- **Analytical equipment:** Elemental analyzer, HPLC, IC, GC, FPLC, GC-MS, ICP-MS, LC-MS and other chromatography systems; visible and UV spectrophotometer, CD Spectropolarimeter; Spectrofluorimeter; Fluorescence microscope and Flow cytometer.
- **Molecular biology:** Several molecular biology labs containing standard equipment such as laminar flow chamber, anaerobic work cabinet, centrifuges, water baths, sonicators, lyophilizer, isoelectric focusing unit, scanning laser densitometer, PCR, and RT-PCR electroporation-electrofusion system. There is also a lab equipped with a scintillation counter for working with radioisotopes.
- **Computing facility:** A separate computation lab with several PCs is also available. A Bioinformatics Centre sponsored by the Department of Biotechnology, Government of India, under the Biotechnology Information System Network (BTISnet) is also housed in the department.
- **Upcoming state-of-the-art imaging and genomics facility**





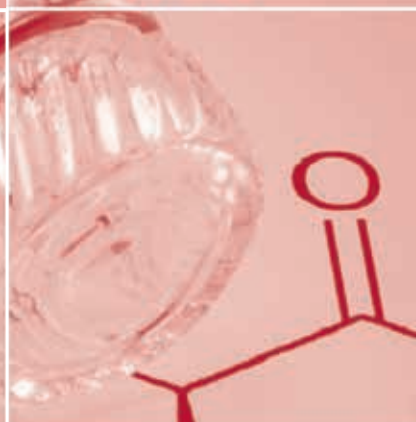
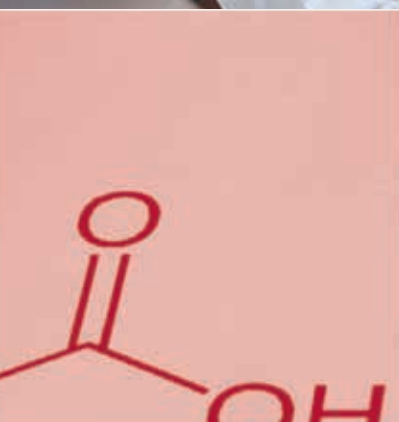
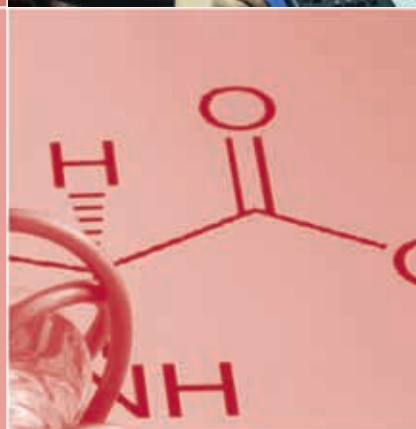


**DEPARTMENT**

**OF**



**CHEMICAL  
ENGINEERING**





**Kamal K. Pant**, Ph.D. (IIT Kanpur)  
*Professor*  
Heterogeneous Catalysis and Reaction Kinetics,  
Catalytic Hydrocarbon Conversion Processes, Water  
Treatment.

## HEAD OF THE DEPARTMENT



**Siddhasatwa Basu**, FNASC, Ph.D.  
(IISc., Bangalore)  
*Professor*  
Hydrogen and Fuel Cell Technology,  
Interfacial and Electrochemical  
Engineering, Enhanced Oil Recovery.

**Shalini Gupta**, Ph.D. (NC State Univ.)  
*Associate Professor*  
Colloidal Interactions and Nanoscale  
Engineering, Molecular Self-assembly,  
Microfluidics, Nanolithography.



**Ashok Bhaskarwar**, Ph.D. (IISc., Bangalore)  
*Professor*  
Interfacial Engineering, Chemical Reaction  
Engineering, Pollution-prevention  
Technologies, Chemical Product Design.

**Sharad K. Gupta**, Ph.D. (Brooklyn Univ.)  
*Professor*  
Transport Phenomenon, Membrane  
Separation Process.



**Divesh Bhatia**, Ph.D. (Univ. of Houston)  
*Associate Professor*  
Automotive Catalysis, Air Pollution Control,  
NOx Emissions, Monolith Reactors, Kinetics of  
Fast Reactions.

**Gaurav Goel**, Ph.D. (Univ. of Texas, Austin)  
*Associate Professor*  
Transport at Nanoscale, Structure-property  
Solvophobic Interactions and Self-  
assembly.



**Vivek V. Buwa**, Ph.D. (IIT Bombay)  
*Professor*  
Computational Fluid Dynamics, Multiphase  
Flows, Reactor Engineering.

**Mohammad Ali Haider**, Ph.D. (Univ. of Virginia)  
*Associate Professor*  
Heterogeneous Catalysis, Biorenewable  
Chemicals and Biofuels.



**Paresh Chokshi**, Ph.D. (IISc., Bangalore)  
*Associate Professor*  
Hydrodynamic Stability, Theoretical /  
Computational Polymer Physics, Dynamics  
of Complex Fluids, Polymer Processing.

**Rajesh Khanna**, Ph.D. (IIT Kanpur)  
*Professor*  
Phase Separation, Thin Liquid Films, Mist  
Reactors, Colloids and Interfacial Science.







**Hariprasad Kodamana**, Ph.D. (IIT Bombay)  
*Assistant Professor*  
 Model Based Control, System Identification,  
 Process Monitoring, Bayesian Inference, Process  
 Data Analytics.



**Manjesh Kumar**, Ph.D. (U. Houston)  
*Assistant Professor*  
 Novel Material Synthesis, Characterization and  
 Design, Heterogeneous Catalysis, Mechanistic  
 Study of Functional Material Failure Modes.



**Sudip K. Pattanayek**, Ph.D. (IIT Bombay)  
*Professor*  
 Polymer Physics, Biopolymers Under Flow,  
 Polymer Nano-composites.



**Jyoti Phirani**, Ph.D. (Univ. of Houston)  
*Associate Professor*  
 Flow through Porous Media, Reservoir  
 Simulation, Enhanced Oil Recovery,  
 Unconventional Energy Resources.



**Manoj Ramteke**, Ph.D. (IIT Kanpur)  
*Associate Professor*  
 Modeling and Optimization of Chemical and  
 Polymeric Systems, Meta-heuristic Algorithms,  
 Process Planning and Scheduling.



**Anurag S. Rathore**, Ph.D. (Yale Univ.)  
*Professor*  
 Biosimilars, Bioprocessing, Quality  
 by Design (QbD), Process Analytical  
 Technology (PAT), Multi-variate Data  
 Analysis (MVDA).

**Shantanu Roy**, Ph.D. (Washington Univ.)  
*Professor*

Multiphase Reactor Engineering,  
 Multiphase Flows, Radioactive Trace  
 Particle Tracking.



**Jayati Sarkar**, Ph.D. (IIT Kanpur)  
*Associate Professor*

Instabilities, Adhesion, Debonding,  
 Dewetting and Pattern Formation  
 of Soft Thin Films, Computational  
 Fluid Dynamics, Self-organization of  
 Complex Fluids, Granular Materials.



**Anil K. Saroha**, Ph.D. (IIT Delhi)  
*Professor*

Multiphase Reactors,  
 Environmental Engineering.



**Munawar Shaik**, Ph.D. (IIT Bombay)  
*Associate Professor*

Process Systems Engineering, Process  
 Operations, Planning and Scheduling of Batch  
 and Continuous Processes, Modeling and  
 Optimization, Evolutionary Computation.



**Anupam Shukla**, Ph.D. (IIT Kanpur)  
*Professor*

Membrane Synthesis & Separations,  
 Electrochemical Systems Engineering.



**Vikram Singh**, Ph.D. (Cornell)  
*Assistant Professor*

Low Reynolds Number Fluid Mechanics  
 – suspensions and emulsions, Colloids  
 and Aerosols, Geothermal Energy.





**Sreedevi U., Ph.D. (IIT Kharagpur)**

*Professor*

Heterogeneous Catalysis & Reaction Engg.,  
Thermochemical & Chemical Pathways  
to Renewable Liquid Fuels, Green  
Chemical Technologies.

**K.D.P. Nigam, Ph.D. (UDCT, Mumbai)**

*Honorary Professor*

Modeling of Flow Systems, In-line Mixing,  
Multiphase Flow Reactors.



**Anil Verma, Ph.D. (IIT Delhi)**

*Professor*

Sustainable Environenergy Electrochemical  
Systems: Batteries, CO<sub>2</sub> Electrochemical  
Reduction to Hydrocarbons, Microbial Fuel Cell,  
Graphene Synthesis and Application in Energy  
Devices, C/C Composites.

**Ratan Mohan, Ph.D. (IIT Kanpur)**

*Visiting Faculty*

Computational Fluid Dynamics, Process  
Engineering, Thermodynamics.



**M.K.S. Verma, Ph.D. (IISc., Bangalore)**

*Assistant Professor*

Fluid Mechanics, Flow Instability in Flexible Channel/  
tube, Microfluidics, Medical Devices, Bio-inspired  
Design, Lithium-ion Batteries, Electrochemical  
Modeling, Battery Management System (BMS).

## ▶ INTRODUCTION

The Department of Chemical Engineering (CHE) at IIT Delhi, one of the finest in India, is dedicated to providing the best education, research practices and ecosystem to all its associated members. The undergraduate and postgraduate students can choose from a wide range of courses and research projects from the Department's meticulously designed academic program. The courses span from fundamental sciences to complex mathematical relationships and engineering design aspects of chemical and biological process technology. The students are rigorously trained and evaluated on a continuous basis so that they are well prepared to be leaders in whichever field they choose to pursue may it be academia, industry, technology management, entrepreneurship or working for a social cause. The course curriculum is upgraded every ten years to keep up with the changing scenario, requirements and technological advancements around the world.

The Department maintains a vibrant research profile and currently boasts of having one of the best group of faculty members in the country who are not only experts in their respective fields of research but are also engaged in multidisciplinary projects that cater to the broader economic, societal and environmental development and growth of the country. The Department maintains a close liaison with a large number of chemical, biotech companies and design organizations because we believe it is essential to perform basic fundamental scientific research alongside the applied one. The faculty regularly undertakes consultancy assignments in which postgraduate students can make great contributions and students at the undergraduate level are constantly encouraged to identify industrial organizations for summer internships.

Every faculty member has a well-equipped lab in which advanced instruments are kept for use by all the students. Some of the facilities include liquid-liquid extraction columns, autoclaves, large capacity blowers, compressors, gasifiers, combustors, pyrolysis systems, bubble and packed columns, circulating fluidized beds, batch and continuous flow reactors, heat exchangers, carbon-dioxide absorption systems, bench-top optical and electron microscopes, centrifuges, GCMS, TGA, DTA, TPD/TPR, submicron particle size analyzer, powdered particle shape analyzer, high speed photographic equipment, data loggers, high speed multipoint recorders, XRF, HPLC, ion chromatograph, CHN analyzer, viscometer, GC with mass spectrometer, atomic absorption spectrometer, automatic contact angle goniometer and tensiometer, radioactive particle tracking (RPT) system, spin coater and surface plasmon resonance (SPR) spectroscopy. The Department also has two pilot plants and a newly refurbished central characterization lab that currently houses an XRD, rheometer and a surface texture analyzer. More instruments are constantly added to this repertoire.

In addition to the analytical instrumentation facilities, there are also extensive computing facilities and softwares like Aspen Plus, SimSci, Fluent, CFX and Promax that are made available to the undergraduate and research students for carrying out their project work. The Department has also set up a state-of-the-art pollution control and testing

laboratory and a process research laboratory provided with 40 intel core 2 duo computers and a state-of-the-art Tata-Honey Well Automation Laboratory.

Once a week, the department organizes a research seminar in which external speakers or our own PhD students present their research work. This helps the students to stay abreast with the latest developments in the Chemical Engineering field and also gives them a perspective about their own research from a global view standpoint. Summer and winter schools under quality-improved program (QIP) are also organized from time to time. With so much happening in the department, we strongly urge you to join us as a student, staff or faculty, or at least pay us a visit when you are in the neighborhood.

## VISION

The Department's long-term vision is to become a world leader as a developer of technologies related to energy, environmental protection, novel materials, and healthcare. The Department has been prolific in the areas of materials development for energy generation and storage, catalysis and multiphase reactor engineering, process intensification in non-renewable and renewable energy sectors, modeling and simulation from molecular to process scales, and manufacturing technology for production of biotech therapeutics. We would like to build on our strengths and strive for national and international presence in these areas by continuing our fundamental research and technology development initiatives, and further strengthening our bachelors, masters and doctoral programs. We expect that these endeavors will not only attract superior faculty but will provide and create an enabling ecosystem for students to explore, innovate and smoothly transition into the professional arena. The Department would like to build focused research programs networked with industry, institutions, universities and government agencies. We would like to develop/co-develop effective and affordable technologies scripting joint IPR in partnership with industry, or through consortia leading to spin-offs. The Department strives to promote a technology temperament in society at large, especially to young minds through extensional activities via technology enhanced video and web based distance learning courses, creation of virtual laboratory and resource centres and participating in policy making and public debates.

## ACADEMIC PROGRAMMES

The Department offers two undergraduate degrees, one leading to a 4 year B.Tech. and the other to an integrated 5 year Dual Degree (B.Tech + M.Tech.). At the postgraduate level, the Department offers M.Tech., M.S. (Research) and Ph.D. degrees. The teaching at the undergraduate level aims at providing the students a broad-based education in theory and practice of Chemical Engineering keeping in view the current and future requirements of the country. At the postgraduate level, students are trained to assume independent responsibilities by laying emphasis on self study component in courses and assigning them TA duties to mentor UG students. Opportunities are provided

to the students at all levels to get acquainted with the latest developments in the various areas of Chemical Engineering. Our institute also has an M.O.U. with Ethiopia and we regularly get students from there as part of our M.Tech. and Ph.D. foreign programmes.

### **UNDERGRADUATE**

B.Tech. students need to do a compulsory foundation courses in the areas of basic sciences, humanities, social sciences and engineering sciences along with Departmental core and elective courses. Departmental courses constitute about half of the total curriculum. Some of the core chemical engineering subjects include fundamentals of mass/heat transfer, chemical reaction engineering, process control, thermodynamics, fluid mechanics, plant design and economics. Students also do open electives to broaden their repertoire of interdisciplinary knowledge-base. Further, there is provision to do a minor degree, for example in computer science and engineering, for which a student needs to do additional credits in the minor area to be eligible for the minor area specialization.

### **POSTGRADUATE**

The 5 year dual degree program (integrated B.Tech. + M.Tech.) in Chemical Engineering is viewed as a high-value added course fit for students who wish to enhance the scope of their B.Tech. degree with one additional year of research experience. The students can take additional elective courses which opens avenues for better placements both in academia and in the industry. The masters of technology (M.Tech.) is a standard two year programme after B.Tech. comprising of one year of rigorous coursework followed by an year of research training under the guidance of a CHE faculty supervisor. The Department also offers M.S. (Research) programme in Chemical Engineering which includes first semester of course work followed by three semesters of rigorous research work. There are also provisions for doing a part-time M.Tech./MS for persons already employed in the industry and are looking for value addition in their knowledge base and resumes.

The highly motivated individuals choose to obtain a Doctor of Philosophy (Ph.D.) degree in Chemical Engineering as this is an intensively research-driven program. The students are also expected to qualify a set of the advanced chemical engineering courses in their first year while maintaining a minimum CGPA requirement. The various broad topics of PhD research include renewable and non-renewable energy, catalysis, multiphase reaction engineering and process intensification, complex fluids and rheology, advanced materials, process modeling simulation, optimization, process control, pharmaceutical biotechnology, environmental engineering and waste management.

### **RESEARCH AREAS**

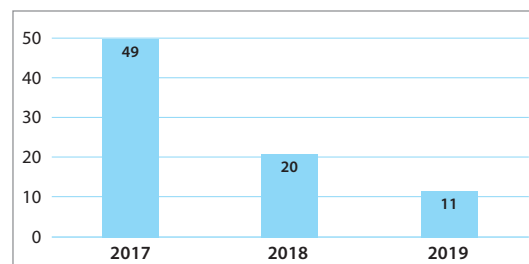
The CHE faculty is actively engaged in basic and applied research leading to the award of many Masters and PhD degrees. These projects are sponsored by industries, user organizations and government funding agencies

(DST, DBT CSIR, DRDO, MNRE, etc.). The projects are directed towards development of innovative and indigenous technologies for processes relating to efficient heat and mass transfer, design of biosimilars, biomass thermo-chemical conversion processes, hydrodynamics and cold flow studies in trickle beds, packed beds and bubble columns, membrane transport studies, recovery of metals from spent catalysts, oil recovery from emulsion effluents, natural gas production from gas hydrates, solid oxide fuel cells, waste water treatment and design of novel diagnostic bioassays. The research activities of the department can be broadly classified in the following subareas.

- Battery and Fuel Cells
- Bioseparations and Bioprocessing
- Colloids and Nano Scale Engineering
- Computational Fluid dynamics
- Density Functional Theory Simulations
- Fluid and Particle Mechanics
- Homogeneous and Heterogeneous Catalysis
- Interfacial Engineering
- Model based Optimization and Process Control
- Molecular Dynamic Simulations
- Petrochemical Technology
- Polymer Physics and Engineering
- Process Data Analytics
- Process Intensification
- Reservoir and Refinery Processes
- Renewable Energy Engineering
- Water Treatment

## A FEW DEPARTMENTAL RESEARCH STATISTICS

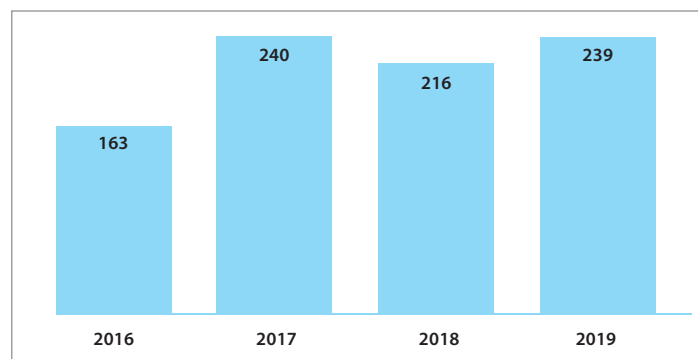
**Research Funding (2017-2019) Sponsored R&D Projects ~INR 80 Crore** : The Department is highly proactive in writing research grants. This has resulted into sponsored R&D Projects worth almost INR 80 Cr over the last three years. The faculty also regularly does industrial consultancy work. The year-wise split is shown in the adjoining bar graph.



Funding for sponsored Research and Consultancy over a Span of 3 years in INR Crore

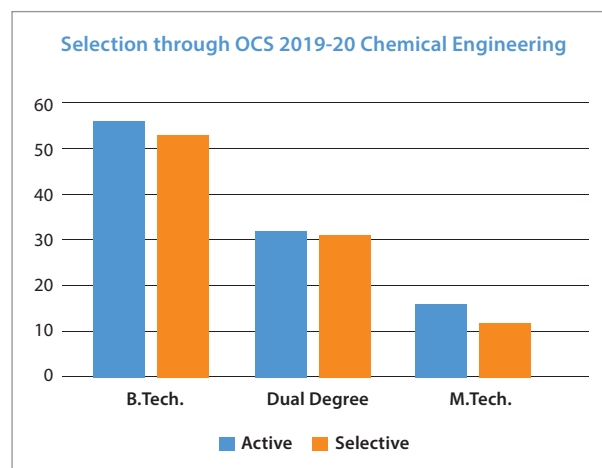
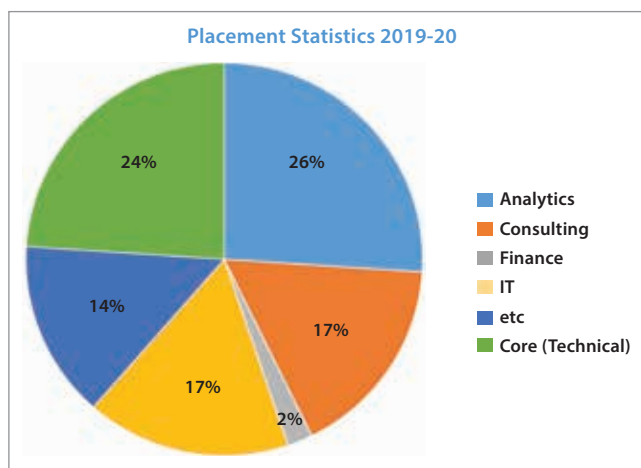


**Number of Peer Reviewed International Journal Publications:** The Department is also very productive in writing scientific articles. These articles are published in international journals of great repute. The year-wise data of the number of international journal articles published in the last 4 years is given in the adjoining graph.



The year-wise data of the number of International journal articles published in the last 5 year

**Placement Statistics 2019-2020:** The Department has a good placement record. Students here are placed in different sectors like Analytics, Consulting, Finance, IT etc. Last year placement graph is shown in the adjacent pie chart.





Thermogravimetric analysis system



Goniometer



Gas chromatograph



HPLC



Microreactor unit



Optical microscope



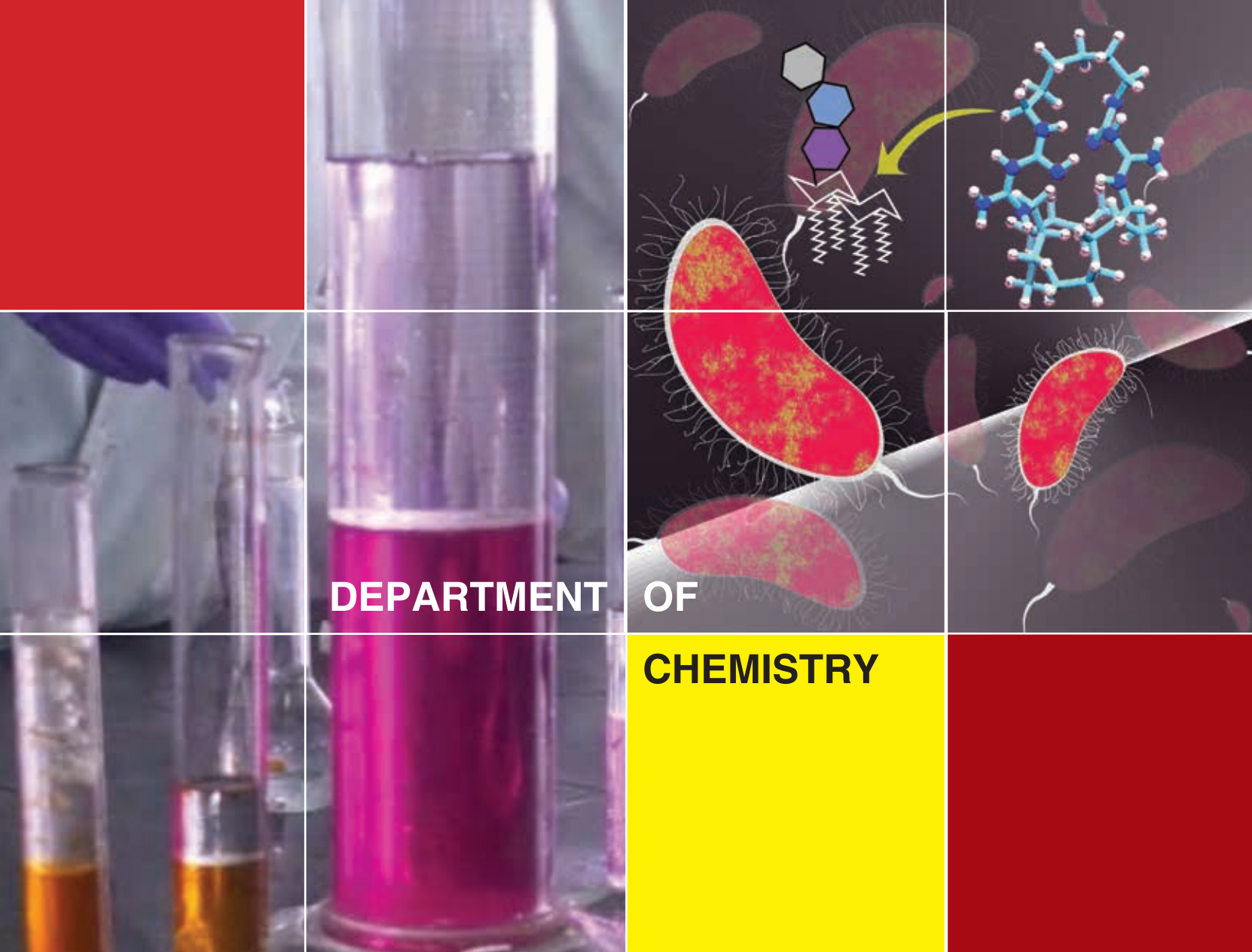
Radioactive Particle Tracking (RPT)



UV-Vis Spectrophotometer



3D-controlled microimaging system



**DEPARTMENT OF  
CHEMISTRY**







**Anil J. Elias, Ph.D. (IIT Madras)**  
*Professor*  
Synthetic Main Group and Organometallic Chemistry.

## HEAD OF THE DEPARTMENT



**D.K. Bandyopadhyay, Ph.D. (I.A.C.S.)**  
*Professor*  
Metalloporphyrin Catalyzed Oxidation Reactions of Organic and Organometallic Compounds, Kinetics & Mechanistic Studies.

**Ashok K. Ganguli, Ph.D. (IISc., Bangalore)**  
*Professor*  
Nanomaterials, Superconductors, Dielectric Oxides and Intermetallics.



**Biswarup Chakraborty, Ph.D. (I.A.C.S.)**  
*Assistant Professor*  
Polyoxometalate Based Hybrid Nanostructure, Bifunctional Materials for Photo- and/or Electro-Catalysis, Small Molecule Activation; CO<sub>2</sub> Reduction and H<sub>2</sub>O Oxidation, Kinetics Study and Reaction Mechanism.

**Shivajirao L. Gholap, Ph.D. (IISc., Bangalore)**  
*Assistant Professor*  
Natural Product Synthesis and Their Biological Studies, Development of New Synthetic Method and its Application in Organic Synthesis.



**Pramit K. Chowdhury, Ph.D. (Iowa State Univ.)**  
*Professor*  
Physical and Biophysical Chemistry, Protein Folding using Single Molecule Confocal Microscopy.

**Chinmay K. Hazra, Ph.D. (Westfälische Wilhelms-Universität Münster)**  
*Assistant Professor*  
Development of New Synthetic Methods, Activation of Small Molecules Such as CO<sub>2</sub> and CO, Catalysis, Remote Functionalizations, Physical Organic Chemistry, Reaction Mechanisms.



**Shashank Deep, Ph.D. (IIT Delhi)**  
*Professor*  
Physicochemical Characterization of Macromolecule Interaction and Biophysical Studies of Protein Folding and Protein Aggregation Surface using Multinuclear NMR Spectroscopy, Fluorescence, Microscopy and different Calorimetric Techniques.

**V. Haridas, Ph.D. (NIIST, Trivandrum)**  
*Professor*  
Chemical Biology of Peptides and Proteins, Biophysics of Peptide/Protein Folding.



**Tanmay Dutta, Ph.D. (Calcutta University)**  
*Assistant Professor*  
Biochemistry, Enzymology, Molecular RNA Biology, Genetics.

**Pravin P. Ingole, Ph.D. (University of Pune)**  
*Associate Professor*  
Electrochemical Techniques, Electroanalysis, Nanomaterials.





**Nidhi Jain**, Ph.D. (Delhi Univ.)

*Professor*

Nanocatalysis in Organic Synthesis,  
Ionic Liquids, Structural Studies of  
DNA-Carcinogen Adducts.



**Hemant Kumar Kashyap**, Ph.D. (Jadavpur Univ.)

*Associate Professor*

Statistical Mechanics of Soft-matter, Molecular  
Dynamics Simulations, Ionic Liquids, Lipid-Membranes.



**Sunil Kumar Khare**, Ph.D. (IIT Delhi)

*Professor*

Biochemistry, Enzyme Technology, Applied  
Microbiology Synthesis.



**Subrata Kundu**, Ph.D. (IIT Kanpur)

*Assistant Professor*

Synthetic Organometallic and Main-group  
Chemistry, Phosphorus Chemistry, Main-group  
Radicals.



**Narayanan D. Kurur**, Ph.D. (Caltech Univ.)

*Professor*

NMR Methodology.



**Kuntal Manna**, Ph.D. (Iowa State University, USA)

*Assistant Professor*

Homogeneous and Heterogeneous Catalysis,  
Metal-organic Frameworks.



**Selvarajan Nagendran**, Ph.D. (IIT Kanpur)

*Professor*

Chemistry of Group 13 and 14 Elements  
with Special Emphasis to the Low-valent  
Compounds of Silicon.



**Siddharth Pandey**, Ph.D. (Univ. of North Texas)

*Professor*

Optical Spectroscopy, Advanced Fluorescence  
Techniques, Molecularly Organized Media,  
Environmentally Friendly Solvent Systems,  
Chemosensors, Photophysical Processes.



**Nalin Pant**, Ph.D. (Princeton Univ.)

*Professor*

Theoretical and Experimental Studies on  
Molecular Conformation, Molecular  
Recognition.



**Sayantan Paria**, Ph.D. (Indian Asso. for the  
Cultivation of Sci.)

*Assistant Professor*

Bioinspired Inorganic Chemistry,  
Water Oxidation, Nitrene Transfer, Late-transition  
Metal-oxo Complexes, Spectroscopic  
Characterization of Metastable Reaction Intermediates.



**Arunachalam Ramanan**, Ph.D. (IISc., Bangalore)

*Professor*

Solid State Chemistry, Crystal Engineering,  
Natural and Synthetic Materials.



**N.G. Ramesh**, Ph.D. (IIT Madras)

*Professor*

Synthetic Organic Chemistry, Carbohydrate  
Chemistry, Asymmetric Synthesis.



**Sudipta Raha Roy**, Ph.D. (NIPER-Mohali)  
*Assistant Professor*  
 Organic Synthesis, Catalysis,  
 Organometallic Chemistry.



**Soumik Siddhanta**, Ph.D. (JNCASR, Bangalore)  
*Assistant Professor*  
 Surface-enhanced Spectroscopic Techniques,  
 Bioimaging, Bioanalytical Chemistry,  
 Applications of Nanomaterials in Biology.



**Sameer Sapra**, Ph.D. (IISc., Bangalore)  
*Professor*  
 Nanomaterials, Semiconductor Nanocrystals,  
 Quantum Dots, Light Emitting Devices,  
 Charge Transfer and Photovoltaics including  
 DSSC and QDSC.



**Jai Deo Singh**, Ph.D. (Lucknow Univ.)  
*Professor*  
 Chemistry of Chalcogens/Organo-  
 chalcogens and their Applications in  
 Organic Synthesis & Catalysis,  
 Organic Metals and Superconductors.



**Ravi P. Singh**, Ph.D. (IIT Kanpur)  
*Associate Professor*  
 Asymmetric Catalysis, C-H and C-F Activation,  
 Total Synthesis of Small Molecules.



**Ravi Shankar**, Ph.D. (Panjab Univ.)  
*Professor*  
 Inorganic Polymers, Organometallic  
 Chemistry/ Coordination Chemistry of  
 Silicon, Germanium and Tin.

**Janakiram Vaitla**, Ph.D. (National Chemical Laboratory)  
*Assistant Professor*  
 Sulfur Ylide Chemistry, Carbene Mediated Transformations,  
 Synthesis of Natural Products, Conversion Carbon Dioxide  
 to Valuable Chemicals, Activation and Functionalization of  
 Relatively Inert Bonds, Photoredox Catalysis.



**M. Ramu Yadav**, Ph.D. (University of Hyderabad)  
*Assistant Professor*  
 Co-operative Catalysis, Decarboxylative  
 Reactions, New Fluorination Reactions,  
 Asymmetric Catalysis, Artificial  
 Metalloenzyme Catalysis.



**B. Jayaram**, Ph.D. (City Univ. New York)  
*Emeritus Professor*  
 Biomolecular Modeling and Simulation,  
 Physicochemical Model for DNA Sequence  
 Analysis, Ab Initio Protein Structure Prediction,  
 Active Site Directed Drug Design.



**Ajai Kumar Singh**, Ph.D. (Delhi Univ.)  
*Emeritus Professor*  
 Organochalcogen Ligand Chemistry,  
 Designing of Metal Complexes for  
 Catalyzing Organic Reactions.



**Ram Ramaswamy**, Ph.D. (Princeton Univ.)  
*Visiting Professor*  
 Chaos and Nonlinear Dynamics,  
 Computational and Systems Biology,  
 Nonequilibrium Statistical Mechanics.





## ▶ INTRODUCTION

The Department offers M.Sc., M.Tech. and Ph.D. programmes in Chemistry and also caters chemistry courses for B.Tech. students in engineering disciplines. It provides good opportunities for research at doctoral and post-doctoral level on a variety of topics in conventional and interdisciplinary areas of Chemistry. As a part of its academic activities, the department organises seminars, symposia, summer schools as well as winter workshops. It also undertakes industrial consultancy projects and has ongoing collaborative research projects in frontier areas with institutions in India and abroad.

## ▶ ACADEMIC PROGRAMMES

### POSTGRADUATE

#### M.Sc.

The Four-Semester Master of Science in Chemistry is designed to provide a broad-based training in physical, inorganic and organic chemistry. Courses in biochemistry and analytical chemistry are also included in the core programme. Students are offered choice of electives in various specialized areas like solid state chemistry, organometallic chemistry, statistical mechanics, bioorganic chemistry and immunochemistry. Students are required to also take two electives from outside the department. The project in second year initiates the students into research work in various branches of Chemistry.

#### M.Tech.

The M.Tech. Programme in "CHEMICAL SYNTHESIS & ANALYSIS" is one-of-a-kind programme in the country which provides advanced training in the design, synthesis, separation, and characterization of molecules while preparing students for careers in industry or academia. In addition, students are offered choice of electives in various specialized areas of chemistry, chemical and polymer engineering and management. It culminates in a year-long project where the foundation for scientific research is laid.

## ▶ RESEARCH AREAS

The Department is actively engaged in research including doctoral research, in all contemporary areas of chemistry. Major disciplines include Analytical, Inorganic, Organic, Physical Chemistry and Biochemistry.

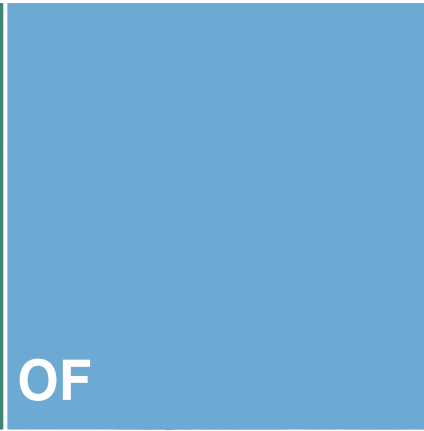
- **Analytical Chemistry:** Optical Spectroscopy, Environmental / Chemical Analysis, Electroanalytical Methods.
- **Biochemistry:** Peptide Synthesis for Molecular Device Construction, Computer Aided Molecular Design, Enzymology, e-Immobilization, Biocatalysis and Bioconversions, Microbial Biochemistry, Extremozymes and Extremophiles, Proteomics, Nano-biocatalysis and nanotoxicity, structural biology, inhibition of amyloid formation, ligand receptor interaction.
- **Inorganic Chemistry:** Organometallic Chemistry of Main Group/Transition Elements, Inorganic Polymers.

- **Supramolecular Chemistry:** Metallo porphyrins as Catalysts, Intermetallic Compounds, Chemistry of Materials, Nanocrystalline Solids, Coordination Polymers, Crystal Engineering, Catalysis through Organometallic Compounds.
- **Organic Chemistry:** Total Synthesis of Natural Products and New Synthetic Methods, Transition–Metal Compounds in Organic Synthesis, Synthetic Carbohydrate Chemistry, Peptides, Proteins and other Natural Products, Chemistry of Singlet Oxygen, Molecular Recognition and Organization, Supramolecular Chemistry, Bioorganic Chemistry, Kinetics and Mechanism of Organic Reactions, Ionic Liquids in Organic Synthesis.
- **Physical Chemistry:** Statistical Thermodynamic investigations of Chemical and Biochemical Systems via Computer, Electrochemical techniques, Electrocatalysis/Photocatalysis, Nanomaterials, NMR methodology, Biophysical Chemistry, Spectroscopy, Single Molecule Confocal Microscopy, Optical and Electronic Properties of Nanomaterials. Simulations, Theoretical Studies on Protein-DNA, Drug-DNA and Receptor-ligand Interactions. Simulation Methods for Quantum Systems, Clusters, Magnetic and Photophysical Properties of Intercalated Materials. Structural and Physico-Chemical Characterization of Protein-protein Interaction and Protein Stability, Understanding Complex Fluidic Systems.

## LABORATORY FACILITIES

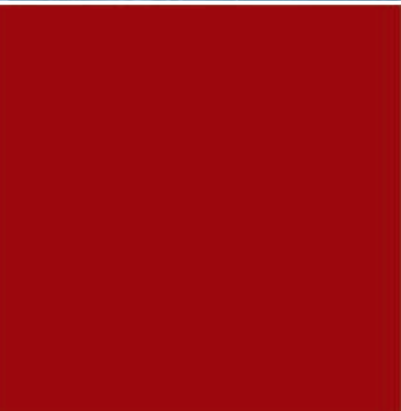
The following equipments are available as part of the department facilities:

- Single Crystal X-ray Diffractometer (Bruker)
- Powder X-ray Diffractometer (Bruker)
- DPX-300 NMR Machine (Bruker)
- 500 MHz NMR
- FTIR Spectrometer (Nicolet, Protege 460)
- Electrochemical (CH Instruments) and Spectro-electrochemical set-up (Metrohm Autolab, PGSTAT-302N)
- UV-Visible Spectrophotometer (Lambda Bio 20 Perkin Elmer / Model 330, Hitachi, Beckman)
- Thermal Gravimetric Analyzer (Perkin Elmer)
- Differential Scanning Calorimeter (Perkin Elmer)
- C,H,N Analyzer 2400 (Perkin Elmer)
- Steady-State Fluorescence Spectrometer
- Fluorescence Lifetime Spectrometer
- Fast Protein Liquid Chromatography
- Gas Chromatograph (Dionex)
- Gel Permeation Chromatography
- High Pressure Liquid Chromatograph (Waters 1525) GPC
- Vapour Pressure Osmometer (Knauer)
- Polarimeter (Rudolph)
- Ion Chromatograph (792 Basic IC, Metrohm)
- Supercomputing Facility for Bioinformatics and Computational Biology
- Glass Blowing
- Polymerase Chain Reaction System
- Gel Documentation System
- CD Spectrometer
- Dynamic Light Scattering System
- Glove Box
- ESI MS/MS Mass Spectrometer (Bruker)
- Confocal Microscope (Nanonics)



DEPARTMENT OF

**CIVIL  
ENGINEERING**





**N.K. Garg**, Ph.D. (Wales Univ.)

*Professor*

Water Resources System, Finite Element, Watershed Modelling, Irrigation Management, CAD.

## HEAD OF THE DEPARTMENT



**B.J. Alappat**, Ph.D. (IIT Bombay)

*Professor*

Environmental Engineering, Solid Waste Management, Incineration and Waste-to-Energy, Fluidized Bed Operations.

**Suresh Bhalla**, Ph.D. (Nanyang Tech. Univ.)

*Professor*

Structural Mechanics, Structural Health Monitoring, Smart Materials & Structures, Tensegrity Structures, Underground Structures, Bio-mechanics, Green Structures.



**R. Ayothiraman**, Ph.D. (IIT Madras)

*Professor*

Soil Dynamics and Earthquake Geotechnical Engineering, Pile Foundations, Deep Excavation and Tunnelling in Soft Ground, Problematic Soils and Ground Improvement, Experimental Geotechnics.

**B. Bhattacharjee**, Ph.D. (IIT Delhi)

*Professor*

Durability of Concrete, Rebar Corrosion, Cement based Composites, Construction Technology, Building Science, Green Building, Sustainability.



**Gurmail S. Benipal**, Ph.D. (IIT Delhi)

*Professor*

Structural Engineering, Nonlinear Dynamics and Stability, Constitutive Modelling, Concrete Mechanics: Creep, Elastoplasticity, Damage, Cable Dynamics.

**Shashank Bishnoi**, Ph.D. (EPFL, Switzerland)

*Associate Professor*

Experimental and Numerical Studies into Hydration of Cements and Supplementary Cementitious Materials, Sustainability, Durability and Life Cycle Costs of Concrete Structures.



**Arnab Banerjee**, Ph.D. (University of Auckland)

*Assistant Professor*

Metamaterial, Structures, Wave Propagation, Nonlinear Dynamics, Contact modeling, Structural Dynamics, Earthquake Engineering, Bridges, Finite Element Analysis, Vibration, Structural Analysis & Optimization, Dams.

**B.R. Chahar**, Ph.D. (IIT Roorkee)

*Professor*

Canal Design, Groundwater Modelling and Artificial Recharge, Seepage and Drainage, Stream - Aquifer Interaction, Optimization, Numerical Techniques.



**Sahil Bansal**, Ph.D. (NTU Singapore)

*Assistant Professor*

Engineering Reliability Estimation, Risk and Loss Modelling, Uncertainty Quantification, Structural Health Monitoring, Optimal Design, Rare Event Simulation.

**Sumedha Chakma**, Ph.D. (IIT Delhi)

*Associate Professor*

Settlement in Landfills, Gas Generation from Landfills, GIS Based Landfill Management, Bioreactor Landfill, Infiltration Characteristics of Different Vegetation and Landuse, Watershed Management, Water Contamination and Remediation, Open Channel Hydraulics, Contaminant Hydrology.







**T. Chakraborty, Ph.D. (Purdue Univ.)**

*Associate Professor*

Foundation Engineering, Soil Plasticity and Constitutive Modeling, Blast Loading in Soil, Soil-Structure Interaction and Underground Construction in Soil and Rock.

**A.K. Jain, Ph.D. (IIT Delhi)**

*Professor*

Design of RCC and Steel Structures, Earthquake Engineering, Wind Engineering, Offshore Structures, Dynamic Testing of Structures.



**Manoj Datta, Ph.D. (IIT Delhi)**

*Professor*

Geotechnical Engineering, Geoenvironment, Landfills, Ash Ponds, Tailings, Ground Improvement, Slope Stability, Dams, Offshore Geotechnology.

**K.N. Jha, Ph.D. (IIT Delhi)**

*Professor*

Construction Project Management, Project Success Factors, Schedule-Cost Estimation, Computer Applications in Project Management, Asset Management.



**Ashok Gupta, Ph.D. (IIT Delhi)**

*Professor*

Structural Engineering, Earthquake Engineering, Health Monitoring of Structures.

**D.R. Kaushal, Ph.D. (IIT Delhi)**

*Professor*

Hydraulic and Water Resources Engineering, Computational Fluid Dynamics, Sediment Transport, Hydraulic Structures, Slurry Pipeline, Flow Instrumentation.



**Supratic Gupta, Ph.D. (Nagoya Univ.)**

*Assistant Professor*

Structural Engineering, Concrete Mechanics, Self Compacting Concrete, High Performance Concrete, Utilization of Fly Ash, Marble Powder and Granite Powder in Low Strength Concrete, Foam Concrete, High Strength Concrete and Fibre Reinforced Concrete.

**A.K. Keshari, Ph.D. (IIT Kanpur)**

*Professor*

Groundwater Flow and Pollution Modelling, Remote Sensing and GIS, Hydrology, Optimization and FEM, EIA and Hydrogeological Hazard.



**Gazala Habib, Ph.D. (IIT Bombay)**

*Associate Professor*

Source and Atmospheric Aerosol Characterization, Regional Air Quality, Health, Source Apportionment Modelling, Climate and Health Effect and Climate Modelling.

**Mukesh Khare, Ph.D. (New Castle Univ.)**

*Professor*

Air and Vehicular Pollution Modelling, Indoor Air Pollution, Urban Air Quality Management.



**K.C. Iyer, Ph.D. (IIT Madras)**

*Professor*

Construction Engineering and Management, Contracts and Arbitration, Structural Engineering, VDC and Building Information Model, Project Risk.

**Rakesh Khosa, Ph.D. (IIT Delhi)**

*Professor*

Water Resources Systems, Stochastic Processes, Conflict Resolution and Hydrologic Modelling of Large River Basin.





**Sri Harsha Kota**, Ph.D. (Texas A&M University, USA)

*Assistant Professor*

Formation, Transformation and Chemical Mechanisms of Air Pollutants Near Roadways, Development of Air Quality Models, Estimation of Emission Factors, Source Apportionment of Air Pollutants, Regional Air Quality.



**Arun Kumar**, Ph.D. (Drexel Univ.)

*Associate Professor*

Human Health Risk Assessment, Nanoparticles, Water Treatment, Decision-making, Emerging Contaminants.



**N.M. Anoop Krishnan**, Ph.D. (IISc., Bangalore)

*Assistant Professor*

Atomistic and Multiscale Simulations of Construction Materials, Mechanics and Physics of Glasses and Cementitious Materials, Radiation Damage and Nuclear-Waste Immobilization, Nanomaterials.



**Alok Madan**, Ph.D. (SUNY Buffalo, USA)

*Professor*

Earthquake Engineering, Nonlinear Structural Dynamics, Concrete Structures, Computing in Structural Engineering, Structural Masonry.



**J. Uma Maheswari**, Ph.D. (IIT Madras)

*Associate Professor*

Design Management, Automation in Design and Construction, Planning for Fast-track and Concurrent Engineering Projects, Matrix Based Planning Tools.



**B. Manna**, Ph.D. (IIT Kharagpur)

*Associate Professor*

Foundations for Industrial Machines, Dynamic Soil-Pile Interaction, Soil Dynamics, Foundation Engineering, Geotechnical Earthquake Engineering.

**M. Manoj**, Ph.D. (IISc., Bangalore)

*Assistant Professor*

Transportation Planning, Activity/Travel Demand Modelling, Long-Term Mobility Decisions, Travel Behaviour Data Collection, Built Environment and Travel Behaviour, Econometric Modelling.



**Shashi Mathur**, Ph.D. (Delaware Univ.)

*Professor*

Groundwater Contamination Bioremediation of Soils, Flow through Porous Media, Phyto-remediation, Biodegradation in Landfills.



**Vasant Matsagar**, Ph.D. (IIT Bombay)

*Professor*

Structural Engineering, Earthquake and Wind Engineering, Offshore Structures, Fiber Reinforced Polymer Composites, Finite Element Analysis, Blast & Fire Engineering, Multi-hazard Protective Structures.



**A.K. Nema**, Ph.D. (IIT Bombay)

*Professor*

Environmental Engineering, Modelling, Simulation and Optimization of Environmental Systems, Integrated Waste Management, Environmental Impact and Risk Assessment.



**Nezamuddin**, Ph.D. (Univ. of Texas)

*Assistant Professor*

Transportation Network Analysis, Transportation Logistics and Optimization, Traffic Operations, Intelligent Transportation Systems.



**G.V. Ramana**, Ph.D. (Rensselaer, USA)

*Professor*

Geotechnical Earthquake Engineering, Dynamic Site Characterization, Machine Foundations, Environmental Geotechnology, Geosynthetics.







**Kalaga R. Rao**, Ph.D. (IIT Kharagpur)  
*Professor*  
 Mass Transit Planning, Traffic Flow Modelling and Travel Demand Modelling, Road Safety.

**Geetam Tewari**, Ph.D. (Univ. of Illinois)  
*Professor*  
 Transportation Planning, Public Transport Systems, Non-Motorised Vehicle Planning, Traffic Safety.



**K.S. Rao**, Ph.D. (IIT Delhi)  
*Professor*  
 Rock Mechanics and Rock Engineering, Geotechnical Engineering, Engineering Geology, Seismic Microzonation.

**Dhanya C.T.** Ph.D. (IISc., Bangalore)  
*Associate Professor*  
 Hydroclimatological Modelling, Nonlinear Dynamics and Chaos Theory, Stochastic Hydrology, Optimization in Water Resource Systems, Data Mining in Hydrology, Water Resources Management.



**Manabendra Saharia**, Ph.D. (University of Oklahoma, USA)  
*Assistant Professor*  
 Flood Forecasting, Land Surface Modeling, Radar and Satellite Precipitation, Statistics, and Machine Learning, Human Computation.

**V. Arya**, Ph.D. (IIT Madras)  
*Assistant Professor*  
 Biological Wastewater Treatment, Physico Chemical Treatment of Water and Wastewater, Removal of Emerging Contaminants, Advanced Oxidation Processes.



**Dipti Ranjan Sahoo**, Ph.D. (IIT Kanpur)  
*Associate Professor*  
 Supplemental Damping and Energy Dissipation, Earthquake Engineering, Performance Based Seismic Design, Strengthening, Retrofitting, Steel & Concrete Structure, Large-Scale Seismic Testing, Dampers.

**Prashanth Vangla**, Ph.D. (IISc., Bangalore)  
*Assistant Professor*  
 Interface Behavior of Particulate and Continuum Interfaces, Morphological Characterization of Soils Based on Digital Image Processing, 3D Printing in Geosynthetics and Granular Materials, Bio-inspired Geotechnics, Characterization and Quantification of the Pore Structures of Granular Materials, Site Characterization and Monitoring.



**J.T. Shahu**, Ph.D. (IIT Kanpur)  
*Professor*  
 Geotechnology for Tracks and Pavements, Constitutive Modelling of Soils, Ground Improvement, Geosynthetics.

**A.K. Gosain**, Ph.D. (IIT Delhi)  
*Emeritus Professor*  
 Integrated Watershed Modelling, GIS Hydrological Modelling, Irrigation Management, Environmental Impact Assessment.



**Aravind K. Swamy**, Ph.D. (New Hampshire Univ.)  
*Associate Professor*  
 Pavement Engineering, Constitutive Modeling of Pavement Materials, Damage Mechanics.

## ▶ INTRODUCTION

The Civil Engineering Department at IIT Delhi was established along with the inception of the Institute in 1961. It now offers a regular four year bachelor's degree in Civil Engineering, and eight different M.Tech. Programs along with M.S. (Research) and Ph.D. Programmes in different frontier areas of research in Civil Engineering. The Department has faculty of international reputation and possesses laboratories/research/computational facilities comparable to any lead in university of the world. It promotes industry-academia interaction through consultancy services and undertakes cutting-edge research through sponsored research projects. The department also takes a lead role in ensuring that the advancements in Civil Engineering and Technology reach service professionals through training and continuing education programmes. The Department undertakes curriculum development activities by updating the existing course, developing new courses and preparing resource materials for teaching.

## ▶ ACADEMIC PROGRAMMES

### UNDERGRADUATE

The Undergraduate curriculum is broad-based and is designed to introduce the students to the wide range of problems encountered by civil engineers. The major components of the curriculum are Geotechnical Engineering, Structural Engineering, Water Resources Engineering, Environmental Engineering, and Transportation Engineering.

### POSTGRADUATE

The Postgraduate courses of the Department cover a wide range and enable students to specialize in one of the programmes listed below and also to study courses in other fields of interest in the department. In addition, each M.Tech. student is required to do a major project which involves introduction to the methodology of research or design and development and submit a dissertation. The specialization in M.Tech. Programmes are:

- Construction Engineering and Management
- Environmental Engineering and Management
- Geotechnical and Geoenvironmental Engineering
- Rock Engineering and Underground Structures
- Structural Engineering
- Water Resources Engineering
- Transportation Engineering
- Construction Technology and Management (Industry Sponsored)

## RESEARCH AREAS

The Department offers doctoral and post-doctoral research programmes in the following areas:

- **Building Science and Construction Management:** Quantification in Industrial Research, Quantitative Techniques and Monitoring in Management of Capital Projects, Network Techniques for Scheduling and Resources Allocation Problems, Contract Management, Value Engineering. Durability, Creep, Shrinkage and Temperature Effects of Concrete, Fiber Reinforced and Special Concrete, Corrosion of Reinforcing Steels, Energy Efficient Building, Building Sciences, Asset Management, Project Success Factors, Green Buildings.
- **Design, Planning and Management,** Lean Construction, Automation in Design & Construction.
- **Engineering Geology:** Weathering Processes and their Effects, Petrography of Aggregate, Rock Drill Ability, Geomorphology, Terrain Evaluation, Landslide Hazard Zonation, Seismic Microzonation and Waste Disposal in Rocks, Hill Slope Engineering.
- **Environmental Engineering:** Water Supply and Wastewater Engineering, Industrial Pollution Control, Physico-Chemical, Biological and Thermal Treatment Techniques for Wastes and Wastewaters, Emerging Molecules in the Environment, Solid Waste Management, Fluidized Bed Reactors, Carbon Sequestration, Environmental Impact and Risk Assessment, Microbiological Risk Assessment, Environmental Indices, E-Waste Management, Nanoparticles in the Environment, Human Health Risk Assessment, Air Pollution and Control, Urban and Regional Air Quality Management, Indoor Air Pollution, Aerosols, Chemical Constituents, Precursor Gases, Source Profile Development, Atmospheric Chemistry, Receptor Modeling, Climate Modeling, Benchmarking, Endocrine Disrupting Chemicals and Personal Care Products in Environment, Incineration, Waste-to-energy.
- **Geoenvironmental Engineering:** Hazardous Waste Landfills, Municipal Solid Waste Landfills, Ash Ponds, Ash Utilization, Mine Tailings Dams, Waste Mounds, Liners, Covers, Vertical Barriers, Geotechnical Reuse of Waste Materials.
- **Offshore Structure:** Fixed and Floating Offshore Oil Production Platforms-Steel Jackets, Concrete Gravity Platforms-Guyed Towers, Tension Leg Platforms, Articulated Towers, Modelling of the Sea Environment: Soil-Structure-Fluid Interaction, Model Analysis for Linear and Non-linear Systems, Submarine Pipeline, Dynamics of Floating Bodies.
- **Rock Engineering:** Strength and Deformation of Rocks and Rock Masses, Joint Systems, Application of Finite Element Method, Boundary Element Method and other Methods, Stresses and Deformation around Underground Openings, Stability of Rock Slopes, Subsurface Exploration by Geophysical Methods, Geomechanics Modelling, Underground Support Systems, Ground Improvement, Servo Controlled Stiff Testing Machine, Environmental Hazards.

- **Soil Engineering:** Shear Strength Behavior under Generalised Stress and Strain, under Partial Saturation, under High Stresses, under Cyclic Load, Shallow and Deep Foundations, Constitutive Relationships of Soils, Application of Finite Element, Boundary Element and Finite Difference Methods to Analysis of Problems of Flow, Stability, Substructures, Earth and Earth Retaining Structures and Soil-Structure Interaction, Reinforced Soil Structures, Geosynthetics, Marine Geotechnology, Environmental Geotechnology, Landfill Engineering, Ground Improvement, Geotechnical Earthquake Engineering, Seismic Microzonation, Geotechnology related to Roads and Railway Tracks, Geomechanics from micro to macro, Bio-Geotechnics.
- **Structural Engineering:** Nonlinear Dynamics and Stability, Elasto-plasticity, Performance-based Seismic Design, Strengthening, Large-scale Seismic Testing, Micro-structural Modeling, Hydration of Cements and Supplementary Cementitious Materials, Smart Materials & Structures, Structural Health Monitoring, Biomechanics, Engineered Bamboo Structures, Energy Harvesting, Sustainability, Durability and Repair of Concrete Structured, Blast, Fire and Wind Engineering, Multi-hazard Protective Structures, Green Building, Non-destructive Evaluation, Structural Dynamics and Control Systems, Mechatronics.
- **Surveying and Remote Sensing:** Land and Geographic Information Systems, Multipurpose Surveys using Aerospace Data, Remote Sensing Applications to Land and Water Resources, Environmental Problems, Analytical Photogrammetric Control Extension.
- **Transportation Engineering:** Travel demand modeling, Public transport planning and operations (BRT, Metro, LRT, Bus systems), Traffic engineering and management, Traffic flow modeling and simulation (heterogeneous traffic), Pedestrian dynamics and evacuation modeling, Transportation system analysis, Urban and regional transportation system planning, Planning and modeling of non motorized transport system (pedestrian, bicycles), Traffic safety, Accident prediction modeling, Highway safety analysis, Evaluation of pavement materials, Modeling of pavement materials, Pavement Design and Modelling Economic Analysis to Transportation Systems, Airport engineering, Continuum damage mechanics, Recycling of pavement materials, Bitumen rheology.
- **Water Resources Engineering:** Surface and Groundwater Hydrology, Flood Forecasting, Hydraulic and Hydrological Modelling, Irrigation, Drainage, Erosion and Sedimentation Problems, Mathematical Modelling of Geophysical Systems, Planning and Management of Water Resources Systems, Environmental Impact Assessment. Groundwater Contamination, Bio-remediation, Watershed Management, Physically Based and Statistical Modelling of Hydrologic Systems, Rationalization of Floods through Pattern Analysis, GIS and Remote Sensing, Finite Element and Optimization Methods in Water Resources.

**Doctoral research is being carried out in the following areas:**

Structural Dynamics and Control Systems, Elastodynamics and Stability, Smart materials & Structures, Structural

Health Monitoring, Engineered Bamboo Structures, Micro-Structural Modelling of Cements and Supplementary Cementitious Materials, Durability of Concrete Structures, Multi-hazard Protective Structures, Green Building, Earthquake Engineering, Wind Engineering, Structural Control, Reinforced Concrete Structures, Bridge Engineering, Offshore Structures, Tall Buildings, Soil Structure Interaction, Fiber Reinforced Polymer Composites, Fire Engineering, Blast Resistant Structures, Waste Utilization in Building Materials, Corrosion of Concrete/Reinforced Concrete, Performance Life Prediction of Structure, Fatigue, and RC Mechanics, Neural Network, Brick Masonry, Constitutive Modelling: Creep, Elastoplasticity, Damage of Concrete, Rebar Band Modelling Self Compacting and High Performance Concrete, Smart Structures Non-Destructive Testing & Evaluation of Structures.

Geological Engineering, Rock Weathering, Aggregate Reaction, Rock Mechanics, Geophysical Methods, Stability of Rock Slopes, Underground Structures, Numerical, Physical and Geomechanical Modelling, Geosynthetics in Infrastructure Projects, Soil Mechanics, Foundation Engineering, Earth Dams, Earth Retaining Structures, Geosynthetics, Reinforced Soils, Environmental Geotechnology, Marine Geotechnology, Earthquake Geotechnics, Soil Dynamics, Landfill Engineering, Geotechnology for Roads and Railway Tracks.

- **Biological Processes for Wastewater Management:** Upflow Anaerobic Sludge Blanket Reactors, Constructed Wetlands, Compact Activated Sludge Process, Urban Water, Water Quality Modeling, Urban Air Quality Management including Monitoring and Modeling, Indoor Air Pollution Modeling, Vehicular Pollution Modeling, Source and Atmospheric Aerosol Characterization, Emission Inventory Development, Receptor Modeling, Climate Modeling, Human Health Risk Assessments, Nanoparticle Removal, Nanoparticle Toxicity to Bacteria, Multi-criteria Multi-objective Multi-stakeholder Decision making, Emerging Molecules in the Environment, Carbon Sequestration through Mineral Carbonation, Engineered Landfills, GHG emissions from reservoirs, Circulating Fluidized Bed Operations, Environmental Forensics. Thermal performance of buildings and Energy Efficient Building Design.

Contraction Management System Engineering and Design, Transport planning, Transport policy, transportation safety, construction work zone safety, Heterogeneous Traffic flow modeling, Traffic safety and capacity of hill roads, Mass transportation planning, Fuzzy systems, urban transport infrastructure planning and design, Expert systems in transportation engineering, Environmental impact assessment, Non-motorized transport planning, Modeling of pedestrian behavior, Geometric design of transportation infrastructure, Characterization of pavement materials, Pavement design (flexible and rigid), Damage modeling of bitumen and bituminous mixtures, Constitutive modeling of pavement materials, Recycling of civil infrastructure materials, Rheology of asphaltic materials, Condition assessment of highway infrastructure, Pavement management systems, Highway engineering, Airport infrastructure, Environmental Impact Assessment of Transportation and Urban Environment.

Mathematical Modelling in Water Resources, Flood Forecasting, Statistical Modelling in Hydrology, Water Resources Systems, Surface and Ground Water Quality Modelling, River Hydraulics, Applications of Remote Sensing Techniques in Water Resources, Soil Characteristics, Watershed Modelling, Vegetation and Crop response to Moisture, Application of Neural Networks in Water Resources Modelling, Bio-remediation of Soils, Irrigation Water Management, Climate Change and its Impact on Water Resources, GIS Applications in Water Resources Modelling, Morphotectonic and Geological Studies, Natural Hazards such as Landslides, Coastal Erosion etc. and Environmental Monitoring, Pattern Recognition in Remote Sensed Data, Digital Terrain Modelling and Computer Applications and Photogrammetry.

## ▶ LABORATORY FACILITIES

- **Structural Engineering Laboratories** is a cluster of 10 laboratories, namely Concrete Structures Laboratory, Heavy Structures Laboratory, Materials Research Laboratory, Smart Structures and Dynamics Laboratory, Structural Analysis Laboratory, Structural Simulation Laboratory, Advanced Dynamics Laboratory, Construction Technology Laboratory and Construction Simulation Laboratory and Multi-Hazard Protective Structures Laboratory. This laboratory cluster has facilities to test material strength and prototype structures. Some of the key equipment includes strain controlled dynamic compression testing machine (4000 kN), MTS actuator, mercury intrusion porosimeter, atomic force microscope, corrosion testing facilities, portable dynamic shaber, high tech data logging systems and special interrogation systems for structural health monitoring based on smart piezoelectric sensors. It houses fire furnace (1300° C) with universal testing machines. In addition, it has state-of-the art shake table and large strong floor for conducting destructive tests on large specimens.
- **Computational Laboratory** is equipped with two Xenon Servers with Windows 2003 server Edition, for domain control and as license server, 50 core 2 Duo/Quad systems with 4GB of RAM and Windows 7 Enterprise Operating System. All the systems are connected to IITD LAN through Gigabit switches. The laboratory is equipped with some of the latest software viz. Microsoft Office 2010, Microsoft Office projects 2007, ArcGIS V10.0, Bentley Civil Engineering Software including STAAD pro V8i, Microstation, MX Road, WaterGEMS, SewerGems, StormCAD, Matlab V2012a, Abaqus V11.0, Ansys V14.0, Plaxis 2D, RocScience, GeoStudio V2007, SAP2000 V15, Etabs V9.0, SAFE V14.0, SAFIR etc. The laboratory is also equipped with a 3000 ANSI Limens LED Projector mounted on the ceiling for conducting computer-aided tutorial classes and presentations. The laboratory has been equipped with PA system comprising of wired and wireless microphones and 6 speakers connected through a Digital Amplifier and a 12 Channel Mixer.
- **Soil Mechanics Laboratory** has facilities for testing soils under generalised stress-strain conditions (universal triaxial cell), under high confining pressures (up to 1400 kg/cm<sup>2</sup>), in large size specimens (100 mm diameter), and under partially saturated conditions. Computer controlled GDS triaxial test system is



available. It has equipment for measurement of electric resistivity, thermal conductivity, testing soils under dynamic conditions, etc. and for model tests. Equipment to carry out field investigations by drilling boreholes, standard penetration tests, collection of undisturbed samples, plate load tests, dynamic cone and static cone penetration tests are available. A specially built tank 7x3x3 m. with a reaction frame of 40 ton. capacity to test prototype models of retaining walls (active and passive conditions), bridge abutments, geotextile reinforced walls, pile foundations, and footings, to study the thermal conductivity of soils, stability of model submarine pipelines, pullout behaviour of model anchors and skin friction behaviour of model piles. Facilities have been developed for the assessment of strength and friction behaviour, hydraulic behaviour, construction serviceability of geosynthetics (both natural and polymeric). Soil dynamics testing facilities include SASW for soil profiling, block vibration test, dynamic pile load test etc. MASW Shear wave velocity field testing apparatus, Geosynthetics test equipment for pullout, interface and sliding.

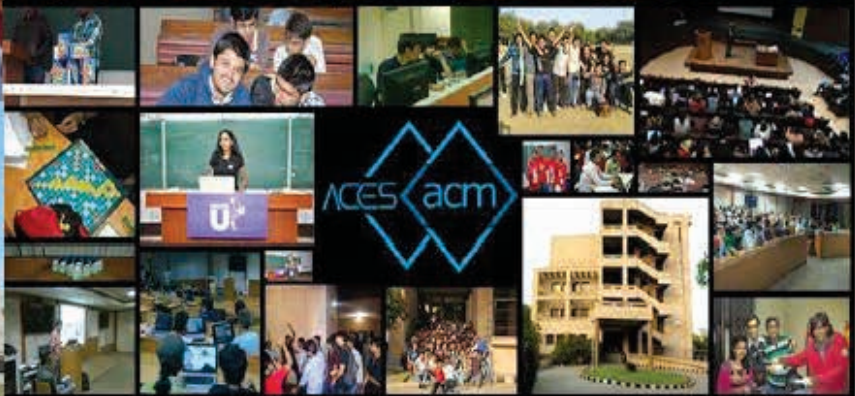
- **Rock Mechanics Laboratory** has facilities to test intact rocks and jointed rock masses, to model and test the modelled materials. The laboratory has the following equipment: a loading frame (500 ton vertical load, 100 ton lateral load) to test up to 70 x 70 x 70 cm. Specimens, with system for monitoring cell pressures and volume changes, loading and unloading sequences, biaxial and triaxial testing unit (up to 1400 kg/cm<sup>2</sup>), triaxial (200 kg/cm<sup>2</sup>), oblique shear and double shear equipment, strain indicators, sonic wave velocity apparatus, borehole extensometer, core drill cutting and lapping machines. Laboratory extensions exist to study the foundations of dams, tunnels and strata control problems with 100 channel data logger.
- **Transportation Engineering Laboratory** has facilities to test aggregates, bituminous materials, bituminous mixes as well as soils. Digital Master Loader with the ability to test marshal and CBR specimens, connected with the data logger, Video Image processing system, Digital Video Camera, Software MX-ROADS, CUBE. The laboratory is also equipped with accelerated polishing equipment, skid resistance tester, automatic vehicle counting devices, etc. Pavement evaluation by Profilograph, Roughometer and Benkelmann beam apparatus. Traffic data collection system (miovision), Rut tester, Dynamic shear rheometer.
- **Environmental Engineering Laboratory** is equipped to examine water and wastewater chemically, physically, bacteriologically and biologically. Filtration columns, pilot scale rotating biological contactors, mini ion exchange plant, Simulated landfills, cold model re-circulating fluidized bed reactor, etc. are available for conducting research. It has the facilities of a constant temperature room and a dark room with a microbiological camera. An advanced instrumentation room houses modern equipments e.g. GCMS, AAS, HPLC, microprocessor based UV 2000 spectrophotometer, TOC Analyzer, digital gas liquid chromatograph, Dedicated microbial quality facility, digital electronic ion analyser, flame photometer, Digital Balance, Microbalance, digital microprocessor based DO and Ion meter, digital pH controller, indoor air quality monitor, air velocity meter, handy air samplers, respirable dust monitors, Bio-aerosol Sampler, Stack monitoring kit, Indoor air quality chamber, Bomb

calorimeter and many other allied analytical equipments for the analysis of water / wastewater / air / organics / inorganics / metals. Besides, flue gas analyzer, RSPM Monitor for monitoring PM10 and Impactor based PM 2.5 monitor, multi-stream cyclon based monitor, Ozonator and Weather station are available.

- **Surveying and Remote Sensing Laboratory** is equipped with precise survey instruments for field surveying like Total, Station, GPS, Digital & Auto Level, etc. Precise angle measuring equipment measuring upto 1" and electronic distance measuring equipment of accuracy 1:50,000 are also available.
- **Engineering Geology Laboratory** is equipped for research work in the field of geochemistry, geophysics and industrial mineralogy, qualitative assessment of minerals for hydroelectric projects can be carried out. Data base is available for preparing landuse map of any area in India. PCs with large variety of softwares are available to process the geological data. There is a good geological museum with large collection of minerals, rocks, fossils and models.
- **Water Resources Simulation Laboratory** has two components. The laboratory is equipped with latest computational tools available in the area of Water Resources. The laboratory is equipped with 35 core2 Duo and i7 processors, LAN facilities for satellite image processing and application softwares dealing with ARCGIS and Expert System (LEVEL 5 OBJECT). Experimental facilities include Advanced Hydrologic System, Hydraulic Work Bench, Spectrophotometer, Ion Meter and other instruments for carrying out a detailed water quality analysis. River Hydraulics Facility in the form of two flumes enables model studies, sediment transport analysis, dam break and flood wave propagation studies. Bench scale test facility for slurry transportation pipeline systems is also available.







**DEPARTMENT OF  
COMPUTER SCIENCE AND ENGINEERING**

**ROSHNI INDOOR NAVIGATION SYSTEM FOR VISUALLY IMPAIRED**





**Sanjiva Prasad**, Ph.D. (Stony Brook Univ.)  
*Professor*  
 Semantics and Verification, Programming Languages,  
 Concurrent Systems, Formal Foundations of Networks.

## HEAD OF THE DEPARTMENT



**Chetan Arora**, Ph.D. (IIT Delhi)  
*Associate Professor and Pankaj Gupta Faculty Fellow*  
 Computer Vision and Machine Learning.

**Subhashis Banerjee**, Ph.D. (IISc., Bangalore)  
*Professor (Ministry of Urban Development Chair)*  
 Computer Vision, Real-time Systems, Robotics.



**Amitabha Bagchi**, Ph.D. (Johns Hopkins Univ.)  
*Associate Professor*  
 Data Algorithmics and Analytics, Probability  
 and Networks.

**Sorav Bansal**, Ph.D. (Stanford Univ.)  
*Associate Professor (Microsoft Chair)*  
 Compiler Design and Optimization.



**M. Balakrishnan**, Ph.D. (IIT Delhi)  
*Professor*  
 Embedded Systems, Assistive Technology,  
 System Level Design.

**Srikanta Bedathur**, Ph.D. (IISc., Bangalore)  
*Associate Professor and Pankaj Gupta Faculty Fellow*  
 Data Management, Knowledge Discovery  
 and Data Mining, Information Retrieval.



**Ashish Chiplunkar**, Ph.D. (IIT Bombay)  
*Assistant Professor and Pankaj Gupta Faculty Fellow*  
 Algorithm Design, Stochastic Problems.

**Naveen Garg**, Ph.D. (IIT Delhi)  
*Professor (Janaki and K.A.Iyer Chair)*  
 Algorithms, Optimization.



**Soham Sundar Chakraborty**, Ph.D.  
 (Technische Universitaet Kaiserslautern and Max  
 Planck Institute for Software Systems (MPI-SWS))  
*Assistant Professor and Pankaj Gupta Faculty Fellow*  
 Programming Languages and Software  
 Engineering.

**Rahul Garg**, Ph.D. (IIT Delhi)  
*Professor*  
 Machine Learning, Big  
 Data Analytics, Neuroimaging, High  
 Performance Computing.







**Ragesh Jaiswal**, Ph.D. (Univ. of California, San Diego)  
Associate Professor  
Algorithms, Complexity Analysis.



**Prem Kalra**, Ph.D. (EPFL, Switzerland)  
Professor  
Computer Graphics, 3D Animation.



**S. Arun Kumar**, Ph.D. (TIFR, Bombay)  
Professor  
Semantics and Verification.



**Amit Kumar**, Ph.D. (Cornell Univ.)  
Professor (Jaswinder & Tarwinder Chadha Chair)  
Algorithms, Combinatorial Optimization.



**Subodh Kumar**, Ph.D. (Univ. of North Carolina)  
Professor  
Computer Graphics, Virtual Reality, Parallel Programming, High Performance Computation.



**Mausam**, Ph.D. (Washington, Seattle)  
Professor (Jai Gupta Chair)  
Artificial Intelligence, Natural Language Processing, Machine Learning.

**Rahul Narain**, Ph.D. (Univ. of North Carolina)  
Assistant Professor and Pankaj Gupta Faculty Fellow  
Computer Graphics, Animation, Numerical Methods.



**Preeti Ranjan Panda**, Ph.D. (Univ. of California, Irvine)  
Professor  
Embedded Systems - architectures and Compilers, Cache and Memory Technologies, Energy-efficient Computing, VLSI Design Automation.



**Kolin Paul**, Ph.D. (BESU)  
Professor (Microsoft Chair)  
Embedded Systems, Hardware Security, Reconfigurable Computing.



**Rohan Paul**, Ph.D. (University of Oxford)  
Assistant Professor and Pankaj Gupta Faculty Fellow  
Human Robot Interaction, Language Grounding, Symbolic Reasoning.



**Maya Ramanath**, Ph.D. (IISc., Bangalore)  
Associate Professor  
Database Systems and Information Retrieval, Semantic Web Data Management Including Information Extraction, Query Processing, Result Ranking and Reasoning.



**Vinay Joseph Ribeiro**, Ph.D. (Rice Univ.)  
Associate Professor  
Computer and Network Security, (Blockchain, DDoS, IoT Security), Internet of Things (IoT), Wireless Networks (Cognitive Radio, LTE, Wi-Fi, etc.), Indoor Positioning and Navigation.





**Sayan Ranu**, Ph.D. (Univ. of California, Santa Barbara)  
*Assistant Professor*  
 Data Mining, Network Science, Spatiotemporal Data Analytics, and Bioinformatics.



**Huzur Saran**, Ph.D. (Univ. of California, Berkeley)  
*Professor*  
 High Speed Networks, Graph Theory & Algorithms.



**Smruti Ranjan Sarangi**, Ph.D. (Univ. of Illinois)  
*Associate Professor (Usha Hasteer Chair)*  
 Computer Architecture, Operating Systems, Cyber Security, IoT.



**Aaditeshwar Seth**, Ph.D. (Univ. of Waterloo)  
*Associate Professor*  
 Information and Communication Technologies for Development, Media Analysis, Computer Networks.



**Rijurekha Sen**, Ph.D. (IIT Bombay)  
*Assistant Professor and Pankaj Gupta Faculty Fellow*  
 Mobile and Embedded Systems (Hardware Architecture, OS, Sensing, Efficient Processing, Security), Computational Sustainability.



**Sandeep Sen**, Ph.D. (Duke University)  
*Professor (Microsoft Chair)*  
 Computational Geometry, Algorithms.

**Parag Singla**, Ph.D. (Washington Seattle Univ.)  
*Associate Professor*  
 Neuro Symbolic Reasoning, Probabilistic Graphical Models, Machine Learning, Artificial Intelligence.



**Subodh Sharma**, Ph.D. (University of Utah)  
*Assistant Professor*  
 Formal Verification, Program Analysis, Concurrent Systems, System Security.



**Anshul Kumar**, Ph.D. (IIT Delhi)  
*Emeritus Professor*  
 CAD for VLSI, Computer Architecture.



**S.C. Gupta**  
*Visiting Faculty*  
 Software Engineering, Databases, Cloud Computing, Software Defined Storage and Networks.



**B.N. Jain**, Ph.D. (State University of New York)  
*Honorary Professor*  
 Computer Networks, Network Security.



**S.N. Maheshwari**, Ph.D. (Northwestern Univ.)  
*Honorary Professor*  
 Algorithms, Parallel Processing, Information Systems.







**Deepak Kapur**, *Ph.D. (MIT, USA)*  
*Honorary Professor*  
 Formal Methods, Program Analysis,  
 Distributed Computing and Social Aspects  
 of Computing.



**Umesh Vazirani**, *Ph.D. (UC Berkeley)*  
*Honorary Professor*  
 Quantum Computing.



**Anish Arora**, *Ph.D. (UT Austin)*  
*Adjunct Faculty*  
 Dependable Distributed and Networked  
 Systems, IoT, Cybersecurity.

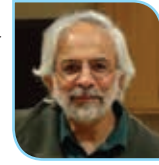


**Karthikeyan Bhargavan**, *Ph.D.*  
*(University of Pennsylvania)*  
*Adjunct Faculty*  
 Security and Privacy, Formal  
 Verification.



**Sanjeev Khanna**, *Ph.D. (Stanford  
 University)*  
*Adjunct Faculty*  
 Theoretical Computer Science.

**Gopalan Nadathur**, *Ph.D. (University of  
 Pennsylvania)*  
*Adjunct Faculty*  
 Programming Language.



**Yogish Sabharwal**, *Ph.D. (IIT Delhi)*  
*Adjunct Faculty*  
 High Performance Computing Group  
 IBM India Research.



**Rajiv Shorey**, *Ph.D. (IISc., Bangalore)*  
*Adjunct Faculty*  
 Communication Networks,  
 Data Analytics, Machine Learning  
 and Artificial Intelligence.



**Gautam Shroff**, *Ph.D. (Rensselaer  
 Polytechnic Institute)*  
*Adjunct Faculty*



**Manik Varma**, *Ph.D. (IISc., Bangalore)*  
*Adjunct Faculty*  
 Machine Learning and Computer  
 Vision.



## INTRODUCTION

IIT Delhi has been active in Computer Science education and research since the early 1970s. The Department of Computer Science and Engineering was established in 1982. It currently has 31 full-time faculty members, all with PhDs from leading institutions and recognised in their fields of expertise, with a plan to grow to around 40 in the coming two years. Apart from full time faculty members, the Department currently has several distinguished honorary and emeritus professors, adjunct faculty from leading research laboratories and international universities, and several visiting faculty members, all of whom participate in teaching and research activities.

## ACADEMIC PROGRAMMES

The CSE department currently offers B.Tech., 5-year Integrated Dual Degree, M.Tech., M.S. (Research) and Ph.D. programmes in Computer Science and Engineering. It offers a minor area programme for non-majors, as well as 6 specialisations each for B. Tech and M. Tech students. In addition, the department participates in interdisciplinary M.Tech. programmes in VLSI Design, Tools & Technology, the Ph.D. and M.S. (Research) programmes of the Khosla School of Information Technology, the Bharti School of Telecommunication M.Tech. programmes, and will participate in interdisciplinary programmes in Cyber-security. The curricula are in line with current international trends, and are also used as model curricula by other Indian universities and colleges.

The current student strength in the department is about 700 (370 in Undergraduate, 165 in dual degree, 115 in Masters and 50 in Doctoral programmes). Admission to the programmes is highly competitive - for the undergraduate and dual-degree programmes, there is a nation-wide Joint Entrance Examination (JEE) Advanced where approximately the top 1,50,000 students (Senior Secondary School) who cleared JEE Main appear annually and candidates only from the top 300 are offered admission to the CS programmes. At the Masters/Ph.D. level, only students with a score of 99 percentile or better in the nation-wide GATE exam are offered admission. A significant number of employed computer professionals are also enrolled in our postgraduate programmes as sponsored candidates.

The curricula are comprehensive in their coverage of various aspects of computer science including algorithms and computational theory, architecture and systems software, networks, reliability and security, graphics, vision and computing applications, especially those involving AI and machine learning. The emphasis is on design, methodology, analysis and good software practices. As part of the degree requirements, undergraduate, dual-degree and Masters students are expected to complete a two-semester project which may involve developing a subsystem that typically contributes to fulfilling the objectives of a research project.

## RESEARCH AREAS

- **Algorithms and Complexity Theory:** (*associated faculty:* Amitabha Bagchi, Ashish Chiplunkar, Naveen Garg,

Ragesh Jaiswal, Amit Kumar, Sandeep Sen and S.N. Maheshwari).

Algorithmic graph theory, Computational geometry, Randomized algorithms, Approximation algorithms, Complexity theory, Online algorithms.

- **Artificial Intelligence (AI) and Machine Learning (ML):** (*associated faculty:* Chetan Arora, Amitabha Bagchi, Subhashis Banerjee, Srikanta Bedathur, Rahul Garg, Mausam, Rohan Paul, Sayan Ranu, Aaditeshwar Seth and Parag Singla).

Reinforcement learning and AI planning, Neuro-symbolic ML, Probabilistic graphical models, Statistical relational learning, Extreme classification, Embodied artificial intelligence, Ethical AI, Fairness and reliability in ML, Privacy issues in ML, ML for social networks, ML applications to healthcare, AI for crowdsourcing, Knowledge-based AI, Computational advertising, AI for robotics.

- **Natural Language Processing (NLP):** (*associated faculty:* Srikanta Bedathur, Rahul Garg, Mausam and Maya Ramanath).

2D and 3D object recognition, real-time motion tracking, image compression, image based geometric modeling, 3D graphics and animation.

- **Databases and Data Analytics:** (*associated faculty:* Srikanta Bedathur, Amitabha Bagchi, Mausam, Maya Ramanath, Sayan Ranu, Aaditeshwar Seth and Parag Singla).

Intention mining, Policy driven databases, Information retrieval, Information dissemination in social networks, Semantic web data management, Opinion mining, Indexing and querying in graph databases, Spatio-temporal data analytics, Data wrangling.

- **Architecture and Embedded Systems:** (*associated faculty:* M. Balakrishnan, Preeti Ranjan Panda, Kolin Paul, Smruti Ranjan Sarangi, Rijurekha Sen and Anshul Kumar).

Hardware-software co-design, Embedded systems design, Reconfigurable computing, Fault-tolerant computing, Hardware implementations, Temperature-aware architectures, Energy-efficient architectures, Design-for-debug, Cache memory, 3D and non-volatile memory, Architectural extensions for mobile security, Architectures for machine learning, Architectures for computer vision, Secure architectures.



- **Graphics and Vision:** (*associated faculty:* Chetan Arora, Subhashis Banerjee, Prem Kalra, Subodh Kumar and Rahul Narain).  
Computer graphics, Virtual reality, Computer vision, Digital image and video processing, Mobile multimedia, Embedded computer vision, Robotic vision, Medical image analysis.
- **Computer Networks and Distributed Systems:** (*associated faculty:* B.N. Jain, Vinay Ribeiro, Huzur Saran, Rijurekha Sen and Aaditeshwar Seth).  
Mesh networks, 4G LTE/ WiMAX, Cognitive radio, Cellular network measurements, Wireless networks, Network security, Operating systems security.
- **Programming Languages, Semantics and Verification:** (*associated faculty:* Sorav Bansal, Soham Chakraborty, S. Arun-Kumar, Sanjiva Prasad and Subodh Sharma).  
Programming language semantics, Theory and practice of concurrent systems, Process algebras, Distributed computing, Program analysis and verification, Logic in computer science, Applications of verification in network models, multiprocessors, and relaxed memory models.
- **Operating Systems, High Performance Computing and Systems Software:** (*associated faculty:* Sorav Bansal, Soham Chakraborty, Subodh Kumar, Smruti Ranjan Sarangi and Subodh Sharma).  
Compiler design, mobile operating systems and device drivers, Operating systems for IoT systems.
- **Information and Communication Technologies for Development:** (*associated faculty:* M. Balakrishnan, Kolin Paul, Rohan Paul and Aaditeshwar Seth).  
Poverty mapping, Urbanization, Bias in mass media, Computer systems for less-literate populations, Content distribution in rural areas, Community radio, Community media, Mobile health, Assistive Technology, Governance and accountability.
- **Neuroinformatics and Medical informatics:** (*associated faculty:* Chetan Arora and Rahul Garg).  
Brain Imaging, Functional MRI (fMRI), Electroencephalography (EEG), Near-infrared spectroscopy (NIRS), Human Functional Connectome.
- **Cyber Security and Secure Information Systems:** (*associated faculty:* Ragesh Jaiswal, Sanjiva Prasad, Huzur Saran, Smruti Ranjan Sarangi and Subodh Sharma).  
Formal notions of security, Formal verification for security, Language-based security, Secure architectures and Embedded systems, Network security, Blockchain-based systems, Privacy and data protection, Electronic voting, Digital identity.

### Sponsored Research and Funding

The CSE Department faculty works on funded research projects in all areas of computer science research. Currently funded project budgets amount to around ₹162 million, of which around ₹56 million is from Indian government agencies, ₹96 million from Indian and international industrial sources, and 10 million from internal resources. The department also participates in institutional computing and network infrastructure projects worth ₹550 million (mainly from government sources), and interdisciplinary projects with other departments worth ₹40 million. In addition, current faculty consultancies are worth approximately ₹11 million.

## LABORATORY FACILITIES

Computing resources in the department include several high-end servers, server clusters, and data storage systems. All of these are networked and connected to more than 150 PCs and workstations. Every faculty member, staff and Ph.D. student has a fully networked workstation with access to the Internet and adequate long term storage space in the central repository. Every undergraduate and postgraduate student is also given full access to the Internet and the Department servers. Besides, all the laboratories in the Department also provide full access to the internet and to the central repository. Other major equipment include EDA software, multi-million gate FPGA based prototyping and validation system, robot platforms etc. The PCs and workstations are connected through 10/100 mbp/s links. The departmental network is connected to the Institute-wide network through a 1Gbps switched fiber optic line with a 100 Mbps link to the outside world.

### The major laboratories are:

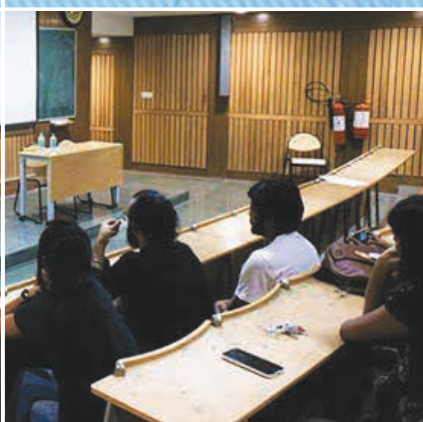
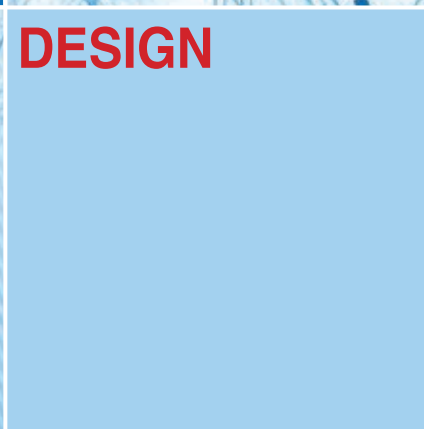
- **General Computing Lab:** This laboratory supports the general purpose computing needs of most students. It houses more than 70 workstations and provides full email and internet access. The servers provide the software required for laboratories in most of the Department courses.
- **Digital Hardware Design Lab:** This laboratory supports the training and project needs of students in the area of digital hardware design. Facilities include microprocessor based system design and FPGA based design equipment.
- **Advanced Networking Lab:** Besides providing access to ERNET and internet services, the laboratory supports development of multimedia communications and applications, ATM protocol stack, wireless and mobile communications, network security and simulation studies in high-speed networks.
- **Vision & Graphics Lab:** This laboratory supports development efforts in two areas, namely real-time vision and graphics. The facilities include the latest graphics workstations, robot manipulators, computing clusters, virtual reality and other state of the art equipment.
- **VLSI Design & Tool Lab:** This laboratory, established in 1996 with support from Philips Semiconductors as part of the VLSI Design, Tools and Technology programme houses a state-of-the-art CAD facility consisting of several servers and workstations. P4 clients, X-terminals, plotter and VLSI design software. The CAD facility features in-house, commercial and public domain software (including Cadence and Synopsys) for VLSI synthesis and simulation.
- **Database and Analytics Lab:** This lab features multiple high-end servers and GPU clusters, along with a number of state of the art workstations. Work in this lab is primarily on addressing scalability challenges in managing and analyzing structured and unstructured data including relational, graph, textual and streaming data.



- **Verification Lab:** This laboratory hosts several workstations supporting various specialized model-checking and verification tools.
- **Architecture Lab:** This lab houses state of the art workstations, and a Dell storage server for supporting research activities in high performance computer architecture and modern embedded systems.
- **Cyber Security Research Lab:** The mandate of the cyber security lab is to carry out fundamental research in the areas of Cryptography, Computer Systems & Network Security and Advanced Information Systems Security. The main focus is on developing provably secure algorithms to meet the efficiency and security demands of emerging technology trends such as cloud computing.
- **Data Analytics Lab:** Data analytics as a field of computer science is comparatively new and is an amalgamation of other fields such as data management, information retrieval, machine learning, natural language processing, data mining and statistics. It is concerned with consuming and processing large amounts of diverse data, including, text (HTML web pages, online books, scientific publications, etc.), structured data (for example, data residing in database systems), video, audio, etc. to derive useful insights. The current focus of the lab is on processing large scale text-data and large scale graphs. Open Information Extraction, Coherent Large-Scale Multi-Document Summarization, AI Applications to Crowd-sourcing, Commonsense Knowledge Extraction and Natural Language Processing over Microblogs.
- **Cloud Computing Lab (HIPC Lab):** The lab contains infrastructure facilities for research in high-performance computing, operating system and compiler design, distributed and cloud computing.
- **The Dynamics Lab:** This lab works on works on a number of current problems in nonlinear science, ranging from a study of time delay dynamics to dynamical chimeric states, to problems of computational neuroscience, systems biology, and nonequilibrium statistical physics.
- **SAPIEnt Lab:** Systems & Algorithms Protecting Indian Environment. The word SAPIEnt itself means humans, for whom we need to take good care of the environment. This Lab is works on road traffic measurement and management, Air Pollution measurement and Analysis.



**DEPARTMENT OF  
DESIGN**





**P.V. Madhusudhan Rao, Ph.D. (IIT Kanpur)**  
*Professor*  
Product Design and Realization, Computer Aided Design & Manufacturing.

## HEAD OF THE DEPARTMENT



**Jay Dhariwal, Ph.D. (IIT Bombay)**  
*Assistant Professor*  
Product Design, Engineering Design, Mechatronics, Digital Fabrication.

**Sumer Singh, M.Des. (IIT Delhi)**  
*Assistant Professor*

Product Design, Transportation Design, Design for Sustainability, Design Sketching, Computer Aided Surfacing, Design Innovation.



**Jyoti Kumar, Ph.D. (IIT Guwahati)**  
*Associate Professor*  
Human Computer Interaction, Consumer Decision Making Process, Design Research Methodology, Design for Emotion and Persuasion, Design for Usability, User Experience Design.

**Subir Dey, Ph.D. (IIT Guwahati)**  
*Assistant Professor*

Visual communication, visual semiotics, Comics studies, Visual narratives, Language of Graphic Design, comics and graphic novels, Illustrated content for children.



**Srinivasan Venkataraman, Ph.D. (IISc, Bangalore)**  
*Assistant Professor*  
Design Creativity, Design Theory and Methodology, Functional Reasoning, Engineering Design, Design Thinking, New Product Development.

**Sabyasachi Paldas**  
*Visiting Faculty*

Industrial Design, Product Detailing.



## ▶ INTRODUCTION

IIT Delhi has started a new Department of Design which came into existence in the year 2017. Major objectives of creating this department are:

- Imparting high quality design education to produce industry-ready and socially conscious design professionals
- Create new leaders in design among both faculty and students.
- To inculcate design thinking among students and faculty across the campus.
- Advancing knowledge through high impact research in the area of design.
- To promote, nurture and advance the culture of design and innovation in the institute leading to significant contributions and breakthroughs impacting quality of human life.
- Playing major role in addressing some of the grand challenges facing our society/country by designing and delivering products/solutions through multi-disciplinary teams.
- Contribute to creation of intellectual property and entrepreneurial ecosystem in the institute and country.
- Contribute to betterment of institute campus ambience using design as a tool.
- To build flagship programmes in the area of design which can be replicated in other institutes/universities in our country.
- To promote increased interactions/collaborations with institutes/organizations worldwide working in this area design education and research.

## ▶ ACADEMIC PROGRAMMES

Department of Design has identified following area of interest for its academic activities.

Industrial Design, Product Design, Engineering Design, Creativity and Innovation, Design Theory & Methodology, Applied Ergonomics and Human Factors in Design, Universal and Inclusive Design, Design for UX/UI, HCI; Graphic Design, Communication Design, Computer Aided Design and Manufacturing, Design Automation and Design Optimization, Design Computing and Design Informatics, Materials & Design, Design for Product Life-Cycle, Art & Design, Product Aesthetics, Digital Media & Design, Social and Cultural aspects of Design, Design Policy, Design Strategy and Design Management.

The faculty of Department of Design are responsible for running two postgraduate programme in the area of design namely Master of Design (M.Des.) in Industrial Design and Doctor of Philosophy (Ph.D.). Department has also started minor area in Design for B.Tech. students to specialize in. Department is in the process of launching Bachelor of Design (B.Des.) and B.Tech. (Design) programmes.

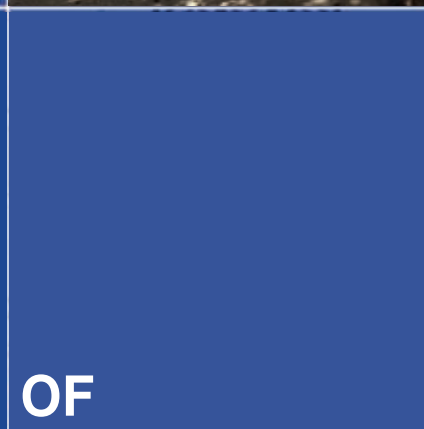


## MASTER OF DESIGN PROGRAMME

The M.Des. programme caters to the requirement of industry for innovators and designers capable of creating high quality design of products for competitive markets. It is open only to graduates in Engineering and Architecture. The programme is of two years duration, and admission to the programme is through CEED. It involves extensive studio work with hands on practice and is a project based, industry and consumer oriented programme. The thesis projects are often supported by the industry and there is close interface with the industry throughout the programme of study. The programme emphasizes development of free hand conceptualization skills, CAD modeling skills on mid level platforms and above all design thinking skills and detailing over a diverse range of products.

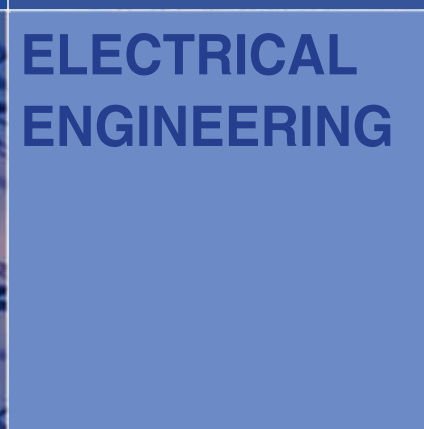
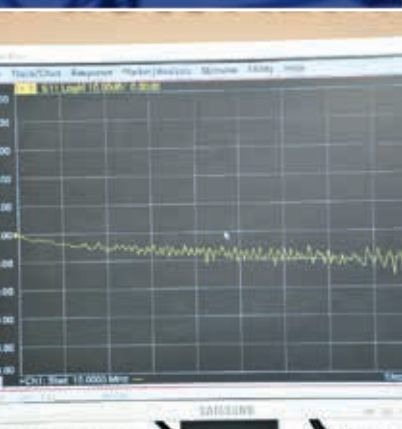






**DEPARTMENT OF**

**ELECTRICAL  
ENGINEERING**





**Jayadeva, Ph.D. (IIT Delhi)**  
*Professor*  
Machine Learning, Neuromorphic Engineering, VLSI Design,  
Swarm Intelligence Optimization.

## HEAD OF THE DEPARTMENT



**Abhijit R. Abhyankar, Ph.D. (IIT Bombay)**  
*Professor*  
Power System Analysis and Optimization, Power  
System Security, Power Markets, Smart Grids,  
Distribution System Analysis and Optimization,  
Power System Flexibility, Electricity Regulatory  
and Policy Matters.



**Sumeet Agarwal, D.Phil. (Oxford Univ., U.K.)**  
*Assistant Professor*  
Machine Learning, Complex Networks,  
Systems Biology, Evolution and Evolvability,  
Computational Linguistics, Cognitive Science,  
Public Health Informatics.



**Shubhendu Bhasin, Ph.D. (Univ. of Florida)**  
*Associate Professor*  
Nonlinear Control, Adaptive Control of Uncertain  
Nonlinear Systems, Robotics, Autonomous Systems,  
Reinforcement Learning Control, Approximate  
Dynamic Programming, Differential Games.



**Manav Bhatnagar, Ph.D. (Oslo Univ.)**  
*Professor*  
Signal Processing for MIMO Communication Systems,  
Cooperative Communications, Ultra Wideband (UWB)  
Communications, Non-Coherent Decoders, Cognitive Networks,  
Coding Theory of MIMO Communication Systems, Power Line  
Communication, Satellite Communications.



**Debanjan Bhowmik, Ph.D. (University of  
California Berkeley)**  
*Assistant Professor*  
Magnetism, Spintronics, Micromagnetics,  
Memory devices, Condensed Matter Physics.

**G. Bhuvaneshwari, Ph.D. (IIT Madras)**  
*Professor*  
Power Electronics, Electrical Machines and  
Drives, Power Quality.



**Ranjan Bose, Ph.D. (Pennsylvania Univ.)**  
*Professor (Microsoft Chair)*  
Wireless Communications, Broadband Wireless  
Access, Ultra Wideband Communications  
(UWB), Information Theory and Coding.



**Shouribrata Chatterjee, Ph.D. (Columbia Univ.)**  
*Professor (NXP/Philips Chair)*  
Analog and RF Circuit Design and VLSI, Analog  
and Digital Filter Design, Low Power and Low  
Voltage Circuit Techniques, Measurement and  
Instrumentation Techniques.



**Arpan Chattopadhyay, Ph.D. (IISc, Bangalore)**  
*Assistant Professor*  
Communication and IoT Networks; Cyber Physical  
Systems: Design, Analysis, Control, Learning and  
Cyber-security, Blockchain; Signal Processing and  
Resource Allocation for Radar; Statistical Signal  
Processing; Networked Estimation; Applications of  
Reinforcement Learning.



**S. Chaudhury, Ph.D. (IIT Kharagpur)**  
*Professor (Dhananjay Chair)*  
Computer Vision, Multimedia Systems,  
Computational Intelligence.





**Amol Choudhary**, Ph.D. (University of Southampton, UK)  
*Assistant Professor*  
 Photonics, Integrated Optics, Microwave Photonics, Optical Communications, Nonlinear Optics, On-chip Lasers, Frequency Combs, Ultrafast Lasers, Photon-phonon Interactions.



**Anandarup Das**, Ph.D. (IISc., Bangalore)  
*Assistant Professor*  
 Power Electronics, High Power Multilevel Converters, Electric Drives, Modular Converters, Power Quality.



**Subashish Datta**, Ph.D. (IIT Bombay)  
*Assistant Professor*  
 Linear Control Theory, Robust Control and LMs, Graph Theoretic Control and Multi-agent Systems.



**Swades De**, Ph.D. (State Univ. of New York)  
*Professor*  
 Communication Networks and Systems, Broadband Access and Mesh Networks, Performance Modeling and Analysis.



**Anuj Dhawan**, Ph.D. (State Univ. North Carolina)  
*Associate Professor*  
 Nanomaterials, Plasmonics, Photonic devices, Biosensors, Biomedical Devices, Nanofabrication, Growth and Self-Assembly of Novel Optical and Electronic Materials, Integrated Nano-scale Systems, Computational Electromagnetic, Sensors: Fiber-optic and Chip-based, Biophotonics and Bioimaging.



**Abhisek Dixit**, Ph.D. (K U Leuven Belgium)  
*Associate Professor*  
 Sub-10nm Logic CMOS Device Design and Characterization, CMOS Variability/ Reliability/Thermal-effects, Aggressively Scaled CMOS embedded DRAM (eDRAM) and SRAM cells, Compact Device Modeling and Process Design Kits (PDK), Modeling and Characterization of Si Solar-Cells and Modules.



**Abhishek Dixit**, Ph.D. (Ghent University)  
*Assistant Professor*  
 Optical Networks, Fibre-Wireless Converged Networks.



**Tapan Kumar Gandhi**, Ph.D. (IIT Delhi)  
*Associate Professor*  
 Computational Neuroscience, Neuro-Inspired Engineering, Biomedical Signal and Image Processing, Machine Learning, Assistive Technology.



**Ankesh Jain**, Ph.D. (IIT Madras)  
*Assistant Professor*  
 Analog and Mixed Signal Circuit Design, Data Converters (ADC and DAC), Phase Locked Loop (PLL) and Clock Synthesizers, High Speed Circuit Design, Low Voltage Circuit Design.



**Amit Kumar Jain**, Ph.D. (IISc., Bangalore)  
*Associate Professor*  
 Power Electronics, High Performance Electric Motor Drives, FACTS and Power Quality, Power Generation Control, Renewable Energy.



**Harshan Jagadeesh**, Ph.D. (IISc., Bangalore)  
*Assistant Professor*  
 Coding Theory, Wireless Security, Cyber-physical Systems, Wireless Networks, Distributed Storage.



**S. Janardhanan**, Ph.D. (IIT Bombay)  
*Associate Professor*  
 Model Free Control, Robotics, Time-delayed Systems, Model Order Reduction, Controller Co-design, Functional Observation.





**S.D. Joshi**, Ph.D. (IIT Delhi)  
*Professor*

Statistical Signal Processing, Image Processing, Theoretical Approach to Signal/Image Analysis.



**I.N. Kar**, Ph.D. (IIT Kanpur)  
*Professor*

Robust Control, Mechatronics, System Identification, Intelligent Control, Non-linear Systems.



**Subrat Kar**, Ph.D. (IISc., Bangalore)  
*Professor (Ram and Sita Sabnani Chair)*

Photonic Switching, Optical Networks, Computer Communication Networks.



**M. Jagadesh Kumar**, Ph.D. (IIT, Madras)  
*Professor*

Nanoelectronics, VLSI Device Modeling and Simulation, IC Technology and Power Semiconductor Devices.



**Lalan Kumar**, Ph.D. (IIT Kanpur)  
*Assistant Professor*

Array Signal Processing.



**Brejesh Lall**, Ph.D. (IIT Delhi)  
*Professor*

Multiscale Modeling of Stochastic Processing, Widescale Cyclostationary Process Representation, Physical Layer in Wireless Communication.

**Dhiman Mallick**, Ph.D. (Tyndall National Institute, University College Cork)  
*Assistant Professor*

MEMS, Energy Harvesting, Magnetic/Piezoelectric/Magnetolectric Devices, Micro-power Management.



**R.K. Mallik**, Ph.D. (Univ. of Southern California)  
*Professor (JC Bose Fellow)*

Communication Theory and Systems, Difference Equations, Linear Algebra.



**S. Mishra**, Ph.D. (Sambalpur Univ.)  
*Professor (Power Grid Chair)*

Power System Engineering, Intelligent Techniques for Control of Power System and Power Quality Studies, Renewable Energy.



**Bhaskar Mitra**, Ph.D. (University of Michigan)  
*Assistant Professor*

MEMS and Microfabrication, Microfluidics, Plastic MEMS, Microplasmas, Gas Phase Nanofluidics.



**Saif Khan Mohammed**, Ph.D. (IISc., Bangalore)  
*Associate Professor*

Wireless Communication (Large MIMO Systems/Massive MIMO Systems), Communication Theory and Systems, Information Theory and Statistical Signal Processing.



**Mashuq-un-Nabi**, Ph.D. (IIT Bombay)  
*Associate Professor*

Control Systems, Guidance and Control, Computational Methods for Modeling, Simulation and Control, Finite Element Method, Distributed Parameter Systems, Flexible Structures, Electromagnetic and Coupled Systems, Electromagnetic NDT.





**Soumya Shubhra Nag**, Ph.D. (IIT Kanpur)  
*Assistant Professor*

Power Electronics, DC-DC Converters, High Gain Inverters, Electric Vehicle, Renewable Energy System, DC Distribution System, Marine Ship and Aircraft Power Supply, Power Electronics Converters, Mainly DC-DC Converters, High Gain Inverters, Impedance Source Converters.



**Rakesh Kumar Palani**, Ph.D. (Univ. of Minnesota, Minneapolis)  
*Assistant Professor*

Analog/RF Mixed Signal Design, Data Converters, Low Power Circuits, Frequency Reference Circuits.



**B.K. Panigrahi**, Ph.D. (Sambalpur Univ.)  
*Professor*

Power Quality, FACTS Device, Power System Protection, AI Application to Power System.



**Deepak U. Patil**, Ph.D. (IIT Bombay)  
*Assistant Professor*

Optimal Control, Multi-Agent Systems, Switched and Hybrid Systems.



**Shankar Prakriya**, Ph.D. (Univ. of Toronto)  
*Professor*

5G, Beyond 5G and 6G Communications.



**Sumit Pramanick**, Ph.D. (IISc, Bangalore)  
*Assistant Professor*

High Frequency Link Converters, Multilevel Converters for Machine Drives, Grid Connected Converters, HVDC Circuit Breakers.

**A.P. Pratosh**, Ph.D. (IISc, Bangalore)  
*Assistant Professor*

Vision and Image Processing Audio, Speech and Music Analytics And Learning (Deep Learning, Sequential Modelling And Transfer Learning).



**Sumantra Dutta Roy**, Ph.D. (IIT Delhi)  
*Professor*

Computer Vision and Image analysis, Pattern Recognition, Audio Data Retrieval and Analysis, Biometrics and Bioinformatics..



**Mukul Sarkar**, Ph.D. (Technical University of Delft)  
*Associate Professor*

Solid State Imaging, CMOS Image Sensors, Bio-Inspired Vision Systems, Neuromorphic Imaging, Analog/Digital Circuit Design, Optoelectronics and Photonics.



**Nilanjan Senroy**, Ph.D. (Arizona State Univ.)  
*Professor*

Power System Stability and Control, Wide Area Measurement and Control, Statistical Techniques in Power Systems, Power Quality.



**Shaunak Sen**, Ph.D. (California Instt. of Tech.)  
*Associate Professor*

Control Systems, Dynamical Systems.



**Bhim Singh**, Ph.D. (IIT Delhi)  
*Professor (JC Bose Fellow)*

Power Electronics, Electrical Machines and Drives, HVDC, FACTS, Power Quality, Renewable Energy, DSP Based Control of Power Converter and Drive.







**Madhusudan Singh, Ph.D. (Univ. of Michigan)**  
*Associate Professor*  
 Flexible Electronics, Maskless Lithography And Printing Methods, Organic And Inorganic Photovoltaics, Organic Light-emitting Diodes, Nanoscale Transport, Sustainability, Wide-Bandgap Semiconductors, Device Design And Characterization.



**Seshan Srirangarajan, Ph.D. (University of Minnesota, USA)**  
*Assistant Professor*  
 Signal Processing, Wireless Communications, Wireless Sensor Networks, Optimisation, Machine Learning.



**Manan Suri, Ph.D. (INPG, France)**  
*Assistant Professor*  
 Non-volatile Memory, Neromorphic & AI Hardware, Semiconductor Cyber Security.



**M. Veerachary, Dr. Eng. (Japan Univ.)**  
*Professor*  
 Power Electronics, High Frequency Switch-Mode Power Conversion, Fuzzy-Neuro controllers for PE systems, DSP based controllers, Object Oriented Modeling of PE systems, Development of MPPT controllers for Space/Photovoltaic Sources, Photovoltaic Power Conversion, Intelligent controllers for VRMs, Digital Control Theory and Applications.



**Vivek Venkataraman, Ph.D. (Cornell Univ.)**  
*Assistant Professor (Joint Faculty Phy/EE)*  
 Nonlinear & Quantum Optics, Fiber & Integrated Photonics, Light-matter Interaction & Atomic Physics, all-optical Devices & Novel Light Sources, Optical Signal Processing and Communication.



**B. Bhaumik, Ph.D. (IIT Kanpur)**  
*Emeritus Professor*  
 Biological Neural Networks, Analog and Mixed Signal VLSI Circuits.



**P.R. Bijwe, Ph.D. (IIT Delhi)**  
*Emeritus Professor*  
 Power Systems Analysis and Optimization, Distribution Systems, Analysis & Optimization.



**Vinod Chandra, Ph.D. (IIT Delhi)**  
*Emeritus Professor*  
 Communication Systems, Fault Tolerant Computing Systems, Optical Communication.



**V.K. Jain, Ph.D. (IIT Delhi)**  
*Emeritus Professor*  
 Noise Study and Modeling, Digital Communications, Data Communications and Optical Communications and Networks



**S. Prasad, Ph.D. (IIT Delhi)**  
*Honorary Professor*  
 Signal Processing and Communication, Radar, Sonar, Speech and Image Processing.



**Hiranmay Ghosh, Ph.D. (IIT Delhi)**  
*Adjunct Faculty*  
 Semantic Video, Information Retrieval, Agent Based Systems, Multimedia Systems.



**Mona Mathur, Ph.D. (IIT Delhi)**  
*Adjunct Faculty*  
 Multimedia Systems, Video Processing and Compression, Social Media Analytics, Machine Learning.

## ▶ INTRODUCTION

The faculty members of the department are involved in teaching and research in a wide variety of areas in electrical engineering.

The Department offers two under-graduate programmes and nine post-graduate and Ph.D. programmes.

The Department offers instruction at the undergraduate and postgraduate levels with the aim of providing a sound background in the areas of electrical, electronics and computer engineering. The courses are tailored to the needs of technical manpower in the fast expanding fields of communications, computers, control, electronics and power engineering.

Apart from teaching, the Department is actively engaged in research, development, technology transfer, industrial consultancy, continuing education programmes, curriculum and laboratory development, software development and organization of seminars, workshops, and conferences in related areas. The department has active interaction with industries, alumni, governmental agencies and utilities.

The Department faculty actively participate with a number of interdisciplinary centres and programmes in the Institute through research, instructional activities, and human resource development projects. In particular, the department has a close interaction with Centre for Applied Research in Electronics, Bharti School of Telecom Technology and Management, the Industrial Design and Development Centre, the Centre for Energy Studies, the Centre for Biomedical Engineering, the Computer Science and Engineering Department, and the Department of Physics.

## ▶ ACADEMIC PROGRAMMES

### UNDERGRADUATE

The Department offers B.Tech. in Electrical Engineering and B.Tech. in Electrical Engineering (Power and Automation). These two programmes with different focii provide the desired breadth and inter-disciplinary exposure to the students so that they can pursue any of the diverse areas of Electrical Engineering (e.g. Computer and embedded systems, design and fabrication of VLSI, intelligent robotic systems, cognitive and bio-inspired technologies, control systems, telecommunications and computer networking, wireless communication systems, signal and information processing, micro and nano-electronics, electromagnetic and electrochemical systems, power engineering, renewable energy, electrical transportation systems, green technologies etc.) either in an industry-based or research-based career.

The B. Tech. programme in Electrical Engineering (Power and Automation) concentrates on automation technologies and power engineering catering to the current needs of intelligent and effective energy management. Students of this B.Tech. Programme also have an option of specializing in specific areas by doing additional courses.

## **POSTGRADUATE**

The Department offers M.Tech., M.S. (Research) and Ph.D. programmes in Electrical Engineering.

### **M.Tech. Programme**

The department offers six specialized postgraduate programmes leading to an M.Tech. degree:

- Communication Engineering.
- Computer Technology.
- Control and Automation.
- Integrated Electronics and Circuits.
- Power Systems.
- Power Electronics, Machines and Drives.

In addition, the Department jointly conducts industry sponsored interdisciplinary M.Tech. programmes specializing in:

- Opto-electronics and Optical Communications (jointly with Physics Department).
- VLSI Design, Tools and Technology (VDTT) (jointly with the Centre for Applied Research in Electronics and the Department of Computer Science and Engineering).
- Construction Technology and Management (jointly with the Civil Engineering Department and Mechanical Engineering Department).
- Telecom Technology and Management through the Bharti School of Telecommunication Technology and Management (jointly with the Department of Management).

The full-time M.Tech. programmes are normally of four semesters duration. The department has recently introduced a six semester (three year) M.Tech. programme, with enhanced scholarship. The students enrolled in this three year programme help in the development and maintenance of existing and upcoming laboratories. This gives them an opportunity to develop hands-on experience with state-of-the-art facilities.

### **M.S. (Research) Programme**

The M.S. (Research) programme is appropriate for those wishing to pursue a career in research and development in the industry or for those pursuing a career in teaching. Unlike the students in the M.Tech. programme, the M.S. (Research) students are required to do a more exhaustive research project, and credit fewer number of courses.

## RESEARCH AREAS

The Department offers a doctoral programme with a view to push the frontiers of knowledge and to explore new and emerging areas. Teachers in engineering colleges are particularly encouraged to enroll for the Ph.D. programme. The various research activities are coordinated by different research groups within the department. These groups also represent a broad classification of the research interests of the faculty. The different research areas covered by these groups are given below.

- **Communication Engineering Group:** Performance Analysis of Communication Systems, Cooperative Communications, Cognitive Radio, Information Theory and Coding, Communication Networks, Secrecy and High speed wireless and Wireline Communications, MIMO, Image / Video coding, Multirate Signal Processing, Array Signal Processing, Source Localization and Tracking, Optical Communication and Networks, FSO, Micro and Nano Photonics, Photonics and Switching, Electromagnetics, Plasmonics and Plasma Science, Molecular Communications, 5G, Beyond 5G and 6G Communications, IoT; Cyber-physical Systems: Design, Analysis, Control, Learning and Cyber-security, Blockchain; Radar; Statistical Signal Processing; Networked Estimation; Reinforcement Learning.
- **Computer Technology Group:** Computer Vision, Multimedia Systems, Image Processing, Computer Networks, Computer Architecture, Embedded Systems, Parallel Computation, Neural Computation, Pattern Recognition, Artificial Intelligence, Music Information Retrieval, Bioinformatics, Machine Learning, Biometrics.
- **Control Engineering Group:** Robust Control, Robotics, Optimal Control, System Identification, Reinforcement Learning Control, Nonlinear Dynamical Systems and Control, Adaptive Control, Cooperative Control and Path Planning, Sensor Fusion, Guidance and Navigation, Sliding Mode Control, Interval Analysis in Control Design, Computational Methods for Simulation and Control, Modeling and model order reduction, Attitude Control and Structural Control, Numerical Modeling and Simulation, Embedded Control Systems, Applications to Biomolecular Circuits, Time-delayed Systems, Control of Cyber-physical Systems, Model-free Control.
- **Integrated Electronics and Circuits Group:** Electronic and Optoelectronic Materials, Flexible electronics, Sensors, Optoelectronic and Photonic devices, Field-Effect and Bipolar devices, MEMS devices, Memory, Spintronics, Thin Film and Solution-Processed Devices, Energy Harvesting and Scavenging devices, Analog, Analog and Mixed Signal Circuit, RF Circuits, Power Management Integrated Circuits, Data Converters, Low Power and Low Voltage Circuits, Compact Device Modeling, Machine Learning, MEMS and Microfabrication, CMOS Image Sensors, Emerging Non-Volatile Memories.
- **Power Engineering Group:** Electrical Machines, Energy Conversion, Power Electronics, Power Quality, Drives, Power and Energy Systems, Protection, Stability, Optimization, Energy Conservation, HVDC and FACTS, Applications of Microprocessors and Computers in Power and Drives, Renewable Energy Systems (Small Hydro, PV, Wind), and Energy Audit and Efficiency, Solar Inverters and Power Supplies.

## LABORATORY FACILITIES

The Department maintains a library, a departmental workshop and an ergonomically designed committee room equipped with video conferencing facility. The department has well equipped laboratories with extensive hardware and software facilities for teaching and research in the areas of basic:

- Electrical Engineering
- Measurement
- Communications
- Microwaves
- Integrated Optics
- Signal and Information Processing
- Optical Communications and Optical Signal Processing
- Computer Technology, Computation
- Multimedia and Distributed Computing
- Robotics and Distributed Control
- Microprocessor Development Systems
- Electronic and Optoelectronic Materials, and Device Fabrication.
- Microprocessor Applications
- Control and System Engineering
- Process Control
- Electronic Circuits and Networks
- Electrical Machines and Drives
- Power Systems
- Power Electronics
- VLSI Design
- Electrical Energy Audit and Energy Conservation
- Electrical Machines
- Energy Instrumentation
- IoT, CPS and Networks Lab.

Most electronic experiments within a frequency limit of 40GHz, can easily be conducted in the laboratory facilities of the department.







**DEPARTMENT OF  
HUMANITIES  
AND  
SOCIAL  
SCIENCES**





**Purnima Singh, Ph.D. (Allahabad Univ.)**  
*Professor*  
 Social and Applied Social Psychology,  
 Justice, Identity, Inter Group Relations,  
 Cognition and culture.

## HEAD OF THE DEPARTMENT



**Ankush Agrawal, Ph.D. (IGDR, Mumbai)**  
*Assistant Professor*  
 Development Economics, Applied  
 Econometrics.

**Sisir Debnath, Ph.D. (University of Virginia)**  
*Assistant Professor*  
 Development Economics,  
 Applied Microeconomics,  
 Health Economics.



**Vibha Arora, Ph.D. (Oxford Univ.)**  
*Associate Professor*  
 Political Sociology, Environmental Sociology, Sociology of  
 Development, Globalization and Transnationalism, Visual  
 Anthropology, Medical Anthropology, Gender and Development,  
 Social Research Methods, Sociological Theory, Sociology of South  
 Asia, the Himalayan Region and their Diaspora.

**Divya Dwivedi, Ph.D. (IIT Delhi)**  
*Associate Professor*  
 Philosophy of Literature, Aesthetics,  
 Narrative Theory, Literary Theory,  
 Gandhi Studies, Political Cartooning.



**Mahuya Bandyopadhyay, Ph.D. (University  
 of Delhi)**  
*Associate Professor*  
 Sociology of Organisations and Work, Prison Studies,  
 Ethnography of the State, Gender and Masculinities,  
 Urban Neighbourhoods, Violence and the Carceral  
 Complex, Ethnographic Methods.

**Arjun Ghosh, Ph.D. (Jawaharlal Nehru Univ.)**  
*Associate Professor*  
 Performance Studies, Authorship, Intellectual  
 Property, Digital Humanities.



**Arudra Burra, Ph.D. (Princeton University, USA)**  
*Assistant Professor*  
 Moral, Political, and Legal Philosophy.

**Samar Husain, Ph.D. (IIIT Hyderabad)**  
*Assistant Professor*  
 Human Sentence Processing, Natural  
 Language Parsing, Natural Language  
 Modeling, Dependency Grammars,  
 Cognitive Science.



**Pritha Chandra, Ph.D. (Univ. of Maryland)**  
*Professor*  
 Linguistics, Theoretical Syntax, Language  
 Acquisition (1/2nd), Politics of Language.

**Farhana Ibrahim, Ph.D. (Cornell Univ.)**  
*Associate Professor*  
 Sociology of India, Nationalism and  
 the Nation, State, Sociology of Religion,  
 Historical Anthropology, Medical Anthropology,  
 Migration, Kinship, Qualitative Research Methods.





**Yashpal Jogdand**, Ph.D. (University of St. Andrews)  
*Assistant Professor*  
 Social Identity, Intergroup Relations, Humiliation, Prejudice and Stereotyping.



**Ravinder Kaur**, Ph.D. (Delhi Univ.)  
*Professor*  
 Social Change, Sociology of Development, Gender, Kinship, Family and Marriage, Anthropological Demography, Sociology of India.



**Stuti Khanna**, D. Phil. (Oxford Univ.)  
*Associate Professor*  
 Modernism, Postcolonialism Twentieth-Century Literature, Indian Writing in English, Cities and Gender.



**Reetika Khara**, Ph.D. (Delhi School of Economics)  
*Associate Professor*  
 Economic Development, Education, Health and Nutrition, Indian Economy.



**Richa Kumar**, Ph.D. (Massachusetts Institute of Technology)  
*Associate Professor*  
 Sociology of Agriculture, Sociology of Food and Nutrition, Science and Technology Studies (STS), Rural and Agrarian Policy.



**Debasis Mondal**, Ph.D. (ISI, Kolkata)  
*Associate Professor*  
 International Trade, Economic Growth, Public Economics.



**Saptarshi Mukherjee**, Ph.D. (ISI, Delhi)  
*Associate Professor*  
 Mechanism Design, Social Choice and Game Theory.



**Sumitava Mukherjee**, Ph.D. (IIT Gandhinagar)  
*Assistant Professor*  
 Cognitive Science, Judgement and Decision Making.



**Angelie Multani**, Ph.D. (Jawaharlal Nehru Univ.)  
*Professor*  
 Indian Theatre in English, Culture Studies, Gender/ Studies, Contemporary Fiction.



**Rukmini Bhaya Nair**, Ph.D. (Cambridge Univ.)  
*Professor*  
 Linguistics, Philosophy of Language, Cognitive Science and Cultural Studies, Critical Theory, Postcolonialism, Gender, Creative Writing, Narratology.



**Sourabh B. Paul**, Ph.D. (Uni. of British Columbia)  
*Assistant Professor*  
 Labour Economics, Empirical Development, Trade Policy, R&D and Firm Productivity, Technology Spillover and Labour Market Effects, Health and Nutrition, Household Behaviour Analysis, Crime and Inequality, Applied Microeconomic Theory.



**Bharati Puri**, Ph.D. (Jawaharlal Nehru Univ.)  
*Associate Professor*  
 Philosophy of Culture and History, Moral and Political Philosophy, Contemporary Thought and Intellectual History, Deep Ecology, Buddhism/and Politics, Exile and Travel, Religion/ and Politics, Religion in East Asia, Peace Studies, Tibet/ Tibetan Literature and Politics, Ethnicities and Margins, Culture Religion and Politics in Ladakh, Children and Literature.



**Sarbeswar Sahoo**, Ph.D. (National Univ. Singapore)  
*Associate Professor*  
 Postcolonial State, Civil Society and Democratization, Adivasis of India and the Politics of Development, Hindu Nationalism, Neo-liberal Globalization and Social Inequality, Sociology of Religion and (Anti-Christian) Violence.



**Paroma Sanyal**, Ph.D. (English and Foreign Languages University, Hyderabad)  
*Assistant Professor*  
 Phonology and Syntax, Theoretical Frameworks: Optimality Theory, Lexical Phonology, Distributive Morphology, Minimalism, Minor Research Area Language Teaching: English Language Teaching, Task-based Language Teaching.



**Simona Sawhney**, Ph.D. (University of California)  
*Associate Professor*  
 South Asian Language and Literature, Postcolonial Literature and Theory, Sanskrit Literature, Literary Theory.



**Kamlesh Singh**, Ph.D. (Univ. of Rajasthan)  
*Associate Professor*  
 Positive Psychology, Applied Positive Psychology, Environmental Psychology, Psychometrics, Community Psychology, Rural Women and Adolescents.



**Varsha Singh**, Ph.D. (IIT Bombay)  
*Associate Professor*  
 Behavioural Decision Making and Choice Behaviour, Dual Process Theories of Decision Making, Heterogeneity and Constraints in Decision Making.



**Naveen Thayyil**, Ph.D. (Tilburg University)  
*Assistant Professor*  
 Law, Techno-science and Democratisation, Regulatory Issues in New and radical Technologies, Democratisation of Regulation of Technology, Risk Regulation, Use of ethics in Technology Regulation, Development of Technologies and Public Contestations, Public Participation in Regulation.



**Jayan Jose Thomas**, Ph.D. (IGDR, Mumbai)  
*Associate Professor*  
 Labour, Capital and Technology in Indian Industrialization.



**C.A. Tomy**, Ph.D. (Univ. of Hyderabad)  
*Professor*  
 Philosophy of Mind and Cognition, Philosophy of Science, Scepticism, Metaphysics and Self.



**Milind Wakankar**, Ph.D. (Columbia University)  
*Associate Professor*  
 Indian Mystical Traditions and the Modern Critique of Caste.



**Ashwini Vaidya**, Ph.D. (Univ. of Colorado, Boulder)  
*Assistant Professor*  
 Computational Linguistic.



**Sanil V.**, Ph.D. (IIT, Kanpur)  
*Professor*  
 Philosophical investigations into Art, Science, Technology, Literature and Social Sciences, Reason and Revolt, Violence, Hate and Revenge, Contemporary Indian thought, Intellectual traditions of Kerala, Philosophy of Biology.



## ▶ INTRODUCTION

The Department of Humanities & Social Sciences is an integral part of the Indian Institute of Technology Delhi. The Department houses most of the major disciplines of Social Sciences and Humanities with disciplinary and multi-disciplinary Ph.D. programmes, as well as a diverse range of Undergraduate elective courses at different levels. In addition to these, the Department also runs a Language Learning Centre for strengthening English Language skills. We also run short-term courses in French, German, Spanish and Japanese for students who wish to learn a foreign language.

## ▶ ACADEMIC PROGRAMMES

### UNDERGRADUATE

IITs are mandated to pursue teaching and research in science, technology and arts. IIT Delhi regards knowledge of Humanities and Social Sciences as a core value. All UG students must complete a minimum of 15 credits in HUSS courses. The courses offered for UG students are drawn from all the disciplines of the Department: Economics, Linguistics, Literature, Philosophy, Psychology, Policy Studies, and Sociology and some are also inter or multi-disciplinary. Courses are divided between 200 level and 300 level, and some advanced UG students may also choose to opt for 700 or 800 level courses, apart from doing an independent research paper in any of the HUSS disciplines.

**Minor Area Programme:** B.Tech. Minor Area Programme in Economics was initiated in 2017, which is very popular among the UG students.

### POSTGRADUATE

#### Ph.D.

The Department has a robust Ph.D. programme which is both disciplinary as well as inter-disciplinary, We have both a full-time as well as part-time Ph.D. programme to enable those who may be working to continue their academics. HUSS is one of the few departments that offer a genuine interdisciplinary approach to academics that is both based on a strong disciplinary foundation and yet open to non-traditional ideas and approaches. We promote and support multidisciplinary work of the kind that is possible only when creative researchers from various disciplines are in close locational and intellectual proximity through pre-Ph.D. courses that provide a specialized disciplinary perspective as well as collaboratively taught courses which have a broader inter-disciplinary orientation, We also have Post-Doctoral positions where young doctorates are encouraged to continue their research in a supportive and intellectually exciting atmosphere.

#### M.Sc.

The Department is starting two full-time M.Sc. programmes in Cognitive Science and Economics starting the 2020-21 academic year.



**M.Sc. in Cognitive Science:** The programme will familiarize students with diverse theories, methods, and tools to understand the architecture and functioning of the human mind. It also envisages developing new state-of-the-art labs involved in finding better solutions to cognitive challenges and questions faced in the Indian scenario. It integrates teaching and learning through a multidisciplinary and diverse pedagogical curriculum. The MSc programme trains students to pursue academic careers and to work at the crossroads of academic-industry linkages for advancing and leading intellectual creation in the cognitive science space. The graduates from this programme could work in diverse sectors from basic research, brain sciences, management, engineering/design (robotics, smart software, and technology, human-machine interaction), social organizations; or decide to pursue higher education in cognitive science or any of its allied disciplines.

**M.Sc. in Economics:** The programme draws on the strengths of mathematics, computer science, and other science and engineering disciplines. It is designed for students with bachelors degree in any discipline with substantial knowledge in mathematics. The programme has a strong research component and consist of two-semester long project that would prepare students for research. It aims to impart advanced training in economics with a focus on quantitative skills. The curriculum is designed so as to give exposure to broader issues related to developmental challenges in India and beyond. Students choose fields of specialisation in core economics and emerging areas at the intersection of economics with other social sciences as well as computer science and mathematics.

## RESEARCH AREAS

**Doctoral research is being carried out in:** Organisational Behavior, Human Resource Management, Social Psychology, Positive Psychology, Environmental Psychology, Cognitive Psychology; Sociology of Culture and Knowledge, Sociology of Development, Sociology of Religion, Gender Studies, Visual Sociology, Environmental Sociology, Ethnicity and Nationalism, Agrarian Studies; Economic Theory, Development Economics, International Economics, Quantitative Economics, Transport Economics, Environmental Economics, Industrial Economics, Indian Economy, Game Theory, Decision Theory, Mechanism Design; British Literatures, Theory of Criticism, Indian and Postcolonial Literatures, Performance Studies, Indian Political Thought, English Language, Linguistics, Philosophy of Language, Cognitive Studies. English Language, Linguistics, Philosophy of Language, Cognitive Studies; Epistemology, Metaphysics, Ethics, Aesthetics, Continental Philosophy, Phenomenology, Hermeneutics, Deconstruction, Law, Techno-Science and Democratization, Philosophy of Science, Technology and Social Sciences. History of Science, Sociology of Science, Technology and Society. Interface of Science and Technology with Humanities; Vulnerability and Adaption to Climate Change, Disaster Management Policy, Mitigation to Climate Change, Energy Policy, Social Identity, Intergroup Relations, Intergroup Contact and Social Change, Leadership and Collective Mobilisation.

## ▶ LABORATORY FACILITIES

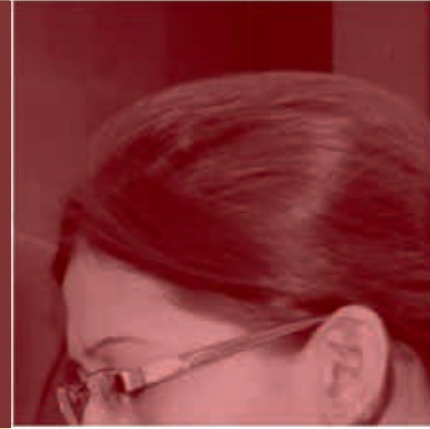
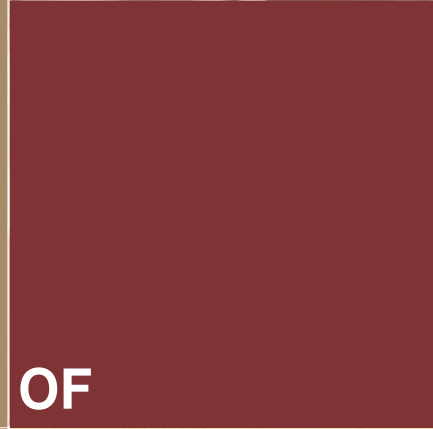
**Cognitive and Behavioural Science (CBS) Laboratory:** The CBS lab caters to the research needs of the Ph.D. scholars and faculty members. The lab is equipped with basic and state-of-the-art equipments in Cognitive Psychology and Psycholinguistics. This includes an SR research 1000 Plus eye-tracker. The lab has several PCs for conducting behavioural experiments. It also has a high performance computing server to handle computationally intensive research tasks.

**Economics Laboratory:** The Department has an Economics Laboratory, located in MS 627B. The laboratory provides access to computing facilities for research and training in economics and is very popular among our Ph.D. students for research and collaborative work. The computers in the labs are equipped with popular open source and proprietary packages like R, STATA, Matlab, and Python. The Department has subscriptions to database such as ASI, EPWRF, NSSO, and PRIME.

Another computing laboratory, jointly for the M.Sc. students of Cognitive Science and Economics programmes, is coming up shortly.

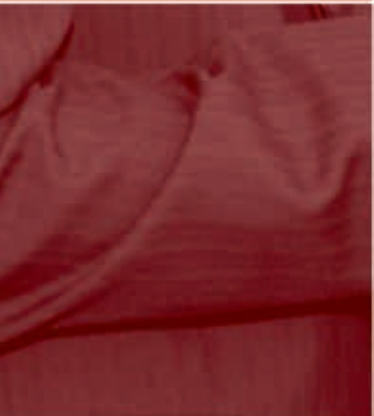
The Department has a Language Learning Centre offering support to all first year students to enhance their language and communication skills. Besides, we have several other tools useful for research including cloud computing, Grammarly, and access to a centralised supercomputing facility. The central library of the Institute subscribes to several journals from different publishers including Elsevier and collections such as JSTOR and is also a part of DELNET.





**DEPARTMENT OF**

**MANAGEMENT  
STUDIES**







**Seema Sharma, Ph.D. (IIT Delhi)**  
*Professor*  
 Economics & Finance.

## HEAD OF THE DEPARTMENT



**Kanika T. Bhal, Ph.D. (IIT Kanpur)**  
*Professor*  
 OB,HR, Business Ethics & Corporate Governance, Leadership and Culture.

**Gourav Dwivedi, Ph.D. (Fellow, IIM Lucknow)**  
*Assistant Professor*  
 Operations Management, Game Theory, Operation Strategy, Project Management.



**Harish Chaudhary, Ph.D. (IIT Delhi)**  
*Associate Professor*  
 Marketing, HR and OB.

**Agam Gupta, Ph.D. (FPM, IIM-C)**  
*Assistant Professor*  
 Sharing Economy, Platform Ecosystems, Organizational Ecology, Computational Social Science, and Networks.



**Neeru Chaudhry, Ph.D. (Monash Univ., Australia)**  
*Assistant Professor*  
 Finance and Accounting.

**M.P. Gupta, Ph.D. (IIT Delhi)**  
*Dhananjaya Chair Professor*  
 Information System Policy & Strategy.



**Sanjay Dhir, Fellow, Ph.D. (IIM, Lucknow)**  
*Assistant Professor*  
 Strategic Thinking, Strategic Innovations, Ambidexterity, Corporate Strategy, Alliances and Joint Ventures.

**P. Vigneswara Ilavarasan, Ph.D. (IIT/K)**  
*Professor*  
 Information and Communication Technologies & Development (ICTD, ICTs & Government, Social Media & Business Practices).



**Amlendu Kumar Dubey, Ph.D. (IGIDR, Mumbai)**  
*Associate Professor*  
 Macro Economics, Development & Environmental Economics, Applied Econometrics.

**Eri Ikeda, Ph.D. (Erasmus Univ., Rotterdam, Netherland)**  
*Assistant Professor*  
 Economics.







**Sonali Jain, Ph.D. (Fellow, IIM-A)**  
Assistant Professor  
Finance.



**Arpan Kumar Kar, Fellow, Ph.D. (XLRI)**  
Associate Professor  
Digital Economy, Digital Business,  
Data Science, ML/AI Application.



**Smita Kashiramka, Ph.D. (BITS, Pilani)**  
Associate Professor  
Finance & Banking, Merger and Acquisition.



**Jitendra Madaan, Ph.D. (IIT Delhi)**  
Associate Professor  
Supply Chain Management, Reverse Logistics,  
Sustainable Operations, Disaster Management.



**Biswajita Parida, Ph.D. (FPM, IIM-A)**  
Assistant Professor  
Consumer Behaviour, Advertising, Branding.



**Prasanna Ramamoorthy, Ph.D. (Fellow, IIM-A)**  
Assistant Professor  
Production and Quantitative Methods, Operations.

**Mahim Sagar, Ph.D. (IIITM, Gwalior)**  
Professor  
Marketing, Public Policy Marketing, Product  
Management, Telecom Policy Research, Community  
Drive Marketing/Branding of Public & Private Goods/  
Service.



**Ravi Shankar, Ph.D. (IIT Delhi)**  
Amar S. Gupta Chair Professor of Decision Science  
Operations & Supply Chain Management,  
Decision Science, Technology Management,  
Business Analytics.



**Manish K. Singh, Ph.D. (Univ. of Barcelona)**  
Assistant Professor  
Risk Management, International Finance,  
Financial Economics, Securities Markets.



**Surya Prakash Singh, Ph.D. (IIT, Kanpur)**  
PDF, NUS Singapore-MIT USA Alliance  
Professor  
Operations Management, Manufacturing Systems,  
Optimization Techniques, Operation Research,  
Strategy.



**Shveta Singh, Ph.D. (Univ. of Allahabad)**  
Associate Professor  
Financial Management, Security Analysis &  
Portfolio Management, Corporate Governance  
& CSR.



**Shuchi Sinha, Ph.D. (Univ. of London)**  
Assistant Professor  
Leadership, Managing Change Workplace  
spirituality, Workplace Deviance, HR & OB .





**Sushil, Ph.D. (IIT Delhi)**  
*Abdulaziz Alsagar Chair Professor*  
 Strategic Management, Strategic Alliances and M & A,  
 Flexible Systems Management, Strategic Change &  
 Flexibility, Technology Management, Creative Problem  
 Solving, Waste Management.

**Harshwardhan Mishra, Ph.D. (Temple Univ. Philadelphia, USA)**  
*Full-time Visiting Professor*  
 Entrepreneurship, Strategic Innovation,  
 Knowledge Transfer, Global Business.



**Surendra S. Yadav, Ph.D. (Univ. of Paris, Sorbonne, Paris)**  
*Professor*  
 Corporate Finance, International Finance,  
 International Business, Security Analysis &  
 Portfolio Management, General Management.

**Sudhir K. Jain, Ph.D. (IIT Kanpur)**  
*Ex. Professor, DMS, IIT Delhi & Former Vice Chancellor, Shri Mata Vaishno Devi University, Katra (J&K)*  
*Adjunct Faculty*  
 Managerial Economics, Entrepreneurship and IPRs.



**P.K. Jain, Ph.D. (Delhi Univ.)**  
*Emeritus Professor*  
 Finance & Accountancy.

## GUEST FACULTY

**Prof. Prem Vrat, Ex-Professor, IIT Delhi & Ex-Director, IIT Roorkee**

**Prof. D.K. Banwet, Ex. Professor, DMS, IIT Delhi**

**Prof. Anuradha Balram, Chief Cord, Awakened Citizen Programme NGO of R.K. Mission**

**Prof. Parul Gupta, MDI Gurugram**

**Prof. Michael Hopkins, Chair and Partner of MHC International Ltd. (MHC), U.K.**

**Prof. Sabri Boubaker, Champagne School of Management, (Group ESC Troyes) Finance & Accounting Department Troyes, France**

**Prof. Nakul Gupta, MDI Gurugram**

**Prof. Thomas Joseph, IIM Udaipur**

**Prof. Prabhat Kumar, Advocate and Consultant (Corporate Affairs)**

**Prof. Marcos Severo, Federal University of Goias, Brazil**

**Prof. Sandeep Goyal, CEO Shared Value (Institute of Competitiveness)**

**Prof. A.K. Nigam, Director HR & CSR- Whiteswan Consulting Group (WCG India)**

**Prof. Manmohan Chaturvedi, CISO Academy, Gurugram**

**Prof. Priyanka Vallabh, MDI Gurugram**

**Prof. Alka Gupta, New Multan Nagar, New Delhi**

**Prof. Manpreet kaur, Bharti Vidyapeeth Institute of Management, Paschim Vihar**

**Prof. Himanshu Manglik, President – WALNUTCAP Consulting LLP, Delhi**

**Prof. Peter Trkman, University of Ljubljana, Faculty of Economics Kardeljeva ploscad 17, 1000 Ljubljana**

**Prof. Adrian, Associate Professor in Cultural Studies at the University of Queensland, Australia**

**Mr. Tarun Gupta - CTO, Chief Architecture, Technology Partner and Advisor**

**Dr. S. N Gosh, ACISI (UK), Chartered Institute for Security & Investment, U.K.**

**Prof. S.K Jain, Ph.D. (Economics- Management), IIT Kanpur**

**Dr. Nikhil Kumar Varma, Advisor QBRICS INC**

**Prof. G.V.R Shastry, SEP Stanford, SELP Harvard, Ph.D. (IIT Delhi)**

**Ms. Sapna Popli, Professor of Marketing - IMT Ghaziabad**

**Prof. Anshul Jain, Assistant Professor, Finance MDI Gurugram.**

## ▶ INTRODUCTION

The Department currently runs three variants of MBA program: a two-year full-time MBA programme, a two-year full-time MBA programme with focus electives on 'Telecommunication Systems Management' and a three-year Executive MBA programme with focus electives on 'Technology Management'. Department offers functional electives in Finance, Marketing, Information Systems, Strategy, operations Management, Human Resource etc. The students in two-year full time MBA programme are admitted through a rigorous screening process of CAT (Common Admissions Test)\*, Written Aptitude Test (WAT) and Personal interview.

Department of Management Studies (DMS) has heavy research orientation as its forte, which is further used extensively for designing courses to respond to the current industry issues. The course content is very contemporary and has involved various stakeholders including industry experts, CEOs and our alumni. DMS faculty who have served on various UN related bodies and international professional associations are widely acclaimed internationally for their contributions in knowledge generation and research publications. Stanford has ranked DMS 2nd for its research output among IIMs and IITs. The faculty members work after nationally and internationally for consulting activities and research projects and have been widely acclaimed for their contributions. Till date in more than three decades of existence, over 150 PhDs have been groomed by Department. The faculty has contributed at the highest policy level committees of Government of India (GoI), served on various boards of corporate entities, as Chairman 'All India Board of Management Education' of AICTE and contributed to the establishment of 5th Indian Institute of Management (IIM) at Kozhikode, and 7th Indian Institute of Management at Shillong. The Department faculty has published over 80 books and over 1200 papers in various 'A' category journals and conference volumes. DMS has a world class IT infrastructure with a very high faculty to student ratio. DMS has a rich software repository that facilitates computer aided instructions and enables hands on experience on leading business enterprises. The Global Field Study is an unique initiative which provides the students of DMS an international exposure through their visits to various other countries like Germany, Singapore, China (Beijing & Shanghai), Malaysia, Brussels, Netherland, Belgium, France, Australia and Japan.

## ▶ ACADEMIC PROGRAMMES

### UNDERGRADUATE

The Department offers several courses to undergraduate students as electives, and also offers a Minor Area in Business Management and Entrepreneurship.

### PEDAGOGY

The Department places heavy emphasis on experiential and process - oriented learning. The pedagogical tools include extensive use of Harvard case studies (HBS), simulation exercises, industry - oriented project work, eight weeks of summer projects, 3 weeks of Social Sector attachment and the like, to facilitate the same. The process

– oriented learning is further enhanced by Global Field Study (GFS) which students undertake for their projects. Besides honing up the skills of individual decision-making, enough emphasis is laid on developing team skills and value focused decision making. Extensive research and consultancy that have gained wide peer level recognition back the teaching.

### **Masters of Business Administration**

With the unique features of systems orientation and a blend of creativity and analytical problem-solving skills, MBA Full Time is aimed to develop holistic managers who internalize a synthesis of conventional and modern management – thinking and who can comfortably adapt to changing business requirements. The program provides the students with various routes to the industry, matching its requirements with their skills and predispositions. Every student gets the opportunity to take courses in major-streams: Information Systems, Finance, Marketing, Strategic Management and Operations Management. Along with the functional electives, the students also get a cross functional perspective.

The MBA Full Time Program with focus in Telecommunication Systems Management is a hallmark of techno-managerial excellence imparted to the scholars at DMS. This programme is comprehensive in nature, involving all the business functions – Information Systems, Finance, Marketing, Strategic Management, Human Resources Management, with an emphasis on Telecommunications Systems Management, which provides a strong foundation in Telecom Technology, Business and Regulation. This programme draws Telecom technology inputs from Bharti School of Telecom Technology and Management of IIT Delhi. The inclusive nature of the program fosters creation of effective managers across different domains, equipping them with holistic skills and a strategic advantage when it comes to leading business in the Telecom sector.

### **Masters in Business Administration** *(for Working Executives)*

For the Indian industry to gain global competitiveness, effective management of technology is crucial. This would mean using technology as a strategic variable to gain competitive advantage and would require an organization to critically understand processes of technology planning and strategy, management of technology transfer and absorption, management of innovation and R&D and more. The Executive MBA programme with focus electives on ‘Technology Management’ is aimed at fulfilling these requirements so as to enable the managers to effectively contribute in evolving core competencies in Indian industry. This programme is designed to impart management education to working executives.

## **RESEARCH AREAS**

The Department of Management Studies has a full-fledged Ph.D. programme in Management. With its liberal multidisciplinary approach, the department provides excellent ambience for research amidst the world class infrastructure at IIT Delhi. In a Stanford study 2015, on Indian Universities doing research in social science, the Department of Management Studies, IIT Delhi has been ranked second in the Business and Management

category. Surpassed only by IIM Bangalore, DMS is ahead of all other IIMs, IITs and ISB. In the QS Rank 2019 and NIRF Research ranking 2019, DMS, IIT D is ranked among top 3 Management Research Institute in India.

**The research areas are broadly classified into the following areas:**

- Economics
- Finance and Accounting
- Operations and Supply Chain Magement
- Information Technology and Systems
- Strategy and Technology Management
- Marketing
- HR-OB

The full-time doctoral students will receive a financial aid as below. The students are required to do academic duty for 8 hours per week (excluding their research work) as a Teaching Assistant (TA). TAs will be assisting the faculties in developing the course content, taking tutorial and grading. Fellowship is extended for the fifth year, only on the basis and review of the work. Students will be provided financial support for attending national and international conferences as per the institute norms.

Period of Assistantship (With B.E./B.Tech./M.Sc./M.Tech. or Equivalent Qualification)	Assistantship Amount
First 2 year of registration	₹ 31,000/- Month
Next 2 year of registration	₹ 35,000/- Month

## LABORATORY FACILITIES

The Department of Management Studies has five fully air conditioned Wi-Fi enabled lecture theatres equipped with LCD projectors to ensure the best possible environment for learning. The auditorium has a seating capacity of over 120 and hosts numerous guest lectures, seminars and other programs. There is also an exclusive library in addition to the central library of the institute. The following laboratories facilitate learning and research:

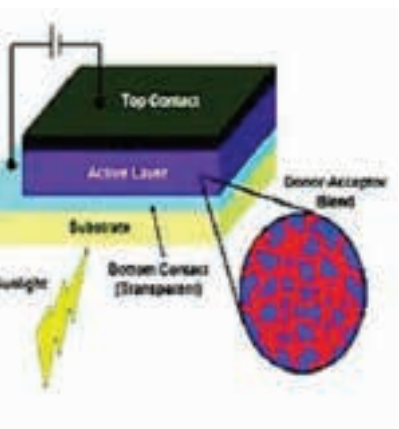
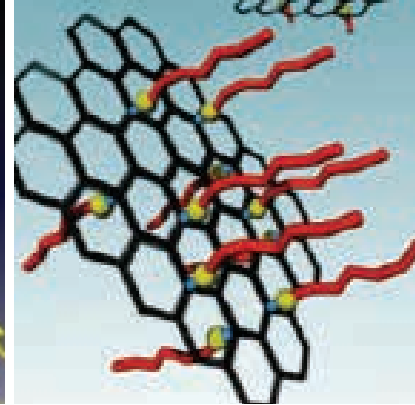
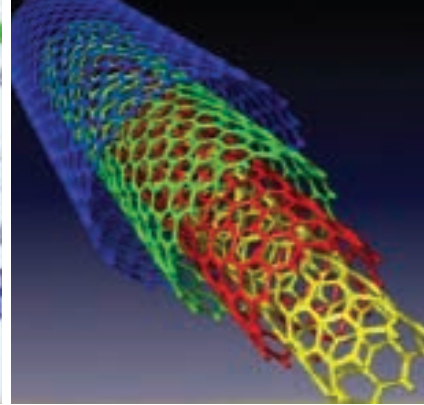
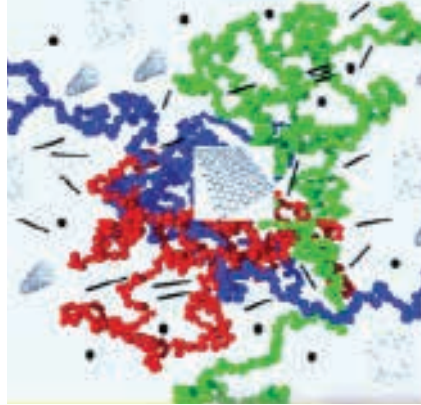
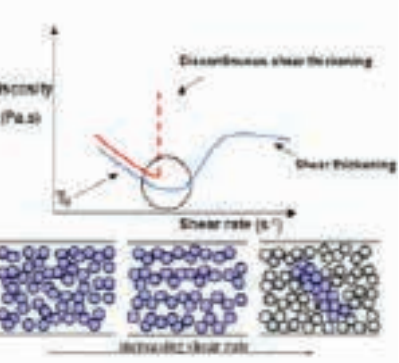
- Research Lab
- Operations Lab
- Behavioral Lab



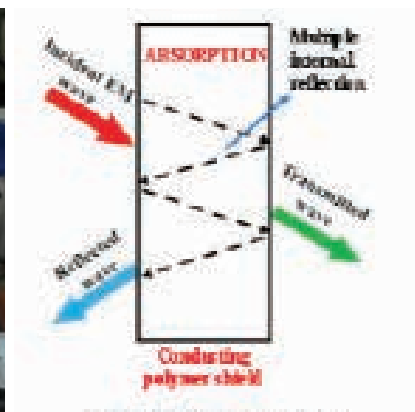
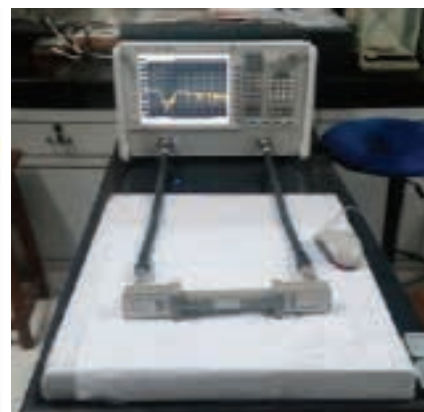
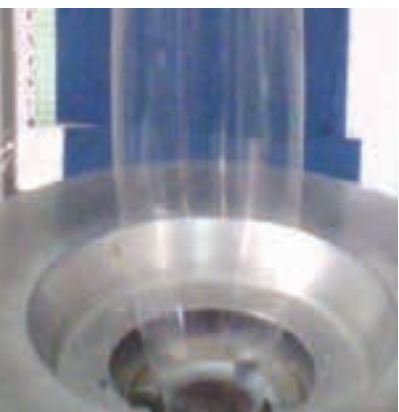
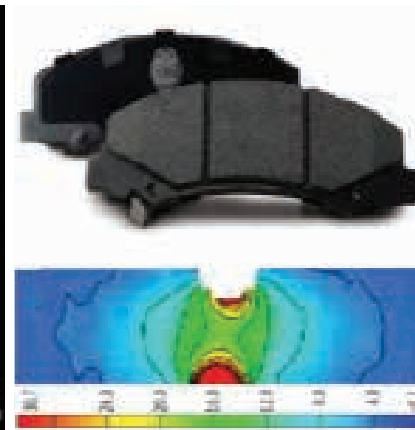
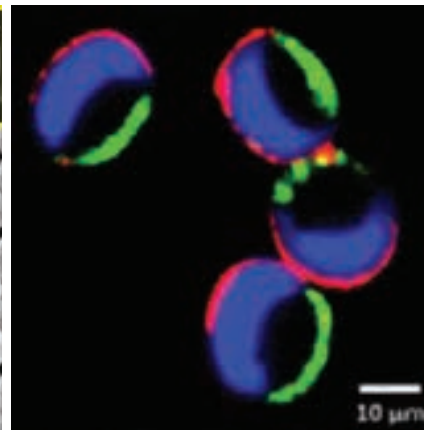
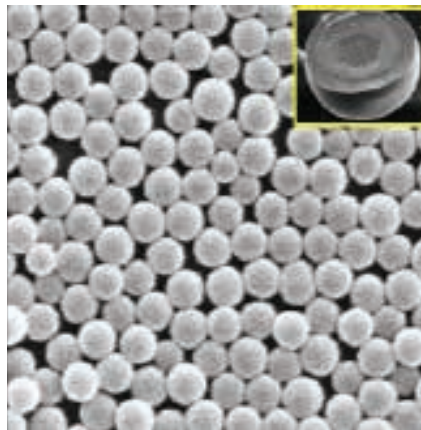
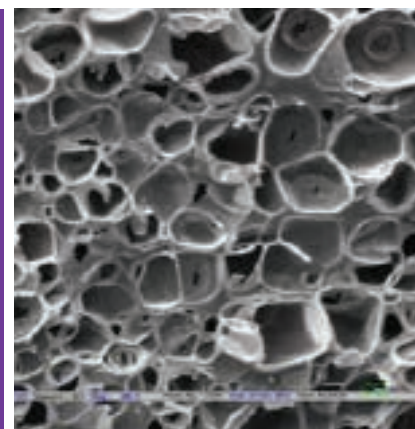
- Strategy and Competitiveness Lab
- Centre of Excellence in Entrepreneurship
- Centre of Excellence “National Centre of Business Ethics, Corporate Governance and Corporate Social Responsibility”
- Information System and Data Science Lab

A large collection of software packages such as SPSS, Ace Equity, AMOS, Vensim, I-Think, LISRD, VIVO, STATA, Hummingbird Knowledge Management Suite, Prowess, LINGO, and ARENA etc. are available in the laboratories. Further, the Behavioral Laboratory has in-house camera, TV and specialized software to help the students hone their behavioral skills.





# DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING





**A.K. Ghosh, Ph.D. (Sury Buffalo)**

**Professor**

Rheology and Processing, Polymer Reaction Engineering, Polymer Blends and Alloys, Mixing and Compounding, Computer Aided Modelling, Polymeric Nano-composites, Polymer Film Processing, Cellular and Biopolymers.

## HEAD OF THE DEPARTMENT



**Tapajyoti Dasgupta, Ph.D. (Ecole polytechnique France)**

**Assistant Professor**

Large Area Scalable Nanofabrication of Wearable Electronic and Photonic Devices.

**Jayant Jain, Ph.D. (British Columbia)**

**Associate Professor**

Mechanical Behaviour of Materials, Alloy Design, Microstructure-property Relationship, Microstructure Manipulation, Characterization of Materials, Phase Transformations, Texture and Anisotropy of Materials, Thermo-Mechanical Processing, Crystal Plasticity Simulations. Fatigue in Materials, Nanoscale Creep and Fatigue, Nanoindentation, Nanomechanics, Fracture and Failure Analysis.



**Ankur Goswami, Ph.D. (IISc, Bangalore)**

**Assistant Professor**

Fabrication of MEMS device for Detection, Sensing and Energy Harvesting Application. Structure Property Correlation in Oxide, 2D semiconductors. Understanding Electronic, Magnetic and Piezo Properties of Materials Using Various Scanning Probe Technique.

**Josemon Jacob, Ph.D. (Iowa State Univ.)**

**Professor**

Polymer Synthesis, Semiconducting Polymers, Polymer Based LEDs and Photovoltaics, Block Copolymers Biodegradable Polymers, Polymerization Catalysis.



**Nitya Nand Goswami, Ph.D. (NUS, Singapore)**

**Assistant Professor**

Fundamental Mechanisms of Friction and Wear of Materials, Nanotribology of Engineering Materials and Industrial Lubricant Additives, Nanoscale in Situ Methods in Tribology, Surface Science & Engineering, Failure Analysis of Materials, Nanoscale Aspects of Corrosion of Materials, Development of Novel Scanning Probe Microscopy Techniques, Nanoscience and Nanotechnology.

**Divya Nayar, Ph.D. (IIT Delhi)**

**Assistant Professor**

Computational Materials Chemistry, Molecular Simulations of Soft Matter (Polymers, Biomolecules), Macromolecular Solvation Thermodynamics, Self-Assembly in Nanomaterials.



**N.M. Anoop Krishnan, Ph.D. (IISc, Bangalore)**

**Assistant Professor (Joint Faculty)**

Molecular Modeling and Simulation, Multiscale Simulations, Design of Novel Silicate Glasses Including Bioactive and Nuclear Waste Glasses, Radiation Damage in Materials, Atomistic Modeling of Mechanics of Metals and Polymers, Peridynamics Based Modeling of Fracture and Impact.

**Suresh Neelakantan, Ph.D. (TU Delft)**

**Assistant Professor**

Mechanical Behaviour of Advanced Materials in Bulk and Porous forms, Materials Characterization. Current Interest in  $\beta$  Titanium Alloys, TRIP Steels & Ti-, Ni- and Fe- Based: Shape Memory Alloys, Stochastic Fibre Networks and Auxetic (i.e. Negative Poisson's Ratio) Materials/Composites. Main Focus on in-situ Transformation Effect on Deformation Behaviour and Structure-property Correlations in Metallic Materials.







**Leena Nebhani, Ph.D.** (Karlsruhe Institute of Technology)

**Assistant Professor**

New Synthetic Routes for Polymer and Surface Functionalization Based on RAFT Polymerization and Click Chemistry, Antimicrobial Hydrogels and Cryogels for Water Disinfection, Synthesis and Polymer Functionalization of Organically Modified Silica.



**Rajesh Prasad, Ph.D.** (Cambridge)

**Professor**

Physical Metallurgy, Heat Treatment, Phase Transformation, Metal Foams, Granular Materials.



**Nirat Ray, Ph.D.** (MIT)

**Assistant Professor**

Synthesis and Characterization of Nanomaterial Based Designer Solids and Nanocomposites, Electron Beam Lithography, Electronic Charge Transport and Optical Properties, Semiconductor Nanostructures, Organic and Molecular Organic Semiconductors and Device Applications, Materials for Non-volatile Memory, Magnetic Nanowires and Magnetic Tunnel Junctions for Spintronics, Multiferroics, Computational Material Science.



**Sampa Saha, Ph.D.** (Michigan State Univ.)

**Assistant Professor**

Biodegradable Polymeric Materials, Polymer Brushes, Electro Hydrodynamic Co-jetting, Micro and Nano Structured Materials, Multi-layered and Multi-compartmental Polymeric Particles.



**Saneeta Santra, Ph.D.** (IISc., Bangalore)

**Assistant Professor**

Solid State Diffusion, Thermodynamic-kinetics Microstructure, Superconducting Materials, Interfacial Reactions of Multimaterial Systems and Advanced Functional Materials.

**Bhabani K. Satapathy, Ph.D.** (IIT Delhi)

**Professor**

Morphology and Phase Behaviour of Block Copolymers, Polymer Blends and Composites, Micromechanics, Fracture and Fatigue of Polymer Nano-composites, Tribology of Polymer Based Materials, Biotribology, Thermo-Mechanical Behaviour of Biomaterials.



**Lakshmi Narayan Ramasubramanian, Ph.D.**

(IISc., Bangalore)

**Assistant Professor**

Mechanical Behaviour of Metals and Alloys, Metallic Glasses Fracture, Fatigue, Indentation and Structural Integrity of Materials, Additive Manufacture Materials.



**Bijay P. Tripathi, Ph.D.** (CSMCRI, Bhavnagar)

**Assistant Professor**

Functional Materials and Membranes with Tailored Properties, Next Generation Membranes for Water, Energy, and Separation, Clean Water Generation (Micro, Ultra, and Nanofiltration), Antifouling and Antibacterial Surfaces and Membranes, Nanostructured Membranes for Molecular Separation, Membranes, Separators, and Electrodes for Energy Generation and Storage, Flow Catalysis for Synthesis and Environmental Remediation, Platform for Enzyme Immobilization and Biocatalysis.



**S.N. Maiti, Ph.D.** (Calcutta Univ.)

**Emeritus Professor**

Polymer and Rubber Technology, Compounding, Particulate Filled Composites, Thermal, Crystallization, Rheological, Morphological and Mechanical Properties, Polymer Blends, Micro and Nano-Composites, Structure-Properties, Relations in Polymer Systems.



**Rajesh Kr. Sharma, Ph.D.** (BHU)

**Visiting Faculty**

Compound Semiconductor Materials and Devices Crystal Growth and Epitaxy, Defects in Semiconductors Quantum Magneto-Transport, High Resolution X-Ray Diffraction, Secondary ion Mass Spectrometry.



## ▶ INTRODUCTION

The Department of Materials Science and Engineering (DMSE) has been established on 1st January 2018 for developing and undertaking research on materials for specific end uses. It holds the privilege of being the only materials research and engineering department in Delhi-NCR region. The principal thrust of the department is manpower development and research for enhancing the fundamental knowledge as well as developing new materials. The department emphasizes interaction with the related industry. The changing needs of the industry are kept in view while designing and upgrading teaching and research programmes.

### **Mission**

To provide frontier education in Materials Science and Engineering at the postgraduate level to:

- Achieve excellence in education and research to meet the growing needs of the society.
- Expose the students broadly to research intensive curriculum for skill enhancement to suit the global market.
- Provide an environment conducive to innovation, creativity, implementation of new ideas and team spirit so as to foster young and fresh talents.
- Promote high standards of professional ethics.

## ▶ ACADEMIC PROGRAMMES

The new Department envisions to embark on the postgraduate (PG) programme, M.Tech in Materials Engineering in July 2019, while the four year undergraduate programme shall start in July 2020. This PG programme will be running in parallel to the already existing M.Tech. in Polymer Science and Technology programme (previously under the umbrella of Centre for Polymer Science and Engineering) of DMSE.

Faculty of the department has major role in teaching of interdisciplinary M.Tech. Programme in Polymer Science and Technology. The primary purpose of this programme is to train scientists and engineers to fulfil the constantly growing requirements of the polymer based industry in the country.

## ▶ RESEARCH AREAS

- **Metals:** Structure-property correlation in advanced materials, Metal matrix composites, 3D printing, nano-scale friction and wear, Auxetic materials, Materials characterization using advanced microscopy, phase transformations, tools, functionally graded materials, nanomaterials.
- **Polymers:** Synthesis of polymers, structure-property correlation in polymers, Rheology and processing of polymers, polymer matrix composites, tribology and mechanical behaviour of polymers, membranes for various applications, antifouling and antibiofouling materials.

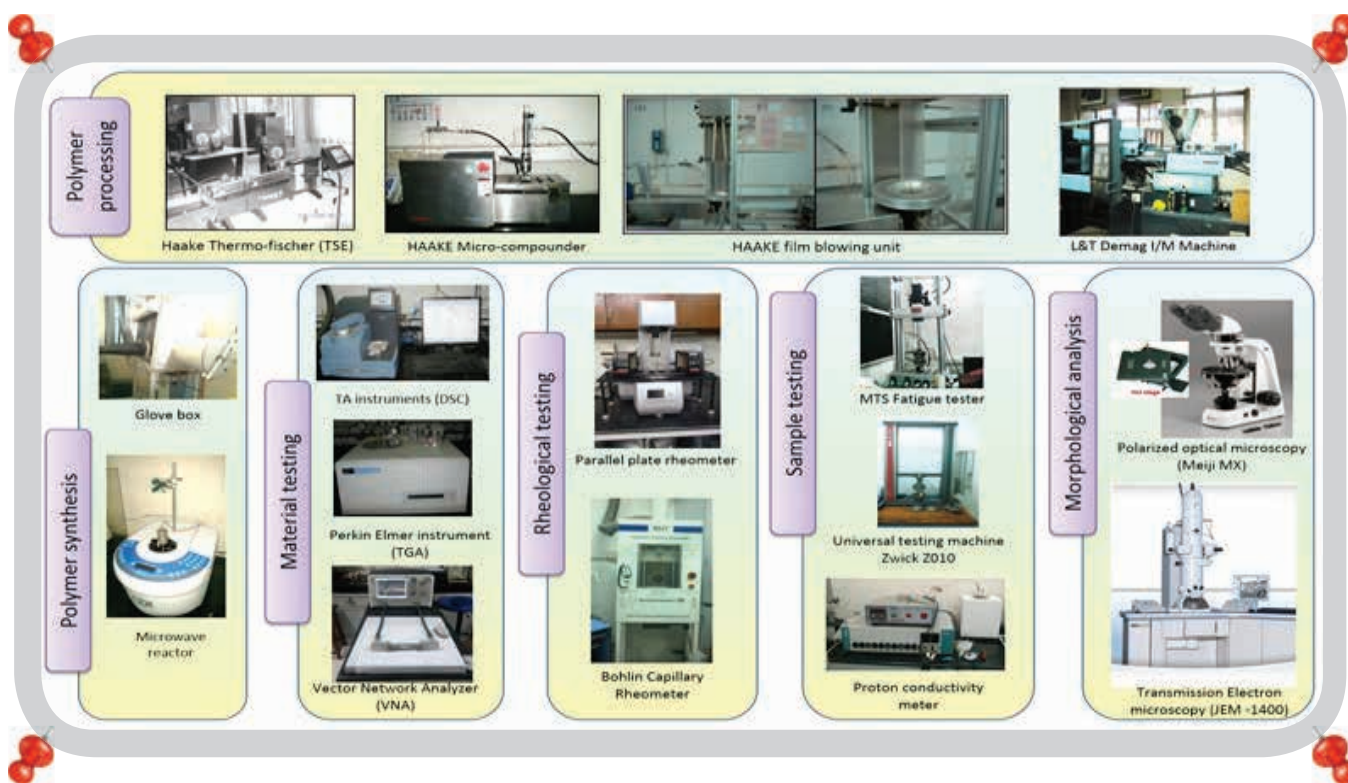


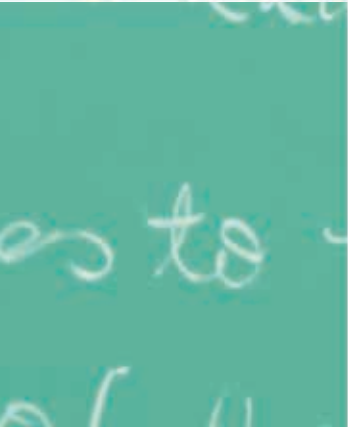
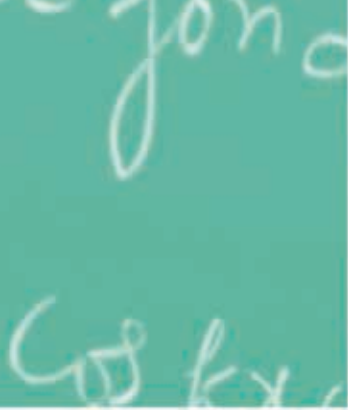
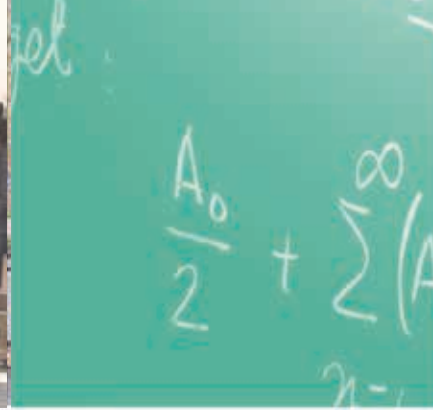
- **High Temperature Materials:** Advanced ceramics, high entropy alloys, materials for extreme environments, thermal barrier coatings, Alloy processing and properties, refractory metals and compounds.
- **Computational Materials Science:** First principles Density Functional Theory (DFT) based material design, Micromagnetic simulations.
- **Electronic and Functional Materials:** Semiconductor nanostructures and device applications, Magnetic nanowires and magnetic tunnel junctions for spintronic device applications; Organic electronics, Large area scalable nanofabrication of wearable electronic and photonic devices.

## LABORATORY FACILITIES

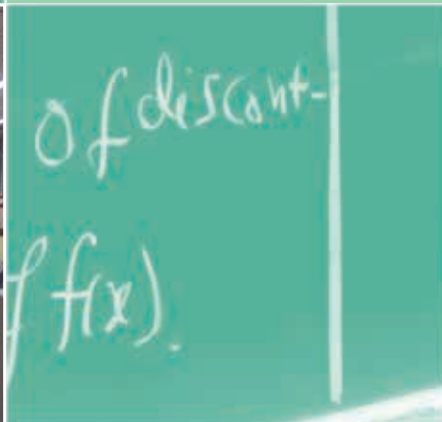
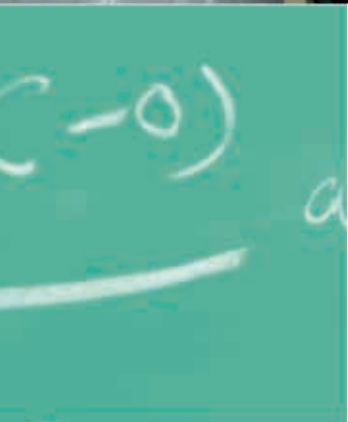
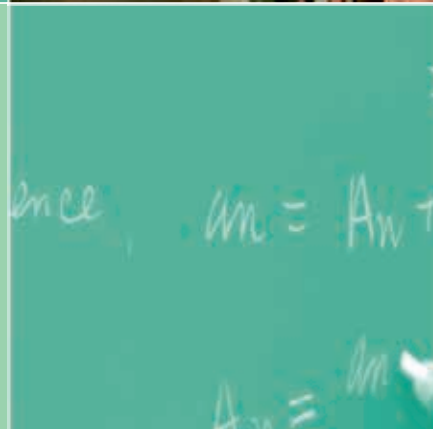
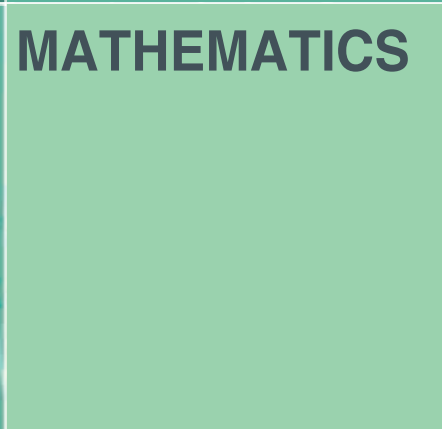
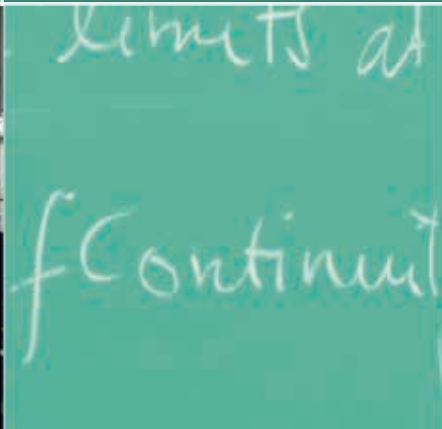
- **Material Chemistry Lab:** Freeze Dryer, Specialised Polymerization set-ups, Distillation apparatus including Vacuum Distillation, Rotary Vacuum Evaporator, Constant Temperature Baths, Deionized & Distilled Water Apparatus, Hot Air Ovens, Vacuum Ovens, High Precision Balances, High Speed Stirrer, Glove Box, Spin Coater.
- **Material Characterization Laboratory:** Differential Scanning Calorimeter (DSC), Thermo-gravimetric/Analyser (TGA), Gel Permeation Chromatography (GPC), FTIR Spectrometer, Nanoparticle Analyzer, Dynamic Mechanical Analyzer, UV-visible Spectrometer, Fluorescence Spectrometer, Zeta Sizer, High-performance liquid chromatography, Atomic Force Microscopes, Scanning Electron Microscope with EDS, Optical microscopes with heating and cooling stage, Optical emission spectroscopy, Dynamic Contact angle measurement system, Four Probe Electrical Conductivity Apparatus, Vector Network Analyzer, WVTR, OTR, Fluorescence Microscopes, FE-SEM.
- **Material Processing Lab:** Single-screw Extruder, Twin-screw extruder, Injection Moulding Machine, Compression Moulding Machine, 3D-Printing, Two-roll Mill, Chase Friction Dynamometer, Batch Foaming unit, Tool Grinding Machine, Scrap Grinding Machine, Pulveriser, Plasma Coater, Autoclave for Microcellular Foaming, Micro-compounder, Micro-injection Molding Machine, HAAKE Film Blowing Unit, Melt Flow Index Tester, Single screw extrusion foaming, Electro spinner.
- **Material Testing Laboratory:** Bohlin Capillary Rheometer, Malvern parallel plate Rheometer, Anton Paar M702 Rotational Rheometer, Zwick-Z250-UTM with video extensometer, Zwick Z-10-UTM, MTS, Polarized Light Optical Microscopy, Aramis-GOM strain field analyser, Impact Tester, Nanoindentation, Micro and Nano-Hardness Testers.
- **Undergraduate Materials Laboratory:** Tensile and compression testing machines, Rolling mill, High speed cutting machine, Microhardness testing facility, Optical microscopes, X-Ray diffraction.

- **Transmission Electron Microscope (TEM) Maximum point resolution - 0.4 nm:** Maximum magnification - 12 lacs, Facilitated with EDX.
- **Central Facilities for Materials Testing:** Scanning Electron Microscope, Nuclear Magnetic Resonance Facility, Transmission Electron Microscope, Atomic Force Microscope, Raman Spectrometer, Liquid Nitrogen Plant, Confocal Laser Scanning Microscope, Wide Angle X-ray Diffractometer.





**DEPARTMENT OF MATHEMATICS**





**K. Sreenadh**, *Ph.D. (IIT Kanpur)*  
*Professor*  
Differential Equations and Analysis.

## HEAD OF THE DEPARTMENT



**Biplab Basak**, *Ph.D. (IISc., Bangalore)*  
*Assistant Professor*  
Algebraic Topology, Combinatorial Topology  
and Discrete Mathematics.

**Debdip Ganguly**, *Ph.D. (TIFR-CAM)*  
*Assistant Professor*  
Partial Differential Equations, Geometric  
Analysis.



**N. Chatterjee**, *Ph.D. (Univ. of London)*  
*Professor*  
Natural Language Processing, Statistical  
Modeling, Semantic Web.

**Surjeet Kour**, *Ph.D. (IIT Kanpur)*  
*Assistant Professor*  
Commutative Algebra, Group Theory.



**Aparajita Dasgupta**, *Ph.D. (York  
University, Toronto, Canada)*  
*Assistant Professor*  
Harmonic Analysis, Pseudo-differential  
Operators.

**Harish Kumar**, *Ph.D. (ETH Zurich)*  
*Associate Professor*  
Computational Methods for Partial  
Differential Equations.



**Minati De**, *Ph.D. (ISI Kolkata)*  
*Assistant Professor*  
Data Structures & Algorithm, Approximation  
Algorithms, Combinatorial and  
Computational Geometry.

**Shravan Kumar**, *Ph.D. (Madras Univ.)*  
*Associate Professor*  
Abstract Harmonic Analysis.



**S. Dharmaraja**, *Ph.D. (IIT Madras)*  
*Professor*  
Applied Probability, Queuing Theory,  
Performance Modeling, Financial  
Mathematics.

**V.V.K. Srinivas Kumar**, *Ph.D. (IIT Kanpur)*  
*Assistant Professor*  
Computational Partial Differential Equations.







**Subiman Kundu**, *Ph.D. (Virginia Tech. Univ.)*  
**Professor**  
 Topology, Measure Theory.



**Anant Kumar Majee**, *Ph.D. (TIFR-CAM)*  
**Assistant Professor**  
 Stochastic Conservation Laws, Stochastic  
 Optimal Control in Ferromagnetism.



**Aparna Mehra**, *Ph.D. (Delhi Univ.)*  
**Professor**  
 Mathematical Programming, Fuzzy  
 Optimization, Financial Mathematics.



**Mani Mehra**, *Ph.D. (IIT Kanpur)*  
**Associate Professor**  
 Application of Wavelets to Numerical  
 Analysis and PDEs.



**Vivek Mukundan**, *Ph.D. (Purdue University)*  
**Assistant Professor**  
 Commutative Algebra, Algebraic Geometry.



**Anima Nagar**, *Ph.D. (Gujrat Univ.)*  
**Associate Professor**  
 Topological Dynamics.



**B.S. Panda**, *Ph.D. (IIT Kanpur)*  
**Professor**  
 Algorithmic Graph Theory, Graph Theory,  
 Algorithms, Parallel and Distributed Computing.



**Shiv Prakash Patel**, *Ph.D. (TIFR Mumbai)*  
**Assistant Professor**  
 Representation Theory, Automorphic forms,  
 Number Theory.



**Kamana Porwal**, *Ph.D. (IISc. Bangalore)*  
**Assistant Professor**  
 Finite Element Methods for PDEs and  
 Optimal Control Problems.



**Amit Priyadarshi**, *Ph.D. (Rutgers University)*  
**Assistant Professor**  
 Fractal Dimensions, Positive Operators.



**S.C. Sekhara Rao**, *Ph.D. (IIT, Kanpur)*  
**Professor**  
 Parallel Computing, Numerical Analysis.



**Ekata Saha**, *Ph.D. (The Institute of  
 Mathematical Sciences, Chennai)*  
**Assistant Professor**  
 Number Theory.





**Sivananthan Sampath**, *Ph.D. (IIT Madras)*  
*Associate Professor*  
Applied Harmonic Analysis, Inverse Problems,  
Learning Theory.



**Ritumoni Sarma**, *Ph.D. (TIFR, Bombay)*  
*Associate Professor*  
Algebraic Groups.



**Punit Sharma**, *Ph.D. (IIT Guwahati)*  
*Assistant Professor*  
Numerical Linear Algebra,  
Nearness Problems in Control Theory.



**R.K. Sharma**, *Ph.D. (IIT Delhi)*  
*Professor*  
Algebra, Cryptography.



**Vikas Vikram Singh**, *Ph.D. (IIT Bombay)*  
*Assistant Professor*  
Stochastic Games, Chance Constraints,  
Stochastic Optimization.



**A. Tripathi**, *Ph.D. (Univ. at SUNY, Buffalo)*  
*Professor*  
Number Theory, Combinatorics and  
Graph Theory.



**Viswanathan Puthan Veedu**, *Ph.D. (IIT Madras)*  
*Assistant Professor*  
Approximation Theory, Fractal Functions.

## ▶ INTRODUCTION

The Department offers courses at both undergraduate and postgraduate levels. It runs a five year dual degree programme (B.Tech. + M.Tech.) in Mathematics and Computing, a four year B.Tech. programme in Mathematics and Computing, and a two year M.Sc. programme in Mathematics. The Department also has an active Ph.D. programme.

## ▶ ACADEMIC PROGRAMMES

### UNDERGRADUATE

The Department offers a five year dual degree programme (B.Tech. + M.Tech.) in Mathematics and Computing and a four year B.Tech. programme in Mathematics and Computing at undergraduate level. The dual degree programs have replaced former five year integrating M.Tech. in Mathematics and Computing program from 2013 onward. The aim of these programs is to build a broad based theoretical background of Mathematical Sciences and practical training in Computing, Numerical Methods, and Mathematical and Statistical Modeling. Graduate of these programs will be ready for a career in research and development in software industries, financial institutes and for a research-based career.

### POSTGRADUATE

The Department offers a two-year post B.Sc. course leading to the degree of Master of Science in Mathematics. The main feature of this program is that during the first year it makes the student familiar with basic theory in all the streams of Mathematics-Pure Mathematics, Applied Mathematics, Statistics, Operations Research, Computer Science. And in the second year, the student has an option of choosing modern advanced courses in some specialized area(s).

## ▶ RESEARCH AREAS

Doctoral research is being carried out in all major areas of Mathematics, Applied Mathematics, Statistics and Operation Research and Theoretical Computer Science and its application.

**The major research area of the department are:** Algebra, Graph Theory, Computations PDEs, Cryptography, Partial Differential Equations, Financial Mathematics, Natural Language Processing, Number Theory, Numerical Analysis, Optimization, Parallel Computing, Topological Dynamics, Topology, Wavelets and its Applications, Harmonic Analysis, Fractals, Inverse Problems, Learning Theory, Stochastic Game Theory.

## ▶ LABORATORY FACILITIES

The Department has three well-equipped Computing Laboratories with PCs and supporting software. These Laboratories are available to students for training and implementation of their computer programmes on assignments during courses or project work.









**P. Venkateswara Rao, Ph.D. (IIT Madras)**  
*Professor*  
Machining of difficult to machine materials, Grinding of Ceramics, Micro/Nano Manufacturing, Sustainable Machining.

## HEAD OF THE DEPARTMENT



**Krishnakant Agrawal, Ph.D. (IISc., Bangalore)**  
*Assistant Professor*  
Turbulent Reacting Flows, Gas Turbines and IC Engines, Aero-acoustics, Combustion Dynamics and Emissions.

**Anoop Chawla, Ph.D. (IIT Kanpur)**  
*Professor, (Henry Ford Chair)*  
CAD, CAE, Dynamics, Bio-mechanics, Road Safety, Impact and Blast Mechanism.



**S. Aravindan, Ph.D. (IIT Madras)**  
*Professor*  
Ceramics, Composites, Welding, Nano-Manufacturing.

**Ashish K. Darpe, Ph.D. (IIT Delhi)**  
*Professor*  
Machinery Health Monitoring, Rotor Dynamics, Vibration and Noise Engineering.



**Supreet S. Bagha, Ph.D. (Stanford Univ.)**  
*Assistant Professor*  
Microfluidics and Nanofluidics, Electrohydrodynamics, Heat Transfer.

**Debabrata Dasgupta, Ph.D. (IIT Kharagpur)**  
*Assistant Professor*  
Microfluidics and Microscale Transport Processes, Computational Fluid Dynamics, Multiphase Transport.



**Naresh Bhatnagar, Ph.D. (IIT Bombay)**  
*Professor*  
FRP Composite Materials, Processing and Manufacturing, Injection Molding, Biomaterials.

**Naresh V. Datla, Ph.D. (University of Toronto)**  
*Associate Professor*  
Fracture and Fatigue, Composites, Biomechanics.



**Nomesh Bolia, Ph.D. (Univ. of North Carolina)**  
*Professor*  
Operations Research, Stochastic Modeling, Application of MDP to Various Control Problems, Application of OR to Logistics and Economics.

**Subhra Datta, Ph.D. (Northwestern Univ.)**  
*Associate Professor*  
Micro-scale Fluid Mechanics, Electrokinetics, Microfluidics.







**S.G. Deshmukh**, Ph.D. (IIT Bombay)  
**Professor**  
 Supply Chain Management, Quality Management, Information Systems.



**Devendra Kr. Dubey**, Ph.D. (Purdue University)  
**Assistant Professor**  
 Computational Materials Science, Molecular Modeling, Nanomechanics, Biomaterials and Biomechanics, Finite Element Modeling.



**J.K. Dutt**, Ph.D. (IIT Delhi)  
**Professor**  
 Rotor Dynamics, Vibration and Control.



**Arnob Ghosh**, Ph.D. (University of Pennsylvania)  
**Assistant Professor**  
 Game Theory, Stochastic Optimization, Resource Allocation, Smart Grid, Multi-agent learning, Mechanism Design, Transportation Network.



**Sudarsan Ghosh**, Ph.D. (IIT Kharagpur)  
**Professor**  
 Grinding of Ceramics and Superalloys, Machining of Titanium Alloys, Surface Engineering.



**Amit Gupta**, Ph.D. (Univ. of Central Florida)  
**Associate Professor**  
 Microfluidics and Microscale Transport Processes, Computational Fluid Dynamics, Multiphase Transport.



**Harish Hirani**, Ph.D. (IIT Delhi)  
**Professor**  
 Bearings (Hydrodynamic, Rolling Element, and Magnetic), Synthesis and Application of Smart (Magnetorheological Fluids).



**Sanjeev Jain**, Ph.D. (IIT Delhi)  
**Professor**  
 Solar Cooling, Building Energy Efficiency, Decentralized Energy Systems, Natural Refrigerants.



**Sunil Jha**, Ph.D. (IIT Kanpur)  
**Professor**  
 Advanced Machining and Finishing Processes, Micro and Nanofinishing, Mechatronics, Robotics.



**S.R. Kale**, Ph.D. (Stanford Univ.)  
**Professor**  
 Heat Transfer, Fluid Mechanics, Particle-Laden Flows, Combustion and Energy Conversion.



**Jitendra P. Khatait**, Ph.D. (University of Twente)  
**Assistant Professor**  
 Precision Machine Design, Flexures, Medical Devices, Robotics.



**Sangeeta Kohli**, Ph.D. (IISc., Bangalore)  
**Professor**  
 Heat Transfer, Fluid Mechanics, Renewable Energy Technology.



**K. Rama Krishna**, Ph.D. (IISc., Bangalore)  
**Assistant Professor**  
 Kinematics and Mechanisms, Geometric Modeling for CAD and Manufacturing, Mechanics and Machine Design.



**D. Ravi Kumar**, Ph.D. (IIT Madras)  
**Professor**  
 Metal Forming, Mechanical Metallurgy.



**Mayank Kumar**, Ph.D. (Massachusetts Institute of Technology USA)  
*Assistant Professor*  
 Multiphysics Simulations of Energy Conversion Systems, Turbulent Multiphase Reacting Flows, Coal Gasification & Clean Coal Technology.



**Kusum Meena**, Ph.D. (Auckland University of Technology New Zealand)  
*Assistant Professor*  
 Additive Manufacturing, Auxetic Metamaterials, Laser Material Processing.



**Kaushik Mukherjee**, Ph.D. (IIT Kharagpur)  
*Assistant Professor*  
 Orthopaedic Biomechanics & Implant Design, Developmental Biomechanics, Bone and Joint Mechanobiology, Mechanics of Human Movement, Finite Element Analysis.



**S.V. Modak**, Ph.D. (IIT Delhi)  
*Professor*  
 Vibration Engineering, Experimental Modal Analysis, Finite Element Model Updating in Structural Dynamics, Vibro-acoustics.



**Sudipto Mukherjee**, Ph.D. (Ohio State Univ.)  
*Professor (Volvo Chair)*  
 Mechanism, Robotics, Mechanical System Design, Impact Biomechanics.



**Prithviraj Mukhopadhyay**, Ph.D. (IIT Madras)  
*Assistant Professor*  
 Machining of Ceramics, Cutting Tool Development, Joining, Surface Coating and, Vacuum Tech.



**Pulak Mohan Pandey**, Ph.D. (IIT Kanpur)  
*Professor*  
 Rapid Prototyping, Unconventional Machining, Finite Elements, CAD/CAM.

**R.K. Pandey**, Ph.D. (Banaras Hindu Univ.)  
*Professor*  
 Bearing Lubrication, Tribological Elements Design, Engine Tribology, Lubrication in Metal Forming.



**B. Premachandran**, Ph.D. (IIT Madras)  
*Professor*  
 Heat Transfer, Computational Fluid Dynamics.



**Varun Ramamohan**, Ph.D. (Purdue University)  
*Assistant Professor*  
 Probabilistic Modeling, Simulation and Optimization, with Applications in Healthcare Systems Engineering.



**Bahni Ray**, Ph.D. (IIT Kanpur)  
*Assistant Professor*  
 Multiphase Flow, Physics of Fluids, Micro fluidics, Computational Fluid Dynamics, Stability analysis, Traffic flow.



**M.R. Ravi**, Ph.D. (IISc, Bangalore)  
*Professor*  
 Heat Transfer, Computational Fluid Dynamics, Combustion, Biomass Energy, Rural Energy Systems.



**Anjan Ray**, Ph.D. (Michigan State Univ.)  
*Professor*  
 Combustion, Heat Transfer.



**Subir K. Saha**, Ph.D. (McGill Univ.)  
*Professor*  
 Multibody Dynamics, Robotics, Design, Mechatronics.





**Shaurya Shriyam, Ph.D.**  
*Assistant Professor*  
 Data-Driven Optimization for Problems in Automation, Logistics and Healthcare; Complex Resource Distribution Networks; Multi-agent Planning and Reinforcement Learning.



**Satinder Paul Singh, Ph.D. (IIT Delhi)**  
*Professor*  
 Dynamics of Rotary Machinery, Composite Materials, Machine Design, Active Vibration Control, Nano-Mechanics.



**Sujeet Kumar Sinha, Ph.D. (Imperial College London)**  
*Professor*  
 Nano-tribology, Bio-tribology, Polymer Tribology, Materials in Mechanical Design.



**P.M.V. Subbarao, Ph.D. (IIT Kanpur)**  
*Professor*  
 Experimental Turbulence, Tomography, Power Generation Systems and I.C. Engines.



**Prabal Talukdar, Ph.D. (IIT Guwahati)**  
*Professor*  
 Radiative Heat Transfer, Porous Media, Convective Drying, Reheating Furnace, Inverse Problems, Thermal Protective Fabric.



**Bhupinder Godara, M.Tech. (IIT Delhi)**  
*Professor of Practice*  
 Refrigeration and Air-conditioning Product Design With a Focus on Sustainable, Environment Friendly and Affordable Technologies for India.



**Kshitij Gupta, Ph.D. (IIT Delhi)**  
*Emeritus Professor*  
 Vibrations, Mechanical Design, Rotor Dynamics, Composite & Smart Material Applications, Acoustics.

**Dinesh Mohan, Ph.D. (University of Michigan)**  
*Honorary Professor*

Biomechanics and Epidemiology: Expertise in Human Impact Tolerance, Vehicle Crashworthiness and Road Safety Research. Presently Involved in Design of Safer Truck Fronts, Analysis of Highway Crashes, Analysis of Tractor Driver Vibrations and Interaction Between Safety and Environmental Policies.



**Prem Vrat, Ph.D. (IIT Delhi)**  
*Honorary Professor*

Industrial Engg. & Operation Research, Supply Chain Management, Total Quality Management, Value Engineering.



**Kiran Seth, Ph.D. (Columbia Univ.)**  
*Honorary Professor*

**Padma Shri**  
 Operations Research, Applied Probability Models, Fuzzy Models.



**A.D. Gupta, M.Tech. (IIT Delhi)**  
*Guest Faculty*

Industrial Engineering, Operation Research, Value Engineering, Industrial Quality Control.



**T.K. Kundra, Ph.D. (IIT Delhi)**  
*Guest Faculty*

Mechanical System Design, Concurrent Engg., Vibration Design, CAD/CAM, Finite Element Model Updating.



**Suresh Anand, Ph.D. (IIT Delhi)**  
*Adjunct Faculty*

Operations Research, Manufacturing and Marketing Operations, Strategic Decision Making Specifically for Automotive Industry.



**Priya Vashisth, Ph.D. (IIT Roorkee)**  
*DST-Inspire Faculty*

Smart Functional Biomaterials (drug delivery and biomedical implants), Tissue Engineering.



## INTRODUCTION

The faculty of the Department of Mechanical Engineering are engaged in research encompassing a wide variety of areas. Research of an inter-disciplinary nature is being performed in collaboration with faculty of other departments and centres of the institute, and with select faculty from other institutions in India and abroad. The research is largely supported by sponsored projects and consultancies. These research areas form a major portion of the topics of doctoral dissertations and Masters' theses. The research and teaching broadly covers topics in design, industrial, production and thermal engineering. A wide variety of courses in the above areas are offered by the department at all levels.

The research and teaching activities are supported by 12 skilled staff who manage 27 laboratories. Many of the laboratories are equipped with state-of-the-art facilities. The department is also host to faculty on sabbatical from Indian and foreign institutions, INSPIRE Faculty Fellows, and postgraduate and undergraduate students from several institutions/universities in India and abroad. Several faculty members serve as experts on national and international technical committees.

## ACADEMIC PROGRAMMES

The Department faculty offer courses at various levels catering to various degree programmes.

The Department offers two Undergraduate Programmes leading to the Bachelor of Technology degree with specializations in (i) Mechanical Engineering, and (ii) Production and Industrial Engineering.

The Department offers four Postgraduate Programmes leading to respective Master of Technology degrees with a specialization in Mechanical Design, Industrial Engineering, Production Engineering, and Thermal Engineering. Also, Master of Science (Research) programmes is offered in these specializations. The faculty also participate in interdisciplinary Master of Technology programmes in Construction Technology and Management, Computer Applications, Polymer Science and Technology, Industrial Tribology & Maintenance Engineering, Energy Studies, and Transportation Engineering. The faculty also participates in the Master of Design programme and activities of the Khosla School of Information Technology. Recently, several faculty members have been engaged in improving rural technologies for enhanced livelihood.

- **Mechanical Design:** Mechanical vibrations, Rotor dynamics, Damped structures, Composite structures, Smart structures, Active vibration control, Experimental modal analysis and identification, Structural dynamic modification, Finite element model updating, Dynamic design, Noise engineering, Condition monitoring, Bearing dynamics, Lubrication, Bio-tribology, Tribological Coatings, Mechanical system design, Computer aided mechanical design, Computer controlled mechanisms, Vehicle dynamics, Modeling the impact of vehicles, Impact biomechanics, Concurrent engineering design, Mechanisms, Robotics, Multi-body dynamics,

Application of multi-body dynamics in design, Analysis of rural engineering systems, Mechatronics, Sensors and actuator design, MEMS, Design of micro-systems, Nano-mechanics, Artificial intelligence applications in mechanical engineering, Expert systems for design and manufacturing, Mechanical engineering applications to medical science.

- **Industrial Engineering:** Operations research, Applied probability, Stochastic modeling and simulation, Project management, Supply chain management, Computer integrated manufacturing systems, Facilities planning, Value engineering, Flexible systems, ERP, Intelligent manufacturing systems, e-business, Quality and reliability engineering, Maintenance management, Manufacturing system design and analysis, Service system design, Production planning and control. OR applications to healthcare, manufacturing, telecommunications, transportation, policy, governance, finance, etc.
- **Production Engineering:** Metal cutting, Metal forming, Welding, Metal casting, Material characterization, Non-traditional manufacturing processes, Measurements and metrology, Grinding of ceramics and metal matrix composites, Processing of polymers and composites, Injection moulding, Microcellular injection moulding, Finite element applications in manufacturing, CAD/CAM, Rapid prototyping, Intelligent manufacturing, Micro and nano-manufacturing, Biomaterials and medical implants, Nano-composites, Modeling of material behavior, Lean concepts in machine tool design. Magnetorheological Finishing, CNC Fishing Systems.
- **Thermal Engineering:** Flame propagation, Flame stability, Heat transfer to/from flames, Combustion. Fire dynamics and fire safety. Internal combustion engines: alternative fuels, engine modelling and simulation, HCCI combustion in an engine. Biomass utilization, Experimental and modelling studies of gasifires, Biomass stoves, Sustainable energy systems, Energy efficient equipment and devices, Waste heat utilization, Renewable energy systems. High temperature natural convection, Cooling of electronic components, Micro-channel heat transfer, Transport phenomena in micro- and nano-fluidic devices, Heat transfer enhancement, Combined conduction-radiation problems. Heat transfer in two phase flows. Eco-friendly energy conversion, refrigeration and air-conditioning, Thermal system design and simulation. Particle-laden flows. Microfluidics, Flapping wing aerodynamics, Energy Storage, Heat Exchangers, Solar Cooling Technologies, Microscale Heat Transfer.
- **Interdisciplinary Research:** Transportation research and injury prevention program, Energy, quality and productivity audit of rural industries, Medical implants, Autonomous robotics, Development of composite materials, Atmospheric convection, Rural Technology Action Group (Rn TAG).

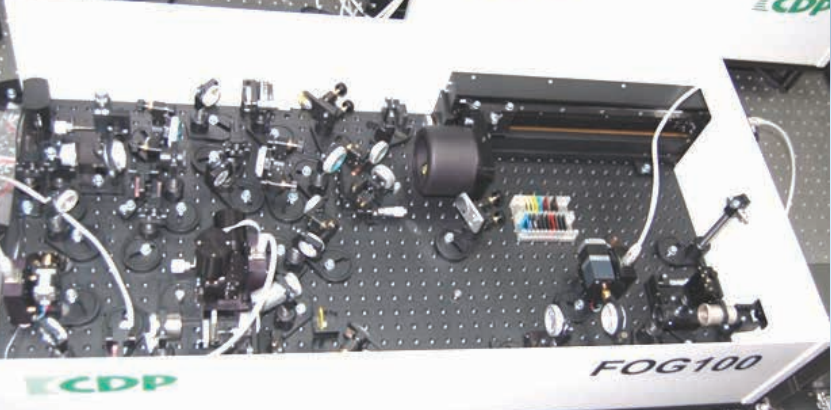
## LABORATORY FACILITIES

The Department has 27 well-equipped laboratories which cater to the needs of research and teaching activities. The Production Engineering, welding, Metrology, Machine Tools & CNC laboratories encompass the different machinery required for manufacturing and inspection. A state-of-the-art Micro-manufacturing laboratory houses sophisticated

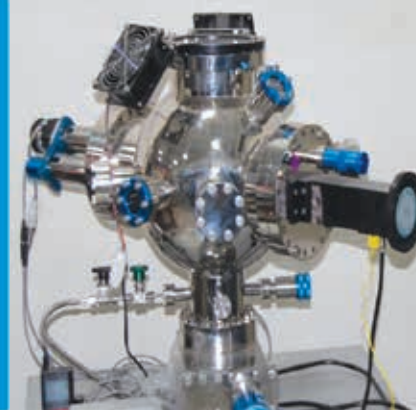


machines for micro- and nano-manufacturing. Laboratories that cater to the activities in the area of mechanical design include: Mechatronics, Vibration and Instrumentation, Vibration Research, Mechanism and Simulation, Bio-tribology, Tribological coatings and Design Research laboratories. A Computer-Aided Graphics instruction Laboratory, equipped with computers, and drawing and design software packages is used for imparting training in mechanical design. Microfluidics, Combustion Refrigeration and Air-conditioning, Internal Combustion Engines, turbo-machinery, Heat Transfer Laboratories serve the needs of research and teaching in thermal engineering. Industrial Engineering Lab houses teaching and research activities in the areas of Operations Research, Health care OR and Health Systems, Public Policy and Governance, Transportation, Clean Air and Manufacturing Analytics.





Condensed  
Matter  
Experiment



Condensed  
Matter  
Theory

## DEPARTMENT OF PHYSICS

Computational  
and  
Statistical  
Physics



High Energy  
Physics

Physics of  
Quantum Matter  
and  
Information Systems

Plasma Physics

Optics  
and  
Photonics





**R. Chatterjee, Ph.D. (IIT Kanpur)**  
*Professor*  
 Experimental Condensed Matter Physics - Novel Magnetic  
 Multi-functional Materials: Bulk and Nano/Thin Film forms.

## HEAD OF THE DEPARTMENT



**Aditya Narain Agnihotri, Ph.D. (TIFR, Mumbai)**  
*Assistant Professor*  
 Ion-atom Collision Physics, Ion-irradiation of  
 Biologically Relevant Molecules.

**Sujeet Chaudhary, Ph.D. (IIT Delhi)**  
*Professor*  
 Experimental Condensed Matter Physics:  
 Thin Films, Magnetism, Spintronics.



**Bodhaditya Santra, Ph.D. (Univ. of Groningen, Netherland)**  
*Assistant Professor*  
 Cold Atom Quantum Technology.

**Amita Das, Ph.D. (IIT, Kanpur)**  
*Professor*  
 Plasma Physics, Laser Plasma Interaction,  
 Particle and Fluid Simulation in Plasma.



**Sujin B. Babu, Ph.D. (Univ. du Maine, France)**  
*Assistant Professor*  
 Aggregation of Colloids, Porous Media, Low  
 Reynolds Number Swimmers.

**Pintu Das, Ph.D. (Uni. of Saarland, Germany)**  
*Assistant Professor*  
 Experimental Condensed Matter Physics:  
 Magnetism at Nanometer Scale, Charge Carrier-  
 dynamics (Low-frequency) as well as Atomic/  
 Nanometer Scale Electronic Phenomena in  
 Correlated Electron Systems, Instrumentation.



**Varsha Banerjee, Ph.D. (IISc., Bangalore)**  
*Professor*  
 Statistical Mechanics of Complex Spin System,  
 Surface Growth Phenomena, Fractal Architectures  
 and their Characterization.

**Rajendra S. Dhaka, Ph.D. (UGC-DAE CSR, Indore)**  
*Associate Professor*  
 Experimental Condensed Matter Physics: Electronic  
 structure, Thin Films, Strongly correlated Systems,  
 Surface-interface physics, High-Tc superconductors,  
 Angle-resolved Photoemission Spectroscopy.



**Saswata Bhattacharya, Ph.D. (IACS, Kolkata)**  
*Assistant Professor*  
 Computational Materials Science, Energy  
 Conservation, Catalysis, Graphene, Genetic  
 Algorithm, Machine Learning.

**Joyee Ghosh, Ph.D. (Jawaharlal Nehru Univ.)**  
*Assistant Professor*  
 Quantum and Nonlinear Optics, Quantum  
 Information Technologies, Atomic, Molecular and  
 Optical Physics.





**Pradipta Ghosh**, Ph.D. (IACS Kolkata)  
*Assistant Professor*  
 Phenomenological Analyses of Physics Beyond the Standard Model in the Areas of Neutrino Physics, Higgs Physics, Leptonic Flavor Violation, Dark Matter and Collider Studies.



**Santanu Ghosh**, Ph.D. (Jawaharlal Nehru Univ.)  
*Professor*  
 Experimental Condensed Matter Physics, Thin Film, Ion Materials Interaction.



**Sankalpa Ghosh**, Ph.D. (Jawaharlal Nehru Univ.)  
*Professor*  
 Bose Einstein Condensate of Cold Atoms, Quantum Hall Effect, Graphene, Topological Insulator.



**Joby Joseph**, Ph.D. (IIT Delhi)  
*Professor*  
 Photonics, Applied Optics, Holographic Data Storage, Digital Holography, Optical Data Security, Photonic Structures.



**Bhaskar Kanseri**, Ph.D. (University of Delhi)  
*Assistant Professor*  
 Quantum Optics, Ultrafast and Non-linear Optics, Optical Coherence and Interferometry, Polarization and Spectral Switching.



**Kedar B. Khare**, Ph.D. (Univ. Rochester)  
*Associate Professor*  
 Optics/Photonics, Computational Imaging, Inverse Problems, Compressive Sensing.



**Neeraj Khare**, Ph.D. (BHU)  
*Professor*  
 Nano-Structure Functional Oxides, Novel Magnetic Materials, Superconductors, SQUID, Solar Cells.



**Sunil Kumar**, Ph.D. (IISc., Bangalore)  
*Assistant Professor*  
 Ultrafast Optics and Spectroscopy, Plasmonics, Electron Correlated Solids.



**Brajesh Kumar Mani**, Ph.D. (PRL, Ahmedabad)  
*Assistant Professor*  
 Computational Condensed Matter Physics, Computational Many-Body Physics, Molecular Dynamics and Monte Carlo Simulations.



**Hitendra K. Malik**, Ph.D. (IIT Delhi)  
*Professor*  
 Plasma Physics: Particle Acceleration, Instabilities, Fusion, Microwaves-Plasma Interaction, Solitons, Space Plasmas, THz Radiation Generation, Hall Thrusters, Plasma-material Interaction.



**Rahul Suresh Marathe**, Ph.D. (RRI Bangalore)  
*Assistant Professor*  
 Non-equilibrium Statistical Mechanics, Biophysics Theory, Modelling, Simulations.



**B.R. Mehta**, Ph.D. (IITD)(Schlumberger Chair)  
*Professor*  
 Thin Film and Nanostructured Materials, Inorganic-Organic Hybrid Interfaces, Resistive Memory, Thermoelectric, Photo Electro Chemical and Solar Cell Devices.





**Dalip Singh Mehta**, Ph.D. (NPL Delhi/CCS Univ. Meerut)  
**Professor**  
 Optical Coherence Tomography and 3D-Profilometry,  
 Optical Tweezers, Optics of LEDs and OLEDs,  
 and Quantitative Phase Microscopy.

**V. Ravishankar**, Ph.D. (Lehigh Univ.)  
**Professor**  
 Semiconductor Physics, Devices and  
 Technology, Organic Semiconductors,  
 Nano-technology.



**Sujit Manna**, Ph.D. (IACS, Kolkata)  
**Assistant Professor**  
 Experimental Condensed Matter Physics, Quantum  
 Materials, Unconventional Super-conductivity, MBE,  
 Spectroscopic Imaging (STM/STS).

**Vikrant Saxena**, Ph.D. (IPR Gandhinagar)  
**Assistant Professor**  
 Computational Plasma Physics, Laser-plasma  
 Interactions, Nonlinear Waves and Solitons in  
 Plasmas, XFEL Irradiation of Rare Gas Clusters,  
 Plasma based Particle Acceleration etc.



**A. Mishra**, Ph.D. (Utkal Univ.)  
**Professor**  
 Superconductivity in Quark Matter and Ultra-  
 cold Atoms, In-medium Hadron Properties and  
 Observable in High Energy Accelerator Experiments.

**Amartya Sengupta**, Ph.D. (Rutgers Univ. & NJIT)  
**Assistant Professor**  
 Experimental Ultrafast Optics, THz Spectroscopy,  
 Optical Spectroscopy at High P-T, Mineral Physics.



**Pranaba Kishor Muduli**, Ph.D.  
 (Humboldt Univ. & PDI, Berlin)  
**Associate Professor**  
 Spin Torque Induced Magnetization  
 Dynamics, Spintronics and Nanomagnetism.

**P. Senthilkumar**, Ph.D. (IIT Madras)  
**Professor**  
 Applied Optics, Singular Optics.



**Rohit Narula**, Ph.D. (MIT, USA)  
**Assistant Professor**  
 Condensed Matter Theory, Raman  
 Spectroscopy.

**M.R. Shenoy**, Ph.D. (IIT Delhi)  
**Professor**  
 Optoelectronics, Fibre and Integrated Optics,  
 Optical Fiber Components, Nonlinear Guided  
 Wave Optics.



**G. Vijay Prakash**, Ph.D. (Andhra Univ.)  
**Professor**  
 Nano-photonics, Quantum Functional  
 Materials, Inorganic-organic Nano-hybrids,  
 Non-linear Optics.

**A.K. Shukla**, Ph.D. (IIT Delhi)  
**Professor**  
 Laser, Semiconductor, Raman Spectroscopy,  
 Ion Implantation, Laser Annealing  
 Superconductors and Nanoscience.







**J.P. Singh**, Ph.D. (Jawaharlal Nehru Univ.)  
*Professor*  
Nano-Structure Growth, Nano-science,  
Experimental Condensed Matter Physics.



**Aloka Sinha**, Ph.D. (IIT Madras)  
*Professor*  
Nonlinear Optics, Liquid Crystals,  
Optical Information Processing, Biometrics.



**Pankaj Srivastava**, Ph.D. (Rajasthan Univ.)  
*Professor*  
Experimental Solid State Physics,  
Electronic Structure of Materials,  
Surface-interface Physics.



**Folke Tobias Florus Toll**, Ph.D.  
(Hamburg Univ., Germany)  
*Assistant Professor*  
High Energy Physics.



**Vishal Vaibhav**, Ph.D. (Max Plank Institute,  
Germany)  
*Assistant Professor*  
Non-linear Optics, Computational Physics,  
Numerical Analysis of PDEs.



**R.K. Varshney**, Ph.D. (IIT Delhi)  
*Professor*  
Fibre and Integrated Optics, Nonlinear Optics,  
Fiber Optic Sensors, Fiber Lasers.



**Rajendra Singh**, Ph.D. (Jawaharlal Nehru Univ.)  
*Professor*  
Semiconductor Materials and Processing,  
Wide Band Gap Semiconductor, Semiconductor  
Nano-wires, Semiconductor Wafer Bonding.

**Vivek Venkataraman**, Ph.D. (Cornell Univ. USA)  
*Assistant Professor* (Joint Faculty Phy/EE)  
Nonlinear & Quantum Optics, Fiber & Integrated  
Photonics, Light-matter Interaction & Atomic  
Physics, all-Optical Devices & Novel Light Sources,  
Optical Signal Processing and Communication.



**Arun Kumar**, Ph.D. (IIT Delhi)  
*Emeritus Professor*  
Fibre and Integrated Optical Waveguides,  
Components and Devices,  
Plasmonic Waveguides and Devices.



**Ajit Kumar**, Ph.D. (Moscow Univ.)  
*Emeritus Professor*  
Nonlinear Fibre Optics, Few-cycle  
Laser Pulses, Nano-magnetics.



**Anurag Sharma**, Ph.D. (IIT Delhi)  
*Emeritus Professor*  
Fiber Optics, Integrated Optics, Gradient Index  
Optics, Applied Optics, Numerical Modelling of  
Guided Wave Optical Devices.



**G.B. Reddy**, Ph.D. (IIT Delhi)  
*Emeritus Professor*  
Thin Film Technology, Smart Windows,  
Nano-Structured Films.



**Mukesh Chander**, Ph.D. (IIT Delhi)  
*Visiting Professor*  
Electronics, Solid State Gas Sensors, Surface  
Characterization, Nanostructure Materials.



**R.K. Soni**, Ph.D. (IIT Delhi)  
*Visiting Professor*  
Laser Processing of Materials, Nanophotonics,  
Fluorescence and Raman Spectroscopy.



## INTRODUCTION

The Department is engaged in advanced research in several areas of physics and offers a variety of courses for undergraduate and postgraduate students. The Department offers a B.Tech. programme in Engineering Physics, M.Sc. programme in Physics, and M.Tech. programmes in (i) Solid State Materials, (ii) Applied Optics, and (iii) Opto-electronics and Optical Communications (an interdisciplinary programme, jointly with the Electrical Engineering Department).

The Department has well-equipped teaching laboratories and an excellent research infrastructure. The research is broadly focused on topical areas like Condensed Matter Physics, Optics and Photonics, Plasma Physics, and Theoretical & Computational Physics. State-of-the-art research on contemporary topics like Nanoscience and Nano-technology, Energy Materials and Devices, Magnetism, Spintronics, Optical Fibers Sensors & Devices, Photonic Crystals, Optical Memory, Microwave and Laser-plasma Interaction, Quantum Optics Optical Imaging etc. is being carried out.

## ACADEMIC PROGRAMMES

### UNDERGRADUATE

The Department offers a variety of courses to all undergraduate students at IIT Delhi under the categories of Basic 'Science course' and 'Elective Course' requirements. The Department also offers a set of specific 'Core Courses' for the undergraduate programme 'Engineering Physics'. These courses are also available to undergraduate students of other engineering disciplines as Open Electives. Department offers programme linked courses to UG students of some other branches. Department also offers two minor area to UG students.

#### **B.Tech. in Engineering Physics**

The programme in Engineering Physics stresses the basic physics that underlies most developments in engineering, and the mathematical tools that are important to all engineers and scientists. This emphasis, combined with hands-on-experience of working with modern computers, electronics, lasers and other equipments, culminates in an excellent preparation for a broad range of careers. There is also provision for students to opt for one of that two departmental specializations : 1) Nano-Science & Technology. 2) Photonics Technology.

### POSTGRADUATE

#### **M.Sc. in Physics**

The M.Sc. (Physics) programme is designed to impart masters-level education in Physics through various lecture courses and laboratory classes. The department also offers three specializations in the broad areas of Optics & Photonics, Material Science and Theoretical Physics.

### M.Tech. in Solid State Materials

The Solid State Materials programme encompasses science and technology of materials, their synthesis, characterization and applications in devices. The programme prepares graduates to take-up challenges in research and development in Solid State Technology, Nanoscience and Technology, Materials Science and Engineering, and Semiconductor Technology and Processing.

### M.Tech. in Applied Optics

The Applied Optics programme, which has been running in I.I.T. Delhi since 1966 is primarily designed to emphasise the “Applied” nature of modern and classical optics. The programme is suited to the requirements of various Optical and Opto-electronic industries and R&D organisations.

### Interdisciplinary M.Tech. in Optoelectronics and Optical Communication

This Interdisciplinary programme is offered Jointly by Physics and Electrical Engineering Department. This program trains students in the areas of Fiber & Integrated Optics, and Optical Communication and Networks, which are useful to various industries.

## RESEARCH AREAS

### Doctoral and post-doctoral research is being carried out in:

- **Condensed Matter Experiments:** The research activity of condensed matter experimental (CME) group at the Physics department covers a wide range of topics such as (i) nanostructured materials, thin films and devices, (ii) novel magnetic multifunctional and topological materials, (iii) spintronics and magnetism, and (iv) wide band gap semiconductors such as GaN and Ga<sub>2</sub>O<sub>3</sub>, AlGa<sub>N</sub>/Ga<sub>N</sub> heterostructures, 2D quantum materials like graphene and transition metal dichalcogenides, Growth and nanoscale devices based on semiconductor nanowires, and (v) optical properties of condensed matter e.g., ultrafast dynamics of condensed matter with femtosecond laser. CME group houses several specialized laboratories as well as several departmental facilities. The CME group has close links with Central Research facilities (CRF) and Nanoscale Research Facility (NRF) of the Institute. NRF houses Class 100 and 1000 clean rooms as well as several characterization facilities. At present, the department has an X-Ray diffractometer, an X-ray photoelectron spectroscopy, a SQUID magnetometer, a physical property measurement system (PPMS), ultrafast-optics laboratory (also housing a Raman spectrometer and a photoluminescence set-up), a pulsed laser deposition (PLD) system and an atomic force microscope as departmental facilities. Individual research labs also have several state-of-the-art facilities, the details of which can be found by visiting the corresponding laboratory web pages.
- **Condensed Matter Theory:** The CMT group has an interdisciplinary focus with broad research interest spanning from first principles based simulation of designing new materials and understanding their properties

using “state-of-the-art density functional theory (DFT) and beyond methods” to the theoretical modelling transport and other properties of various condensed matter systems. Using DFT we probe the fundamental physics and related technological applications for atomic and many-atomic complex systems. Some properties of our interest include electronic and band structure, electric and magnetic properties, phonons, magnons and electromagnons in complex (anti)ferroic oxides bulk and nanostructures. We also use ab initio calculation to explore the viability and rational design of real-world functionalized CNT metastable photoswitches and single-photon emitters (SPEs). We also theoretically model transport in quantum Hall systems, graphene, and topological insulators. Quantum simulation of exotic condensed matter phases with ultra-cold atoms is another area of expertise.

- **Statistical and Computational Physics:** Statistical Physics is devoted to understanding macroscopic assemblies of identical particles. Such systems appear over a wide range of length scales in many different fields. We study diverse systems of contemporary interest, ranging from classical solids, exotic liquids, soft materials, mesoscopic systems and active matter to name a few. Broadly, our research encompasses the following themes: (i) emergent phenomena in complex spin systems with disorder and long-ranged interactions; (ii) non-equilibrium properties of complex fluids such as liquid crystals, ferronematics and patchy colloids; (iii) miniature heat engines, and particle and heat transport in mesoscopic systems; (iv) motility of micro-organisms on surfaces and micro-swimmers in Newtonian and non-Newtonian fluids; (v) pattern formation in granular materials; and (vi) mechanics of extremely flexible structures such as thin films. We use a variety of analytical techniques from equilibrium and non-equilibrium statistical physics, computational techniques such as Monte Carlo, parallel tempering, molecular dynamics and graph cuts along with experiments involving state-of-art imaging techniques and sensitive mechanical characterization.
- **High Energy Physics:** High energy physics encompasses both the very small and the very large distance scales — of elementary particles (femtometer scale) and of the observed universe (cosmology)! It is well described by the standard model, which brings together three fundamental interactions — electromagnetic, weak and strong. Collider physics is a tool which combines both perturbative and non perturbative aspects of these interactions. We study particle production in collider interactions in an attempt to understand both. In particular, strong interaction, described by quantum chromodynamics, is per se notoriously difficult. We employ effective field theoretical techniques to understand its non perturbative aspects — to study low energy properties of hadrons and quark gluon plasma. We also use them to study particle production in gravitational fields, and also some aspects of quantum gravity.

Standard model, though stupendously successful, is still incomplete which makes HEP even more exciting. There are several theoretical problems; even more, there are experimental hints for rich physics beyond the standard model. We study this in the context of topics such as neutrino physics and dark matter.

- **Optics and Photonics:** Historically, the Physics Department at IIT Delhi has made important contributions to R&D in the broad area of Optics and Photonics since the 1960s. Current R&D activities cover a wide range of topics, including Optical Imaging, Holography, Biophotonics, Photonic Crystals, Physical Optics, Singular Optics, Statistical and Polarization Optics, Green Photonics, Optical Metrology, Optical Interferometry, Nonlinear Optics, Quantum Optics, Nanophotonics, Ultrafast Optics, Quantum Photonics and Quantum Information Technologies, Fiber and Integrated Optics, THz metamaterials, Optical Microscopy, Nanoscopy, Spectroscopy, Computational Optics, Holographic Data Storage and Optical Sensors. The faculty in these areas are engaged in both theoretical work as well as experiments.

Bio-photonics and Bio-medical Optical Imaging Systems include a number of microscopy modalities such as Quantitative Phase, Fluorescence, Super-resolution, Optical Coherence Tomography, Optical Tweezers, Fluorescence Spectroscopy, Fourier Ptychography, TIRF Microscopy etc. and has collaborations with leading medical schools/hospitals on the development of novel diagnostic tools for clinical practices, particularly, smart phone based microscopy, spectroscopy and imaging for point-of-care devices for cancer screening and diagnosis. Activities in the area of Green Photonics include Diode Laser based Solid State Lighting, Optics of LEDs and OLEDs, Non-mechanical Tracking Solar Concentrators, Sunlight Harvesting for Day light Saving and Solar Towers. Significant work is also being done on Optical Metrology: Optical interferometry, 3D-surface profilometry/3D-shape measurement techniques. The work on Singular Optics spans generation and propagation effects associated with exotic states of light such as 'optical vortices' having orbital angular momentum and polarization singularities, with application to optical tweezers and robust propagation through random media, including turbulent atmosphere.

The Department hosts a major DST-FIST facility on Ultrafast Optics and has state of the art instrumentation enabling collaborative work across the institute. The department also features India's first comprehensive time domain and frequency domain THz imaging and spectroscopy laboratory with dual-color ultrafast pump – THz probe capabilities. Currently this experimental initiative is applied in the areas of biomaterials, agri-photonics, security screening and advanced material characterization.

- **Physics of Quantum Materials & Information Systems:** The 3 focussed attempts in quantum computation (QC) are- (i) Majorana-based topological quantum computation (TQC) (ii) superconducting qubits based QC and (iii) trapped ion based QC. Importance of the field is evident from the fact that Google and IBM have invested heavily in superconducting qubits while Microsoft has invested in Majorana qubits.

The focus of our Department are towards (i) cold atom-based quantum technologies, (ii) quantum photonics and (iii) general Quantum Materials like Topological Insulators, quantum well based semiconductor technologies, spintronics related research etc.



The atoms are cooled to million times colder than room temperature using precisely frequency tuned lasers. The inherent quantum nature of atoms and photons allows one to design versatile quantum systems and fully control their properties by simple and clever approaches. These technological and conceptual developments will lead us to build large scale quantum information processing network, quantum computation protocols for solving industry and society relevant problems, quantum sensing devices and quantum metrology modules for precision instrumentations and measurements. Using quantum photonics quantum information and secure communication, quantum computing, quantum key distribution in free-space and in optical fibres, entanglement generation and distribution, continuously variable quantum optics, squeezing and quantum state tomography, hybrid variable quantum optics, light-matter interaction are also the focus of studies by many members of our Faculty.

Some other group of researchers are putting their efforts in the direction of studying Topological semi-metals, a quantum phase of matter that host Dirac and Weyl fermions. They study the transport properties of these exotic materials under very low temperature, high magnetic field and high pressures and realise the exotic quantum features in the laboratory scale.

- **Plasma Physics:** Plasmas are known to be the fourth state of matter. These contain large number of positive ions and electrons in almost equal number along with some neutral particles. Negative ions can also occur in plasmas and also there can be dust particles, referring to them as multi-component / dusty plasmas where the charge neutrality holds good. However, the dynamics of plasma greatly alters due to the presence of such additional charges. Each plasma species can contribute to different application of plasma. For example, electrons are responsible for high frequency phenomena including EM radiation generation, whereas the ions contribute to the synthesis of materials, surface hardening, sputtering, device fabrication etc.

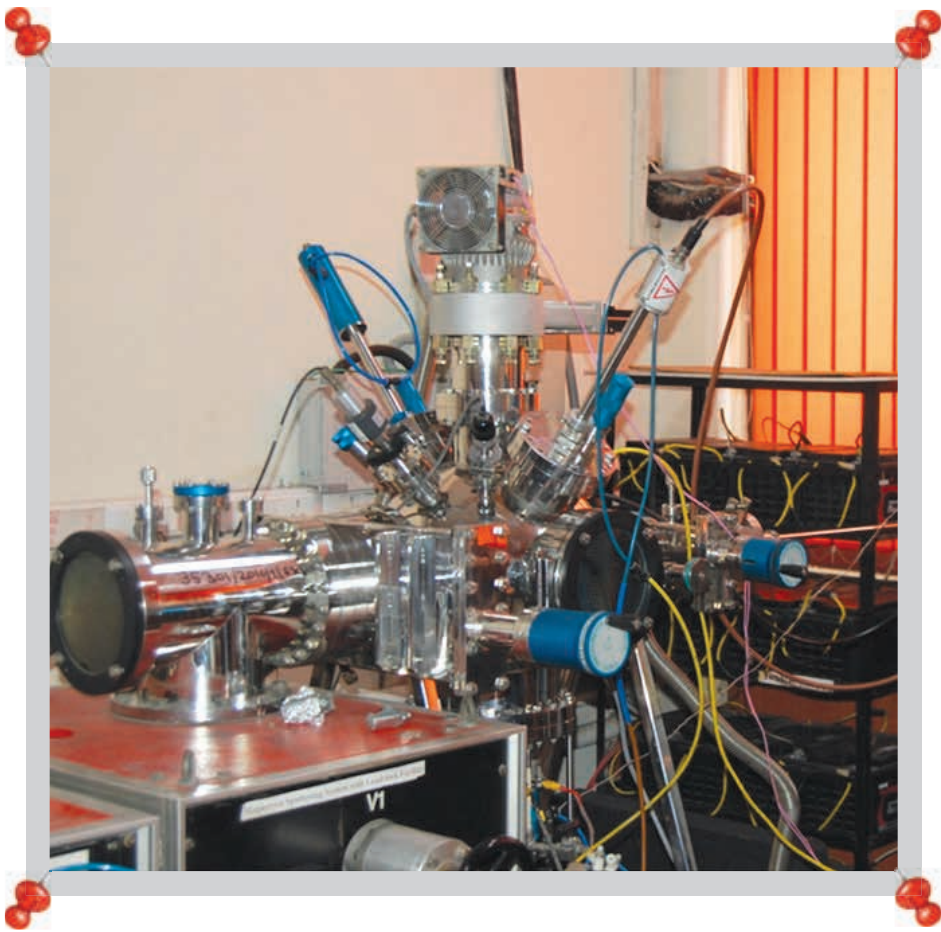
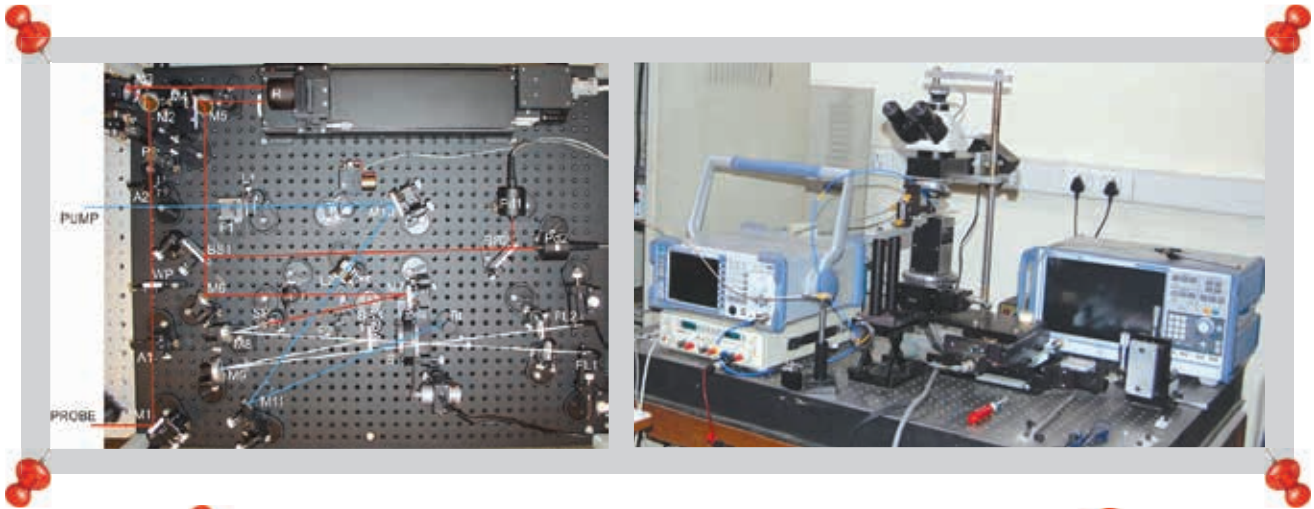
We are primarily working in the broad research areas of intense laser-plasma interaction, plasma-material interaction, plasma propulsion, plasma based radiation sources, and dusty plasmas. Areas of particular research interest include particle acceleration, fast ignition, relativistic electron beam propagation, magnetic field generation, X-ray laser excited nanoplasmas, terahertz (THz) radiation, solitons, Hall thrusters, density modulation by microwaves, surface nitriding, visco-elastic effects in dusty plasmas, and turbulence in laboratory and astrophysical plasmas.

We employ theoretical approach including nonlinear physics as well as numerical methods, namely, hydrodynamics, molecular dynamics and particle-in-cell (PIC) techniques to investigate some of the above areas and also perform experiments. Special focus will be articulated on THz for medical and spectroscopic applications, solitons for communication and diagnosis, plasma technology for device fabrication, plasma medicine, propulsion technology, and plasmas for nanotechnology in view of the upcoming M.Tech. Program in Plasma Science and Technology.

## LABORATORY FACILITIES

The Department has well-equipped laboratories for both teaching and research programmes. Some of the major research laboratories are: Solid State Physics Laboratory, Thin Film Laboratory, Magnetics & Advance Ceramics Laboratory, Nano-Stech. Laboratory, Plasma Physics Laboratory, Beam Plasma Laboratory, Fibre and Integrated Optics Laboratory, Laser Spectroscopy Laboratory, Optical Image Processing Laboratory, Quantum Electronics Laboratory. A large number of facilities are available in these and other laboratories and these include: Electron Microscopes (HRTEM, FESEM, TEM, SEM), Atomic Force Microscope (AFM), Scanning Tunneling Microscope (STM), MOKE Microscope, Scanning Auger Microprobe (SAM), Electron Spectroscopy for Chemical Analysis (ESCA). Photovoltaic, Thermoelectric and Photo electro chemical Characterization facility, Powder and Thin Film X-ray Diffractometers, XRR, FTIR Spectrophotometer, Laser Raman Spectroscopy System, SQUID Magnetometer, Dielectric and Ferroelectric set-up, Arc-melting, Auto Lab General Purpose Electrochemical System, Optical Multichannel Analyser, Closed-cycle Helium Cryotip System, High Power Argon-ion/Neodymium/YAG/Excimer/Dye/Ti: Sapphire Lasers, Optical Photon-correlator, Plasma Diagnostics System, PPMS Facility, Microwave Processing of Materials in a single (E- or H- field) or multiple mode. Ultrahigh Vacuum Units, Vacuum Coating Units, DC and RF Sputtering Units, Concave Reflection Grating, Spatial Light Modulators, Optical Transfer Function Bench, Holographic Recording Set-up, Coherent Filtering Set-up, Facility for Optical Phase Conjugation with Photorefractives, Facility for Fabrication of Tunnel Diodes, Solar Cells, Thin Film Devices and Integrated Circuits, Optical Fibre Splicing and Characterisation Set-up, In-line Optical Fibre Components Fabrication and Testing, Fabrication and Characterization of Planar Optical Waveguides, Erbium doped fibre amplifiers, Optical Spectrum Analyser, Wavelength Meters, High resolution Microscope, DWDM wave length tuned Laser Diode light sources, Long Period Fiber Grating fabrication, variety of optical fibre sensors, and Facility for making High Temperature Superconductors, Plasma and Photo CVD Units, DLTS, PL Facility, Optical CD Fabrication Facility, Indigenously developed HV compatible field emission measurement setup.

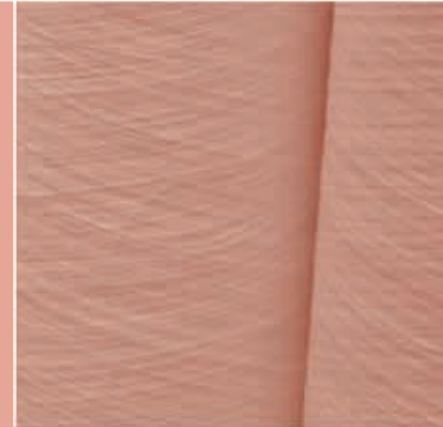
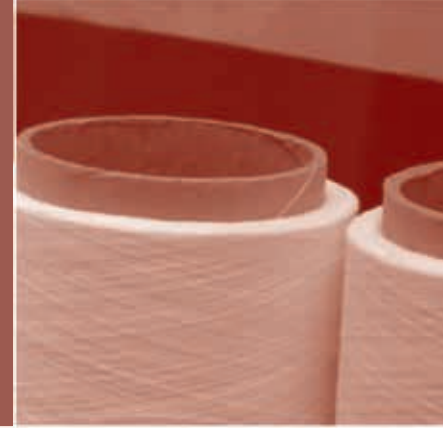
A new ultra fast optics (UFO) facility has been developed in the Department via a DST-FIST Project. This UFO facility is a unique facility that caters to diverse fields of inter-disciplinary research, wherever the research activity demands high power and ultrafast light. This facility, serves a wide variety of research activities aiming at the studies of spatial and temporal dynamics of light-matter interaction or stand-alone experiments. Potential beneficiary disciplines of the faculty are expected in the field of Optics, Nano-photonics, Material Science & Nano-science and Technology, Plasma Physics, Optoelectronics, Biology, Biotechnology, Medicine, Chemistry and Private Industries. The facility is expected to be useful to the research of other departments/Centers/Schools of IIT Delhi namely, Chemistry, Biochemical and Biotechnology, Biomedical, Electrical, Textile, CARE, IDDC, Materials Science and Engineering, and School of Biological Sciences.







**DEPARTMENT OF  
TEXTILE AND  
FIBRE  
ENGINEERING**





**Ashwini K. Agrawal, Ph.D. (Univ of Rochester)**  
**Professor**  
 Fibre Science & Technology, Polymers, Smart Textile  
 Materials, Nano materials, Plasma Processing,  
 Composite Fibres.

## HEAD OF THE DEPARTMENT



**R. Alagirusamy, Ph.D. (Georgia Tech.)**  
**Professor**  
 Textile Performs for Composite Applications,  
 Natural Fibre Composites, Short Staple Spinning,  
 Structure Property Relationship of Yarns, Textile  
 Reinforced Concrete.

**R. Chattopadhyay, Ph.D. (IIT Delhi)**  
**Professor**  
 Yarn Manufacturing Processes,  
 Quality Assurance, Ropes and Cordages,  
 Product Development.



**S. Wazed Ali, Ph.D. (IIT Delhi)**  
**Assistant Professor**  
 Functional Finishing of Textiles (Broadly, Textile  
 Chemistry - Dyeing & Finishing), Nanotechnology  
 in Functional Materials (Polymers & Textiles), Eco-  
 friendly / Green Chemical Processing of Textiles,  
 Electro-active/ Piezoelectric Polymers and Textiles.

**Apurba Das, Ph.D. (IIT Delhi)**  
**Professor**  
 Clothing Comfort, Nonwoven &  
 Technical Textiles, Compression  
 Bandage, Protective Clothing, Yarn  
 Manufacturing, Instrumentation.



**B.K. Behera, Ph.D. (IIT Delhi)**  
**Professor**  
 Fabric Manufacturing, 3D Weaving and Textile  
 Structural Composites, Textile Reinforced  
 Concrete, Mechanics of Textile structure,  
 Project Management.

**Dipayan Das, Ph.D. (Tech. Univ. of Liberec)**  
**Professor**  
 Nonwoven Products & Processes: Fibrous Air  
 Filters, Fiber-reinforced Composites, Theory of  
 Textile Structures, Fiber-to Yarn Engineering,  
 Statistical Analysis and Optimization.



**Vijaykumar Narayandas Baheti, Ph.D. (TU Liberec,  
 Czech Republic)**  
**Assistant Professor**  
 Advanced Materials Utilizing Fibrous Industrial Wastes;  
 Ball Milling of Fibrous Materials in Dry and Wet Condition;  
 Activated Carbon Fabric Structures; EMI Shielding and Joule  
 Heating Fabrics; Textile Reinforced Composites and Concrete  
 Structures; Recycling of Textile Wastes.

**Saurabh Ghosh, Ph.D. (Basel Univ.,  
 Switzerland)**  
**Professor**  
 Tissue Engineering, Medical Textile,  
 3D Bioprinting.



**B.S. Butola, Ph.D. (IIT Delhi)**  
**Professor**  
 Shear Thickening Fluids and Ballistic Textiles,  
 Textile Finishing With Metal Oxides and Bio  
 Materials, Polymeric Nano Composites.

**Bhuvanesh Gupta, Ph.D. (IIT Delhi)**  
**Professor**  
 Biomaterials, Biotextiles, Tissue Engineering,  
 Wound Care Systems, Intelligent Polymers  
 & Fibres, Plasma Processing,  
 Nano-biotechnology and Nanomaterials.







**Deepti Gupta, Ph.D. (IIT Delhi)**  
*Professor*  
 Eco Friendly Finishing of Textiles, Garment Sizing, Functional Clothing, Product Development.



**Manjeet Jassal, Ph.D. (IIT Delhi)**  
*Professor*  
 Speciality & Innovative Polymeric Materials for Textile Applications, Smart Textiles, Nanomaterials and Nanomaterials reinforced composites, Electrospinning.



**Mangala Joshi, Ph.D. (IIT Delhi)**  
*Professor*  
 Nanotechnology Applications in Textiles, Polymer Nanocomposite Fibres, Nanofibres and Nanocoatings, Bioactive and Functional Textiles, Material Development for Aerostats/Airships.



**Abhijit Majumdar, Ph.D. (Jadavpur Univ.)**  
*Professor*  
 Soft Body Armour, Ultra-Violate Radiation Protection, Soft Computing, Multi-Criteria Decision Making, Sustainable Supply Chain Management.



**Bipin Kumar, Ph.D. (IIT Delhi)**  
*Assistant Professor*  
 Fabric Engineering, Knitting, E-Textiles, Personal Protective Equipments, Medical Textiles.



**Samrat Mukhopadhyay, Ph.D. (IIT Delhi)**  
*Associate Professor*  
 Fiber Reinforced Composites, Natural Fibres and Modifications, Single Polymer Composites, Green and Sustainable Technologies, Technology Intervention in Handlooms, Color Science.

**Bhanu Nandan, Ph.D. (Kanpur Univ.)**  
*Associate Professor*  
 Fibrous Materials for Energy Storage and Catalysis, Electro-spinning, Polymer Physics, Nanomaterials via self-assembly.



**Amit Rawal, Ph.D. (Univ. Bolton)**  
*Professor*  
 Nonwovens, Modelling of Fibrous Assemblies, Technical Textiles.



**R.S. Rengasamy, Ph.D. (IIT Delhi)**  
*Professor*  
 Garment Technology, Mechanics of Yarns and Machines, Clothing and Comfort, Oil Spill Removal using Fibrous Materials, Nonwovens, Extreme Cold Climate Clothing.



**Kushal Sen, Ph.D. (IIT Delhi)**  
*Professor*  
 Textile Chemical Processing, Texturing of Synthetics/ Natural Fibres and Blends, Special Finishes, Structure-property Correlations, Conducting Textiles.



**Javed Nabibaksha Sheikh, Ph.D. (I.C.T. Mumbai), FSDC**  
*Assistant Professor*  
 Sustainable Textile Chemical Processing, Functional Modification of Fibrous Polymers, Recycling of Polymeric Waste, Natural Dyeing.



**Rajiv K. Srivastava, Ph.D. (KTH, Sweden)**  
*Associate Professor*  
 Porous and Fibrous Matrices, Reactive Electrospinning and Prototyping, Green Polymerization Methods, Biodegradable Polymers.



**S.M. Ishtiaque, Ph.D. (Tech. Univ. of Liberec)**  
*Emeritus Professor*  
 New Spinning Technologies, Yarn Structure, Machine Design, Textile Management.



## ▶ **INTRODUCTION**

The Department offers a B.Tech. Programme in Textile Technology and three M.Tech. programmes in Textile Engineering, Fibre Science and Technology and Textile Chemical Processing, besides offering the Doctoral programme.

The departmental activities are focused on niche and futuristic area, such as technical & smart textiles, nanotechnology applications, biotextiles, engineering of functional apparel, etc. The department has tie-ups with several universities in India and abroad.

## ▶ **ACADEMIC PROGRAMMES**

### **UNDERGRADUATE**

The B.Tech. programme in Textile Technology covers development and characterization of the polymeric raw materials and methods of conversion of the same into textile materials followed by further value addition and appropriate engineering into niche products. Issues related to the management of the production facilities and marketing the products are also covered adequately.

### **POSTGRADUATE**

The M.Tech. programme, in Textile Engineering focuses on training for mechanical processing of textile fibres into various textile products. The M.Tech. programme in Fibre Science and Technology trains students for the manmade fibre industry as well as in the chemical processing of textile materials. M.Tech. programme on Textile Chemical Processing focuses on advanced science and technology used in wet processing and trains students for the Textile Chemical Processing industry.

All M.Tech. programmes train students for both research and academic careers.

## ▶ **RESEARCH AREAS**

Current areas of doctoral and post-doctoral research include study of structure and properties of fibres and fibrous materials, analysis and design of yarn and fabric formation systems, mechanics of production processes, comfort properties of textiles, optimization and mechanism of dyeing and preparatory processes, eco friendly processing, micro encapsulation, antimicrobial finishes, nanotechnology applications, plasma treatment, design of technical textiles, smart and innovative textiles, electroconductive textiles, medical textiles and tissue engineering, polymer composites and apparel engineering. The activities are supported by several funded projects.

## LABORATORY FACILITIES

The Department has several state of art laboratories which are briefly described below:

- **Fibre Science and Fibre Production Laboratory:** This laboratory houses facilities starting from fibre Production to fibre Characterization. It hosts a complete range of characterization equipment such as DSC, TGA and TMA, Brookfield Rheometer, FTIR, Wide angle X-ray diffractometer, sonic modulus analyzer, etc. It also houses facilities for polymerization from small to pilot scale. Recently bicomponent fibre production facility has also been installed.
- **Yarn Manufacturing Laboratory:** This Laboratory houses a wide range of machines for producing yarns with different technologies at research as well as production scale. Staple fiber yarns can be produced by using ring, rotor and friction spinning technologies. Facilities are also available for production of air-jet texturised yarns. Miniaturized spinning machines are also available for small-scale preparation of yarn samples.
- **Fabric Manufacturing Laboratory:** The Weaving section is equipped with modern preparatory machines and looms. Preparatory section includes latest Schlafhorst 332 model winding machine, Savio lab model Orion winding machine and sectional warping machine with all controls. In weaving section- projectile, rapier, water jet and airjet looms as also a sample loom along with single end sizing and warping machine are installed. Apart from these, the lab is equipped with needle loom for tape and label, Staubly electronic dobby and Bonas electronic jacquard. Weaving section is also equipped with a CAD station system for both woven and printed design. Knitting section includes flat knitting and circular machines. Nonwovens Research laboratory is part of this lab. Industrial sewing machines constitute the garment technology facility.
- **Textile Chemical Processing Laboratory:** Housed in this laboratory are lab scale versatile equipment for chemical processing of textile fabrics, yarns and fibres. In addition, the laboratory contains relevant analytical/ testing equipment for assessing performance of treatment imparted to textiles including computer colour matching system, spectrophotometers, fastness tester, Flame retardancy tester and a full-fledged antimicrobial testing facility. Textile chemistry laboratories are equipped with a wide range of dyeing, printing and finishing machines including IR dyeing machines, HT-HP dyeing machine, lab scale jigger and padding mangles. New additions include magnetic levitation based yarn dyeing system, Plasma machine for surface functionalization, Weather-o-meter, Cone calorimeter, Limiting oxygen index tester, Vertical flammability tester, Electro-chemical work station, Freeze dryer and Rota evaporator, BOD, Padding mangle, Drying & curing chamber, High temperature steamer, etc.
- **Textile Testing Laboratory:** Physical Testing Laboratory of the department is a state of the art lab for testing textile fibers, yarns and fabric.

- » **Fiber:** Physical properties of fibers like length, strength, fineness, maturity etc. can be accessed with various basic instruments as Baer sorter to advanced instruments like HVI which is commonly used in industry for analyzing fiber related physical parameters.
- » **Yarn Testing:** Physical properties of yarns are important for its further use in fabric production. Various physical properties of yarns affect the quality of fabrics. Instruments available for testing of yarn properties are Premier yarn evenness tester, Statex automatic yarn twist tester, CCT Dynamic yarns strength tester, Statimate automatic yarn tensile tester, Zweigle Yarn hairiness tester, Lawson Hemphill and Yarn friction Tester.
- » **Fabric Testing:** Fabric can be tested for its physical and thermal behavior for its different applications. Most common physical properties are thickness, tensile strength, tear strength, crease recovery, bending stiffness and drapability. Properties like hydrostatic head testing, pilling, abrasion testing, bursting strength and air permeability of fabric are also important. Some other important instruments available for testing of various properties of yarn are, thickness tester, GSM cutter for areal density, INSTRON 3365 for tensile testing, Elemondorf tear tester, Eureka bending stiffness tester, Martindale pilling and abrasion tester, Static honestometer for static charge decay, SDL Atlas moisture management tester, TruBurst bursting strength tester, Shirley hydrostatic head tester, hot plate guarded sweat test for thermal and evaporative resistance of fabrics, Kawa bata tester, Getz water wicking tester and water vapor permeability tester.
- **SMITA Research Laboratory:** SMITA Research Lab has emerged as a prime centre of research in the field of Smart Materials and Innovative Textile Applications. Centre has been instrumental in developing novel technologies with key focus on areas like nanomaterial based specialty finishes and coatings, advanced composite fibres and films, nanofibres, responsive materials, atmospheric pressure plasma processing and wearable electronics. SMITA Research Lab owns the world class and most modern state of the art facilities under one roof for ultra-precision analysis and development of the next generation technologies. Some of the important facilities are High Resolution TEM 200 KV with EDS and EELS, FESEM with Oxford EDS system, FESEM with peltier stage, 400 MHz Solid and liquid state ready NMR, Confocal dispersive Raman microscope with automated stage, Micro Tensile Tester, Capillary flow porometer, Rotational Rheometer, Melt Capillary Rheometer, Pressure Drop Analyser with Particle Counter, Electrical property measurement system, GCMS, FTIR-ATR, Differential viscometer and RI detector, DSC, TGA, AFM etc. Centre has a fully equipped chemical lab and houses top notch sample preparation and pilot facilities like Padding, drying and curing units, Plasma processing unit, Bicomponent fiber melt spinning unit, Pilot Reactors, Microbial testing lab, Continuous melt coating unit, Electrospinning systems, Twin Screw Extruder, high temperature muffle furnace, IR dyeing and laundrometer machine, hydrothermal reactors, spin coater, environmental chamber, etc.

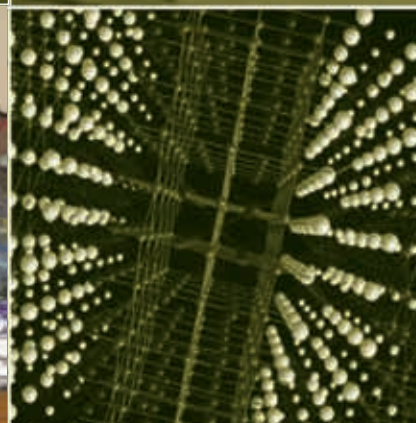
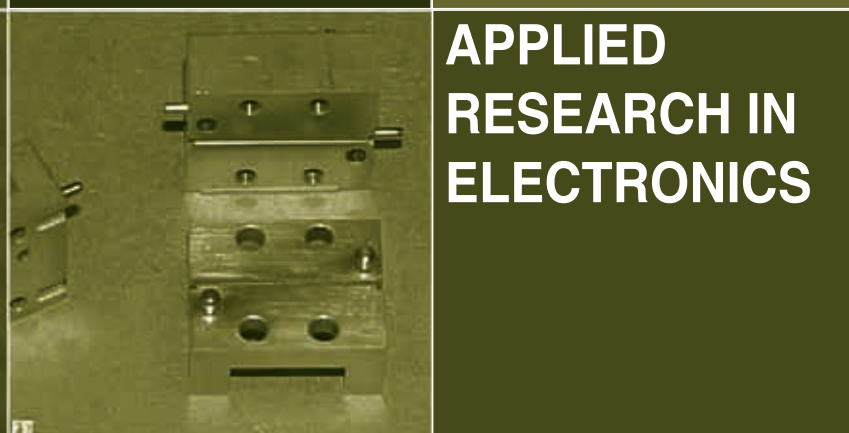
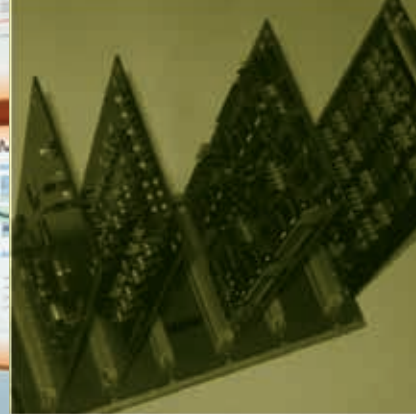
- **Aerostat and Airship Material - Processing and Characterization Lab:** A state of the art laboratory has been set up under Smart and Intelligent Textiles (SITEX) vertical of Joint Advanced Technology Centre (JATC) sponsored by 'Defence Research and Development Organisation', Govt of India for developments related to Aerostat and Airship Hull. The focus of this lab is to develop advanced coated and laminated textiles using specialty fabrics, polymeric resin and films and adhesives to get light weight, strong, weather resistant material with excellent gas barrier properties. Major processing facilities are– Single Screw Extruder with Extrusion cast Line, Twin Screw Extruder with Mini Injection Moulding machine, Hot Melt Coating and Laminating Machine and Solution coating machine. The testing and characterisation include– Thermal system (DSC/TGA/DMA), FTIR, Weatherometer, UTM, Gas Permeability Tester and Flex Durability Tester.
- **Extreme Cold Weather Clothing Laboratory (ECWCL):** Major facilities of this laboratory include a large climatic Chamber & 34-Zone Newton Thermal manikin with motorized walking motion stand as a part of SITEX (Smart and Intelligent Textiles) funded by DRDO (Defense Research and Development Organization), Government of India under JATC (Joint Advanced Technology Centre) initiative. The emphasis of this laboratory is to do focused research in developing light-weight extreme cold climate multi-layer clothing system for Indian soldiers deployed at Siachen Glacier, the highest battle field on the Earth. The other facilities pertaining to ECWCL are: In-house developed fabric thermal insulation tester placed inside a climatic chamber, sweating guarded hot plate and water-vapor transport testers.
- **JATC Soft Body Armour Materials Laboratory:** The objective of this research lab is to develop soft body armour materials using high performance fibres like Kevlar, Dyneema, Spectra, Zylon etc.. 2D and 3D fabric structures are woven by varying various structural parameters on single rigid rapier loom. Often these fabrics are treated with silica based shear thickening fluid (STF) and nano additives. Finally, fabrics and soft armour panels are evaluated for impact resistance using drop tower and ballistic resistance using 9 mm lead core bullet. The facility houses Sample loom for 3D weaving, Compression moulding machine, Super mass collider, Padding mangle, High energy drop tower, Rheometer and UV transmittance analyser.
- **Focus Incubation Centre for 3D weaving and Structural Composites:** This centre was established with the financial support from Ministry of Textiles, Govt. of India. The objective of this centre is to develop variety of innovative 3D woven structures such as 3D solid structures, spacer fabrics, honeycombs, profiled fabrics, tubular structures, aerodynamic structures, stiffeners and 3D auxetic structures primarily suitable for structural composite preforms. The centre also converts these complex 3D fabrics into their respective composite materials. Apart from development of various 3D fabrics and structural composites, the center is equipped with the facilities to characterize these materials. The characterization includes mechanical performance, structural analysis, damage analysis and surface morphology investigation of preforms as well as composites. As of now,



the centre has already acquired some major facilities such as 3D weaving machine using multi beam looms as well as creel fed loom, 4-axis Filament winding machine, Compression moulding machine, VRTM system, UTM with flexural, compression, shear test modules, Impact testing both by drop weight and Izod system, Scanning Electron Microscopy, Fabric thermal tester, and many other ancillary equipment relevant to 3D weaving and composite processing.

- **Regenerative Engineering Laboratory:** This laboratory houses experimental facilities to conduct research at the interface between fundamental and applied research, by combining the principles of Textile Technology (Medical Textiles) and Tissue Engineering to (a) develop novel engineering solutions for complex clinical diseases; (b) gain better qualitative and quantitative understanding of the tissue micro-environmental conditions fundamental for tissue development and pathogenesis; (c) develop patient-specific constructs by 3D Bioprinting.
- **Computer and Microprocessor Laboratory:** Facilities in these labs are used by students for course work, internet search, preparing reports, analyzing test data and preparing presentations. The microprocessor section of this lab is used to teach control and monitoring systems.
- **Resource Centre and Library:** The resource centre is a repository of resources essential for investigators to further their research, for a student to continuously upgrade his knowledge database and for a teacher to keep abreast with the state of art in today's world of textiles. The resource centre has a wide compilation of books, reports, theses (Ph.D., M.Tech. and B.Tech.) and journals. It also has a rich collection of samples of technical textiles for various applications.







**Ananjan Basu, Ph.D. (Univ. of California)**  
*Professor*  
Microwave and Millimeter-wave Engineering.

## HEAD OF THE CENTRE



**Mahesh P. Abegaonkar, Ph.D. (Pune Univ.)**  
*Associate Professor*  
Microwave Engineering, Antennas.

**Kirti Dhvaj, Ph.D. (University of California,  
Los Angeles, USA)**  
*Assistant Professor*  
Antenna Systems.



**Monika Aggarwal, Ph.D. (IIT Delhi)**  
*Professor*  
Signal Processing, Communication, Sensor  
Array Processing and Underwater Acoustics.

**Ankur Gupta, Ph.D. (IIT Bombay)**  
*Assistant Professor*  
MOS and III-V Device Design, DC/RF  
Measurements and Modelling, Smart  
Sensors design.



**Prabhu Babu, Ph.D. (UU, Sweden)**  
*Assistant Professor*  
Signal Processing and Communications,  
Machine Learning and Optimization.

**Arun Kumar, Ph.D. (IIT Kanpur)**  
*Professor*  
Digital Signal Processing, Speech, Audio and  
Underwater Acoustics.



**Samaresh Das, Ph.D. (IIT Kharagpur)**  
*Associate Professor*  
Nanoelectronics and Optoelectronics.

**Pushparaj Singh, Ph.D. (NTU, Singapore)**  
*Assistant Professor*  
Microelectromechanical Systems (MEMS) Sensors and  
Micro-systems, Nanowires for Nano Devices and Sensing  
Applications, Through-silicon via Interconnects and  
Packaging, MEMS/NEMS for Biomedical Applications.





**R. Bahl**, *Ph.D. (IIT Delhi)*  
**Emeritus Professor**  
Sensor Signal Processing, DSP System Design,  
Underwater Acoustics, Bio-Acoustics.



**S.K. Koul**, *Ph.D. (IIT Delhi)*  
**Emeritus Professor**  
Microwave and Millimeter Wave  
Engineering, Antennas and RF MEMS.



**Vikram Kumar**, *Ph.D. (Lehigh Univ.)*  
**Honorary Professor**  
Semiconductor Physics and Technology,  
Nanotechnology.



**Ulrich L. Rohde**, *Ph.D. (Clayton University, USA)*  
**Honorary Professor**  
Microwave circuits, (Amplifiers, Oscillators and  
Mixers ) as well as Frequency Synthesizers.

## ▶ INTRODUCTION

The Centre for Applied Research in Electronics focuses on research and training in specialized areas of Electronics. The areas encompass Signal Processing, Microwaves & Microelectronics. The Centre has several excellent laboratory facilities for post-graduate training and conducting advanced research work.

## ▶ ACADEMIC PROGRAMMES

### POSTGRADUATE

M.Tech. in Radio Frequency Design and Technology (RFDT) [Duration: 2 years/4 Semester]

A multidisciplinary masters programme in Radio Frequency Design & Technology is offered by the Centre. The programme provides specialization in Microwave/Microelectronics/Signal Processing. This course is unique in India imparting hands-on training focusing on hardware in a wide range of topics like digital signal processors and applications, speech processing, wireless and underwater communications, antenna design, active and passive circuit design at microwave and millimeter wave frequencies, fabrication of solid state devices, MEMS based sensors and actuators, RF MEMS etc. The projects done by the students are hardware intensive. Frequently, the projects are part of deliverable products for sponsoring agencies.

## ▶ RESEARCH AREAS

The Centre offers doctoral programme which is highly rated in the country.

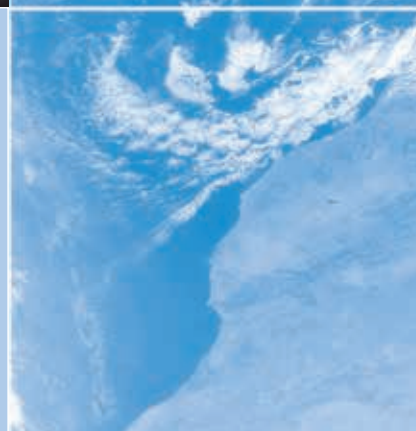
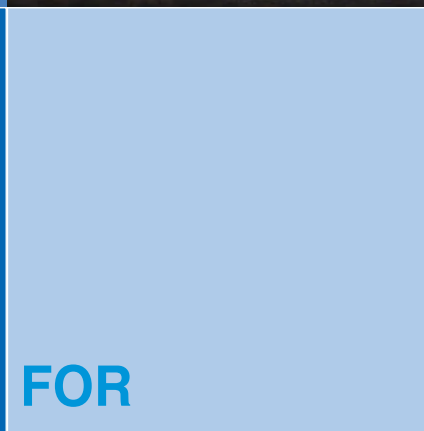
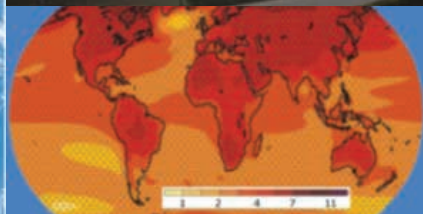
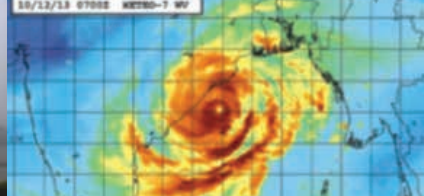
Microwaves and RF: RFIC and RFMEMS, Imaging and Surveillance, RF Digital Co-design, Active and Reconfigurable Antennas and Arrays, High Power Solid-State Systems, Nonlinear Modeling and Measurements, Components & Systems up to THz, Signal Processing: Underwater Acoustics, Acoustics for Air and other Media, Speech Processing, Signal Processing for Communications, Sensor Array Signal Processing, Multi-sensor Fusion, Microelectronics: MEMS and Microsystems, Nanoelectronics, Microsensors development for defense, space, health and environmental monitoring, mm-wave and THz devices and technologies.

## ▶ LABORATORY FACILITIES

The Centre has several state-of-the art facilities, this includes:

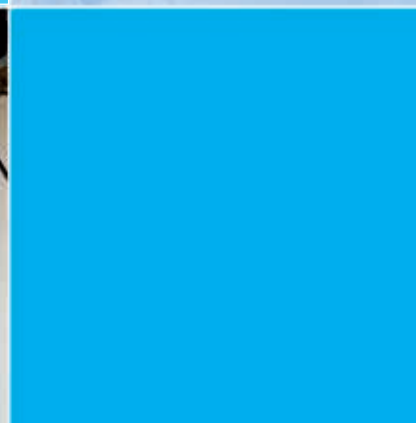
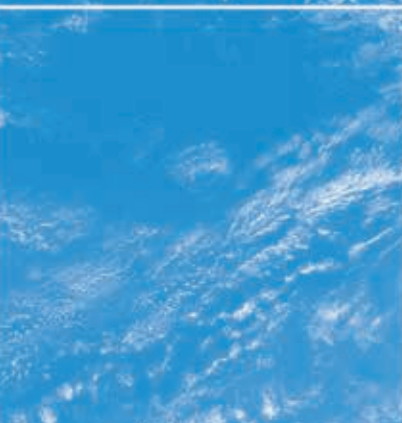
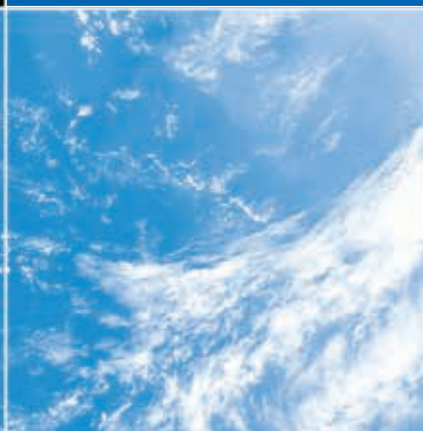
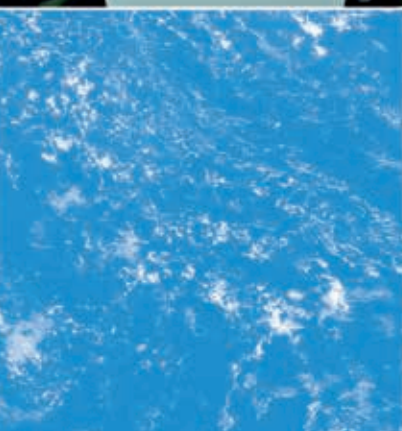
- Acoustic
- RF
- Thermal
- Kerr Effect Measurements
- Labview
- 48 node computational cluster
- Magnetorelaxometry
- NIDAQ Systems
- Texas Instruments DSP Processor Kits
- Real time oscilloscope upto 25 GHz
- Reactive ion etching and RF sputtering System
- MEMS and EM simulation tools
- Surface profiler for thickness measurement
- Anechoic chamber for antenna testing and characterization
- Vector network analyzers (upto 1THz) and Spectrum analyzer (upto 40 GHz)
- Probe stations, Free space material property measurement
- Thermal evaporation System and diffusion/oxidation furnace
- Optical and magnetic systems for non-destructive characterization
- Underwater acoustic tank facility for real-time underwater experiments
- High speed multi-channel data acquisition systems and signal analysis tools
- Full Anechoic Acoustic Chamber and Speech Processing research studies





**CENTRE FOR**

**ATMOSPHERIC  
SCIENCES**





**Manju Mohan, Ph.D. (IIT Delhi)**

*Professor*

Numerical Modeling of the Atmospheric Boundary Layer, Chemical Transport Modeling and Atmospheric Pollution Studies, Heat Island Measurements and Modeling, Urban Climate, Science of Extreme Weather.

## HEAD OF THE CENTRE



**Sagnik Dey, Ph.D. (IIT Kanpur)**

*Associate Professor*

Air Quality, Climate Change and Human Health, Aerosol-Cloud-Climate Interaction, Remote Sensing of the Earth's Climates System.

**Vimlesh Pant, Ph.D. (Univ. of Pune)**

*Associate Professor*

Physical Oceanography, Ocean Modelling, Air-sea Interaction, Atmospheric Aerosols, Meteorological and Oceanographic Observations.



**Sarvesh Kumar Dubey, Ph.D. (IIT Delhi)**

*Assistant Professor*

Atmospheric Modelling, Atmospheric Dynamics, Numerical Weather Prediction, Climate Modeling, Observational Analysis and Tropical Meteorology.

**A.D. Rao, Ph.D. (IIT Delhi)**

*Professor*

Ocean State Forecasting, Storm Surge Modeling, Coastal Circulation, Internal Waves.



**Dilip Ganguly, Ph.D. (Physical Res. Lab., Ahmedabad)**

*Associate Professor*

Aerosol-cloud-precipitation Interaction, Cloud Parameterization, Radiative Forcing and Climate Change, Climate Sensitivity and Feedback Processes, Climate Diagnostics, Monsoon Dynamics.

**Krishna Achuta Rao, Ph.D. (Tulane Univ. USA)**

*Professor*

Climate, Climate Modelling, Climate Model Validation, Climate Variability, Climate Change Detection and Attribution, Ocean Heat Content, Sea-Level Rise, Air-Sea Heat Transfer and Climate Data Analysis Tools.



**Ravi Kumar Kunchala, Ph.D. (University of Pune)**

*Assistant Professor*

Atmospheric Chemistry, Transport Modeling, Remote Sensing of Greenhouse Gases, Monitoring and Modeling of Greenhouse Gases.

**Somnath Baidya Roy, Ph.D. (Rutgers, USA)**

*Associate Professor*

Land-atmospheric Interaction, Deforestation, Agriculture, Carbon Cycle; Mesoscale and Boundary Layer Modeling, Regional Climate Change; Renewable Energy Meteorology.



**Saroj K. Mishra, Ph.D. (IISc., Bangalore)**

*Associate Professor*

Climate Modelling, Indian Monsoon, Climate Projection, Climate Change, Climate Mitigation and Adaptation, Tropical weather and Climate.

**Sandeep Sahany, Ph.D. (IISc., Bangalore)**

*Assistant Professor*

Tropical Deep Convection, High Frequency Rainfall Variability, Climate Modeling, Climate Change, Regional Climate Downscaling.





**Sandeep Sukumaran**, *Ph.D. (IIT Kharagpur)*  
*Assistant Professor*  
Climate Modeling, Indian Summer  
Monsoon, Climate Change.



**Maithili Sharan**, *Ph.D. (IIT Delhi)*  
*Emeritus Professor*  
Air Pollution Modelling, Atmospheric Boundary  
Layer, Computational and Mathematical Methods,  
Physiological Fluid Dynamics.

## INTRODUCTION

The Centre for Atmospheric Sciences (CAS) was set up in the year 1979 with the objective of undertaking modelling studies of atmospheric and oceanic processes for a better prediction of monsoon and its variability. Subsequently, the Ministry of Education, Government of India funded the Centre under the Sixth Five Year Plan, The Centre was also co-sponsored by the India Meteorological Department with a view to initiate research and mathematical modelling in meteorology in an academic institute, In 1981, the Planning Commission upgraded CAS to an advanced Centre for research, In order to complement its research activities, the Centre started the Ph.D. programme in atmospheric sciences which was the first of its kind in the country, In 2008, CAS started the M.Tech. programme in “Atmospheric and Oceanic Sciences & Technology” with the support of Ministry of Earth Sciences and Indian Space Research Organization, In the year 2011, the UG Minor Area Programme “Atmospheric and Oceanic Sciences” was initiated, which is the only one of its kind in the country. Currently, the Centre has faculty strength of 13. In the last five years, 30 Ph.D. and 50 M.Tech. degrees have been awarded by the Centre. Based on the number of research publications, degrees awarded, courses offered and student/faculty strength criteria, we estimate that CAS is ranked nationally among the top two Centres/Departments in the field. According to the 2011 US National Academy of Sciences benchmarking criteria, we also compare favorably with all US Centres/Departments in our discipline.

## ACADEMIC PROGRAMMES

**Currently CAS has three vibrant teaching programmes, namely:**

- B.Tech. Minor Area in Atmospheric Sciences
- M.Tech. in Atmospheric-Oceanic Science & Technology
- Ph.D.

### UNDERGRADUATE

The Centre has initiated Minor Area Programme in Atmospheric Sciences since 2011-12. In this minor area programme, there are six courses exclusively designed for UG students, which deal with fundamentals of weather, climate, climate change, oceanography, monsoon, earths physical processes climate modeling. UG Students need to take at least 2 courses from this pool for minor area.

The students also have options for 26 electives where they have a wide range of choice from various applied courses covering all important topics in atmospheric and oceanic sciences, In order to complete the Minor Area Programme in Atmospheric Sciences, students need to earn 20 credits from among these courses. A minor area project of 5 credits is also introduced as part of the minor area programme to facilitate completion of 20 credits.

### POSTGRADUATE

- i) The M.Tech. Programme in Atmospheric-Oceanic Science & Technology is designed to train students from



diverse backgrounds in the exciting field of Weather and Climate. The courses are also oriented to help the graduate students get employed in government organizations, public and private sectors or continue in a doctoral program within the country and abroad. There are 11 core courses including three bridge courses and a Major Project. Major projects provides an opportunities to students to work on state-of-art- research topics in diverse areas of Weather, Climate and Atmospheric transport of pollutants. In addition to these core courses, there are a number of electives which include all state-of-the-art topics in atmospheric and oceanic sciences. Some special modules for one credit are also floated every semester which are usually timed with the visits of distinguished scientists from inside the country and abroad.

In order to complete the M.Tech. programmes in Atmospheric Sciences, students' need to earn 54 credits from among these courses.

- ii) The Ph.D. programme is for highly motivated students Interested in an academic career. In addition to a thesis on a state-of-the art topic, students are required to complete 12 (for M.Sc. qualifying degree) or 6 (for M.Tech. qualifying degree) credits of coursework.

## RESEARCH AREAS

The goal of CAS is to carry out cutting-edge Interdisciplinary research and create highly skilled manpower through M.Tech. and Ph.D. programmes In 4 core areas: atmospheric modeling, oceanic modeling, air pollution and climate science. In the last five years, CAS faculty has published about 200 publications in peer-reviewed SCOPUS Journals. Regular seminars by distinguished speakers of International repute from India and abroad are arranged in the Centre so that our faculty and students can keep abreast of the latest scientific developments in the field.

### Key Research Areas:

- **Atmosphere:** Numerical Modeling of the Atmosphere, General Circulation, Tropical Meteorology and Indian Monsoon, Land-Surface Process Modeling, Land-Atmosphere Interaction.
- **Ocean:** Ocean Modeling, Coastal Processes, Ocean State Simulations and Forecasting, Storm Surges and Inundation.
- **Climate:** Climate Dynamics, Climate Variability and Changes, Climate Change Detection & Attribution, Global and Regional Climate Modeling, Climate Projections, Climate Change Impacts on Extreme Weather, Health, Agriculture, Water Resources and Energy, Aerosol-Cloud-Climate Interactions.
- **Air Pollution Modeling:** Urban Meteorology, Chemical Transport Modelling, Air Quality and Health Impact Studies, Heat Island Measurements and Modelling, Fog Prediction.
- **Applied Mathematics:** Numerical Methods, Data Assimilation and Adjoint Modeling, Inverse Modeling, GPU Computing.
- **Renewable Energy:** Renewable Energy Meteorology, Renewable Energy Resource Assessment and Forecasting.



## LABORATORY FACILITIES

The Centre for Atmospheric Science has the following Laboratories:

- Computing Server Lab
- Remote Sensing Lab
- Atmospheric Measurement Lab
- Mesoscale Modelling Lab
- Air Quality Modelling Lab I & II
- Climate Modelling Lab
- Ocean State Forecasting Lab

### a) IIT Delhi PADUM HPC System:

Partial funding is provided by CAS in the form of DST-FIST grant (500TB & 60 Tera-Flop) for the procurement of the Hybrid High Performance Computing Facility named PADUM (1 Peta-flop, 1500TB) at IIT Delhi. Currently CAS receives five times more computing time compared to other users from any department of IIT Delhi on the PADUM HPC system.

IIT Delhi HPC PADUM system has following configurations:

- » High Power Hybrid Computational Facility of 1 PFlops
- » Total 606 compute nodes (382 CPU + 201 GPU + 23 Xeon Phi nodes)
- » In addition, there are 4 general login nodes, 2 GPU login nodes and 2 Xeon Phi Login nodes.
- » Storage capacity of 1500 TB

**b) Sikka:** A 320TB storage-cum-data analysis server located in the Center's High Performance Computing Laboratory.

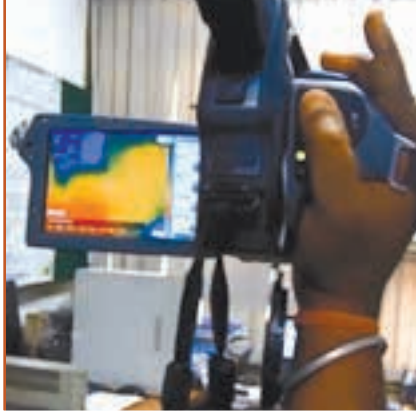
**c) Storage:** A 115TB data storage server located in the Center's High Performance Laboratory.

The computing laboratories at the Centre are equipped with state-of-the-art desktop workstations for data analysis and visualization with software's such as ERDAS imagine, ArcGIS etc.

The following equipment are available for atmospheric pollution and related observations:

- Automatic Weather Station
- Microtops Radiometer
- PM10, PM2.5, Ozone, CO and NOx analysers
- Aethalometer
- Albedometer





CENTRE FOR  
AUTOMOTIVE  
RESEARCH **AND**



**TRIBOLOGY**  
(Formerly ITMMEC)



**B.K. Panigrahi**, *Ph.D. (Sambalpur Univ.)*  
**Professor**  
EV, Charging Infrastructure, IoT & Cyber Security.

## HEAD OF THE CENTRE



**V.K. Agarwal**, *Ph.D. (IIT Delhi)*  
**Professor**  
Dilute and Dense Phase, Pneumatic Handling  
of Bulk Solids and Erosive Wear.

**Deepak Kumar**, *Ph.D. (IISc., Bangalore)*  
**Professor**  
Nanotribology, Tribodynamics, Surface  
Coating, Metal Working Fluid, Light Metals &  
Alloy, Nano Composite Grease.



**J. Bijwe**, *Ph.D. (IIT Delhi)*  
**Professor**  
Tribology of Polymers / Composites,  
Oil Analysis for Condition Monitoring.

**Naresh Tandon**, *Ph.D. (IIT Delhi)*  
**Professor**  
Vibration and Acoustic Emission  
Monitoring, Noise Engineering.



**Akhil Garg**, *Ph.D. (Nanyang Technological University (NTU), Singapore)*  
**Assistant Professor**  
EVs components and its design; Battery Management  
System; Cooling systems for batteries; Multidisciplinary  
Design Optimization.

**S. Fatima**, *Ph.D. (IIT Kharagpur)*  
**Assistant Professor**  
Machinery Health Monitoring, NVH,  
Acoustical Natural Materials, Reliability and  
Maintenance.



## INTRODUCTION

CART, (formerly known as ITMMEC) has been established in May 2019 with a vision to promote interdisciplinary research in Electric Vehicles (EV) and related areas.

Following are the five major verticals of CART:

- Electric Vehicles (EV)
- Energy Storage and Monitoring
- Automotive Health Monitoring
- Calibration and Diagnostics
- Tribology

As this new entity has been evolved from ITMMEC, the current strength of the center is in Tribology but it will be building expertise in all other verticals very soon.

## ACADEMIC PROGRAMMES

### POSTGRADUATE

The Centre coordinates an interdisciplinary M.Tech. programme in 'Industrial Tribology and Maintenance Engineering'. The interdisciplinary programme is industry oriented and it offers curriculum and training, which are of relevance to the job requirement of engineers in industry. The programme is open to fresh candidates through GATE and sponsored candidates from industry and Defence. The teaching faculty is also drawn from Departments of Applied Mechanics, Mechanical Engineering and Centre of Polymer Science and Engineering (CPSE).

## LABORATORY FACILITIES

The Centre has excellent facility for experimental, analytical and development research activities. With its highly specialized manpower, the Centre interacts with industries through consultancy, field service and also joint sponsored research programmes.

The Centre has well-equipped laboratories, which are:

- Lubrication and Oil Monitoring Laboratory,
- Friction & Wear Laboratory,
- Machine Dynamics Laboratory,



- NDT Laboratory,
- Project Laboratory
- Lubricant Laboratory

**The ongoing research areas of the Centre are:**

Condition monitoring of machinery using vibration, noise, acoustic emission and wear debris, thermography, oil analysis, vibration and acoustic emission monitoring of bearing and gears, noise evaluation and control, Tribology of fiber reinforced polymer composites and nano-composites, friction, wear, and lubrication of machines and components, Tribology of non-asbestos friction materials, boundary lubrication studies, hydrodynamic and elastohydrodynamic lubrication (EHL), Engine Tribology, wear studies, development of wear resistant coating, nano-composite greases, aqueous lubrication. Design and troubleshooting of pneumatic conveying systems, residual life assessment of oils, friction and wear studies of composites and elastomers, maintenance, reliability and safety of mechanical systems.







**CENTRE FOR**

**BIOMEDICAL  
ENGINEERING**





**Harpal Singh, Ph.D. (IIT Delhi)**

*Professor*

Medical diagnostics, Drug Delivery Systems, Antimicrobial Polymers, Polymeric Hydrogels, Nanobiotechnology, Polymer based Implants & Medical Devices.

## HEAD OF THE CENTRE



**Jayanta Bhattacharyya, Ph.D. (IICT, Hyderabad)**

*Assistant Professor*

Biomaterials, Drug Delivery, Cancer Diagnosis & Therapy.



**Arnab Chanda, Ph.D. (Univ. of Alabama)**

*Assistant Professor*

Artificial Tissues, Footwear, Sensors, Wearable Technologies, Entrepreneurship.



**Sandeep Kumar Jha, Ph.D. (Bhabha Atomic Research Centre, Mumbai)**

*Associate Professor*

Biosensors; Nanoparticle Sensing; Microfluidic Lab-on-a-chip; Capillary Electrophoresis Microchip; Immobilization and Stabilization of Biomolecules.



**Deepak Joshi, Ph.D. (IIT Delhi)**

*Assistant Professor*

Biomedical Instrumentation, Rehabilitation Engineering.



**Dinesh Kalyanasundaram, Ph.D. (Iowa State University, USA)**

*Associate Professor*

Biomechanics, Diagnostics, Design and Development of Implants (Orthopaedic & Orthodontics), Fabrication/Machining of Materials (Laser Machining).



**Amit Mehndiratta, M.B.B.S., D.Phil. (University of Oxford, U.K.)**

*Assistant Professor*

Quantitative Medical Image Analysis for CT and MRI, Perfusion and Diffusion Imaging, Neuro-rehabilitation, Mobile Healthcare.

**Biswarup Mukherjee, Ph.D. (IIT Madras)**

*Assistant Professor*

Ultrasound Imaging, Bioinstrumentation, Sensors, Biomechanics, Rehabilitation and Prosthetics, Haptics.



**S.M.K. Rahman, M.Tech. (Univ. of Allahabad)**

*Assistant Professor*

Computer Architecture, Embedded Systems, Microprocessor based Industrial Control, Digital Hardware Design and Medical Electronics.



**Anup Singh, Ph.D. (IIT Kanpur)**

*Associate Professor*

Development of Magnetic Resonance Imaging (MRI) Techniques/Methods based on Exogenous or Endogenous Contrast Agents, Medical Image Processing and Data Analysis.



**Neetu Singh, Ph.D. (Georgia Tech., USA)**

*Associate Professor*

Design of Nano-structured Materials for Biomedical Implants, Cancer Diagnostics & Therapy, Tissue Engineering, Drug Delivery, Study of the Bioactivity of Nanostructures and Finding Structure-bioactivity Relationships.



**Sneh Anand, Ph.D. (IIT Delhi)**

*Emeritus Professor*

Biomedical Instrumentation, Rehabilitation Engineering, Biomedical Transducers and Sensors.



**Veena Koul, Ph.D. (Kashmir Univ.)**

*Emeritus Professor*

Biomaterials, Medical Devices, Clinical Diagnostics, Drug/Gene Delivery Systems, Nanomedicine.



## ▶ CENTRE FOR BIOMEDICAL ENGINEERING

Centre for Biomedical Engineering was established in 1971 as a Joint programme of Indian Institute of Technology, Delhi and All India Institute of Medical Sciences, Delhi. The Centre has applied engineering principles to address medical and biological problems. It has faculty from diverse backgrounds who are actively engaged in various interdisciplinary research activities. In addition, the centre has collaborative projects with major institutes and hospitals in India and abroad. Over the years, it has become a premier centre for biomedical research in the country and has provided interdisciplinary base to develop health care technologies. In the last two decades the focus has expanded to include medical imaging, tissue engineering, nanomedicine, implants, biomedical devices, and informatics approaches for the prevention, diagnosis and treatment of diseases.

## ▶ ACADEMIC PROGRAMMES

The Center has a Ph.D. program and M. Tech. programme in Biomedical Engineering. Various courses relevant to Biomedical Engineering, which are open to undergraduate and graduate students at IIT Delhi are offered by the Centre.

Some of the courses being offered include Introduction to Basic Medical Sciences for Engineers, Industrial Biomaterial Technology, Research Techniques in Biomedical Engineering, Tissue Engineering, Biomaterials, Biosensor Technology, Medical Imaging and Processing, Emerging Biomedical Technology & Health Care, Biomechanical Design of Medical Devices, Cancer: Diagnosis and Therapy, Point-of Care-Medical Diagnostic Devices, Orthopaedic Device Design, Biofabrication, Nanomedicine, and Computational Biomechanics.

## ▶ RESEARCH AREAS

The Centre's research focus spans in four thrust areas:

- **Bio-Instrumentation:** Biosensor, Molecular markers in diseases, Lab-on-a-chip, Microfluidics, Biomedical transducers and sensors, Neuro endoscopy, Integrated healthcare, Assistive devices & rehabilitation, DNA based diagnostics.
- **Biomaterials:** Nanomedicine, Controlled drug delivery systems, Soft skin regeneration, Targeting of bioactive molecules to brain and cancer, Wound care healing, Tissue engineering, Medical diagnostics and therapy.
- **Biomechanics:** Orthopaedics, Orthodontics, Computational analysis and software packaging, Neuromechanics, Neural prosthetics, Soft tissue mechanics, Artificial tissue.
- **Medical Imaging:** MRI, CT, etc., Development of protocols, methods/ evaluation of their potential models, techniques and software tools, Image processing, Quantitative image analysis.

The average number of Ph.D. students graduated over the last 5 years per faculty has been 4.4 and the average SCOPUS cited publication per faculty is 8. The Center has received extramural research funding of ~ 10 Crores from government funding agencies and ~20 Lakhs as industrial consultancy for the year 2019-2021.

Recently major facilities such as Confocal laser scanning microscope, Raman Spectroscopy with imaging and Flow cytometer has been installed. New labs based on drug delivery, laser micromachining, Lab-on-a-chip and image processing have been established.

**Technology Developed by the Centre Include:**

MRI Compatible Knee Joint Axial-Load Exerting Device, Wearable gait analysis system, Novel kit for assay of iron in biological fluids, Modulated DC iontophoretic Device, Diblock copolymer in a Nanosystem and Implementations thereof, Contra Lateral Limb Controlled Prosthetic Knee Joint, Wireless ECG patch and system for obtaining High Definition mobile ECG, A Surgical Stapler, Bilayer dressing for wound healing; Biocompatible graphene quantum dots for drug delivery and bioimaging applications, Green Florescent Carbon Dots for pH Sensing.

**The Centre has in Past Transferred Following Technologies to Industries:**

Heat sealable coatings onto paper for adhesion with PVC polyester and polystyrene films for packing application, Immobilization of aminoacylase on functionalized acrylics for production of 6- aminopenicillanic acid from penicillin, Antimicrobial acrylic bone cement for fixation of hip and knee joints, Polymeric nanoparticles and process of preparation thereof for delivery of peptide based anticancer agents, Contra Lateral Limb Controlled Prosthetic Knee Joint, Iontophoretic Transdermal Device for delivery of Diclofenac, Opto- electronic Hemoglobinometer and Intelligent Artificial Leg.

**LABORATORY FACILITIES**

The Centre has the following laboratory facilities:

- Biomechanics
- Bioelectronics, Biomechanics & Fabrication
- Biomaterials, Biosensor
- Pre-Clinical and Animal Experimentation (AIIMS)
- Bio-signal Processing
- Soft Tissue Engineering
- Drug delivery Laboratory
- Nanoparticles Characterization
- Biomaterials Instrumentation
- Nanomaterial Synthesis Lab
- Laser Micromachining Lab
- Lab-on-a-chip
- Biomedical Instrumentation
- Medical Imaging Processing
- Molecular Biology
- Bio-therapeutics
- Artificial Tissue Lab

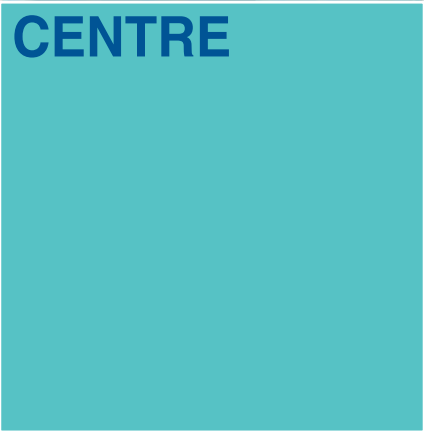
# EDUCATIONAL TECHNOLOGY SERVICES

## CENTRE



- Case for e-Environment
- Live and dynamic experiences
  - Interactivity
  - Storage and retrieval
  - Reach
  - Creation of the real world village virtually
  - Making it learner-centric
  - Reliable connectivity

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*Associate Professor*  
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## HEAD OF THE CENTRE



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**Kolin Paul**, *Ph.D. (BESU)*  
*Professor*  
Department of Computer Science &  
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**Ashok Gupta**, *Ph.D. (IIT Delhi)*  
*Professor*  
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**Shalini Gupta**, *Ph.D. (North Carolina State University, USA)*  
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**Kushal Sen**, *Ph.D. (IIT Delhi)*  
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## INTRODUCTION

The Educational Technology Services Centre (ETSC) is actively engaged in promoting the use of Educational Technology at the Institute and also at the national level. Some of its major activities are:

- Design & Development of Instructional Resources (videos and web based).
- Provision and maintenance of AV equipment for classroom teaching.
- Video and computer based instructional packages.
- Organize training programmes for faculty and professionals across the country.
- Video conferencing for faculty selection interviews and meetings.
- E-learning and distance education.
- Undertake sponsored research and consultancy projects.
- Offer support for classroom teaching.

The Centre has a modern video studio with recording and editing facilities in DVCAM format. A studio-classroom with seating capacity of 60 is available for on-line recording of courses. Nonlinear editing setup and Apple Streaming server are available for post production and video streaming. ETSC takes care of the audio-visual needs of faculty and students. In addition to equipping the classroom with these facilities, ETSC runs a loan service. A media reference library with multiple viewing cabins has been set up in the Central Library for the use of students and faculty. The Educational Technology Services Centre has a computer laboratory with modern multimedia capabilities and internet connectivity. Computer Aided Instruction/Computer Aided Learning courses/packages are developed in the computer laboratory. Learning materials generated by ETSC are disseminated at nominal price throughout the country and abroad and through the NPTEL, Swayam, and Swayam Prabha Platforms.

The Centre conducts short courses and modular programmes on different aspects of educational technology for teachers and staff from the Institute and from other educational institutions and industry institutions. These courses are designed to sensitize and guide the faculty to optimize their effort and time for classroom and laboratory instruction as well as professional development. The Centre offers its services to departments, individual faculty or groups of faculty members in revising, redesigning and innovating curricula.

The Centre has the expertise and experience of undertaking national and international level consultancy and sponsored research projects. It has worked with agencies such as the World Bank, AT&T, AICTE, UNESCO, UNDP Commonwealth of Learning, British Council and Adis Abada University, Ethiopia. The NPTEL (Phase I and II) project, funded by MHRD have been successfully completed. Under this programme, all the seven IITs and Indian Institute of Science have worked together to develop web and video based education material for undergraduates courses

initially in five disciplines, viz., Civil Engineering, Computer Science and Engineering, Electrical Engineering, Electronics and Communication Engineering and Mechanical Engineering. The web courses so developed are available through the various servers authorized by NPTEL.

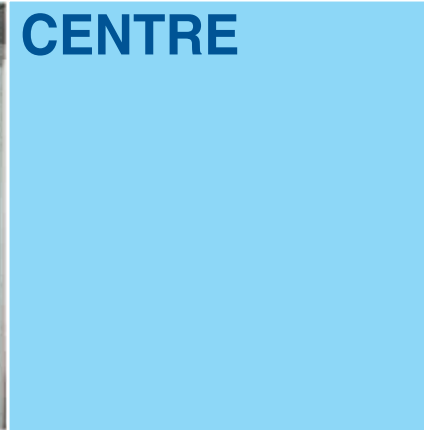
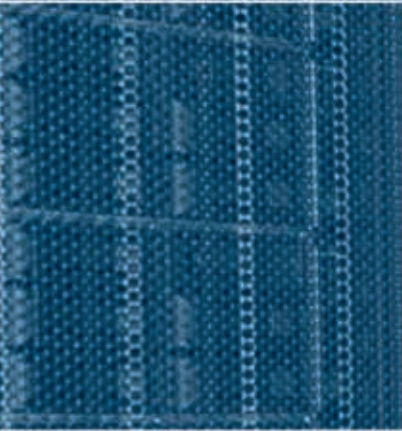
As the third phase of NPTEL, ETSC is involved in helping institute faculty develop massively open and online courses (MOOCs) under the NOC/Swayam (NPTEL online certification) platform. ETSC is also coordinating 6 TV channels under Swayam Prabha and IIT-PAL (Civil Engineering, Electrical Engineering, Physics, Chemistry, Mathematics and Biology).

ETSC has procured and installed Sony ANYCAST system in the Video Studio and in two lecture theatres for non linear editing and recording. Video Conferencing facilities have been installed in the two lecture theatres for non linear editing and recording. Video Conferencing facilities have been installed in the two lecture theatres and in the Conference Room of ETSC. The facility is being used for faculty interviews, meetings and distance education. For connectivity both ISDN and IP based network connection are used. For classes to Adis Ababa University, two lecture delivery rooms have been equipped with remote teaching facility. A dedicated two-way video link is also provided for live delivery. Two new lecture rooms have also been equipped with audio/video, projection, distance education and recording facilities. In addition, three Virtual Classrooms are also being equipped under National Knowledge Network (NKN).

The new Lecture Hall Complex (LHC) has state of the art audio visual facilities managed by ETSC. The LHC includes 2 rooms of capacity 500; 3 rooms of capacity 300; 12 rooms of capacity 150; 9 rooms of capacity 60; and 6 rooms of capacity 30. The facilities include live video recording of lectures, tablet PCs for projection of the written lectures on the screens, document visualizers, microphones and speakers in the class rooms.









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*Professor*  
Computer Graphics, 3D Animations.

## HEAD OF THE CENTRE



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Network & System Administration.



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**Pragya Jain, Ph.D. (IIT Delhi)**  
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Parallel Processing, Cloud Computing & Virtualization, Systems Administration, Numerical Analysis.



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**Jaya, M.Tech. (IIT Delhi)**  
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System Programming.



**Gopal Krishen**, *M.Sc. (Kuruksheetra Univ.)*  
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## ▶ INTRODUCTION

The Computer Services Centre provides round the clock computing and networking facilities to serve a user population of 12,000+ users consisting of Undergraduates, Postgraduates, Research Scholars, Faculty and Staff of the Institute and provide advice on all the aspects of academic computing. The Centre also participates in the academic programmes of various departments and centers.

## ▶ COMPUTING FACILITIES

The Centre is equipped with 144 HP/CISCO UCS blade servers out of which 112 Blade Servers are used for Cloud computing with 200 TB of virtualized storage and 32 blade servers with 130 TB of storage for user homes and infrastructure use like email, proxy, web services etc. CSC also has around 450 Desktop computers connected over a switched fast Ethernet. Uninterrupted Power Supply is provided through 2x80 KVA MGE UPS system and DG set.

## ▶ HIGH PERFORMANCE COMPUTING (HPC)

The HPC facility in the Data Centre consists of the following:-

**Compute Nodes:** 606 (CPU nodes: 405, GPU nodes: 201)

**Haswell nodes (422 nodes):**

- GPU (161 nodes): NVIDIA K40 (12GB)
- CPU (261 nodes): 2x E5-2680 v3 2.5GHz/12-Core
- RAM: 64 GB
- 12 CPU and 8 GPU nodes have 512 GB RAM each

**Skylake nodes (184 nodes):**

- GPU (40 nodes): NVIDIA V100 (32GB)
- CPU (144 nodes):
- RAM: 96GB
- 40 GPU and 8 CPU nodes have 192 GB RAM each

In addition, we have 6 login nodes for job submission, monitoring etc.

Storage: Home space: 678 TB and Scratch space: 3430 TB.

## ▶ PC SERVICES

There are six PC Labs in the CSC premises having about 225+ Desktop computers under Windows10 and Ubuntu environment. Besides this there are four Computing labs in the Lecture Hall Complex (LHC) having 235+ desktop computers running Ubuntu and Windows 10. Projection facility is also provided for the UG/PG courses of the Institute which are held every semester. Every user has been provided a Kerberos user-account and password for logging into the system and also for using Internet facility.

The PC Labs in the main building of the Centre are open Round-the-Clock for authorized users. These labs are extensively used by the departments for conducting UG/PG Lab courses and by general students.

## ▶ NETWORK SERVICES

The Institute LAN is a state-of-the-art switched network with Fiber Optics and enhanced CAT5/CAT6 UTP backbone. It consists of more than 9000 network access points spread over the campus using about 450 Cisco switches and about 75 virtual LANs. Network access is provided to every student, faculty, Doctor, Laboratory, offices and rooms in guest houses. Internet connection has been provided through a router, redundant firewall switching modules, and 2x10 Gbps from NKN.

IIT Delhi is connected to the National Knowledge Network (NKN) with 10 Gbps dual connectivity from Power Grid and RailTel. This connectivity provides virtual routing service, Internet Connectivity, and connectivity with other Institutes connected on the NKN backbone.

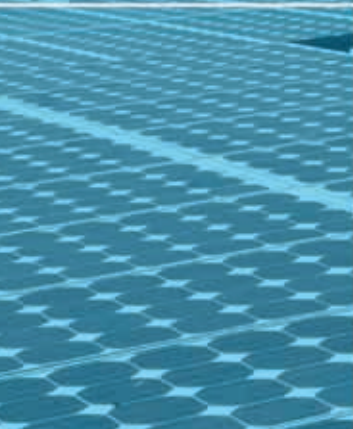
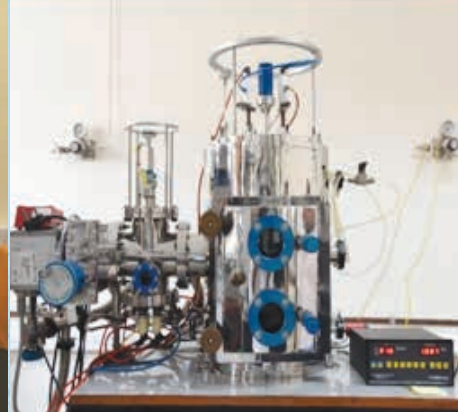
Internet and Intranet access is provided to faculty/officer homes via GPON over fiber (750+ houses) and ADSL connectivity over internal telephone lines.

The Academic, Hostel area, both Guest houses, RCA and Hospital are also connected through IITD\_WIFI and Secure Wi-Fi (IITD\_Secure\_GUEST). There are 1400+ wireless access points. Many network services including mail, web, and domain name, anti-virus is being provided over this network.

## ▶ FACILITIES/SERVICES

- All Services are authenticated and authorized using a central Kerberos system.
- The **email facility** is provided to all students, staff and faculty with webmail interface “Round cube”.
- **Baadal** is a Cloud computing environment that provides virtualized computing resources for academic and scientific environments. Some of the main features of Baadal are: Dynamic Resource scheduling and power management; Facilities for suspend, resume, shutdown, power off, power on, specifying resource requirement of VM; and Dynamic resource utilization monitoring.
- The **Data Center (DC)** consists of Cisco UCS B200 : Five chassis with 40 blade servers – 16 blades each with 2x12 Cores Intel(R) Xeon(R) CPU E5-2695 v2 @ 2.40GHz with 128 GB RAM, 8 blades each with 2x14 cores CPU E5 with 256 GB RAM and 16 blades each with 2x18 cores CPU Intel Xeon Gold 6140 with 256 GB RAM.
- The **Disaster Recovery Data Centre (DRDC)** is situated in the SIT building. The DRDC has been built by IBM and can support a total IT load of 60 KW. It has redundant UPS power supplies and precision air conditioners in N+N and N+1 configurations respectively.
- The CSC provides **Infrastructure Services** through Virtualization technology.
- The CSC has **Microsoft Volume Licensing** EES agreement for the Campus under which Microsoft software such as Windows OS, MS Office, Office365 etc. are available for use.

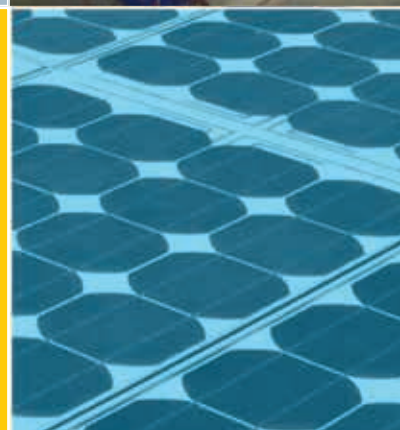
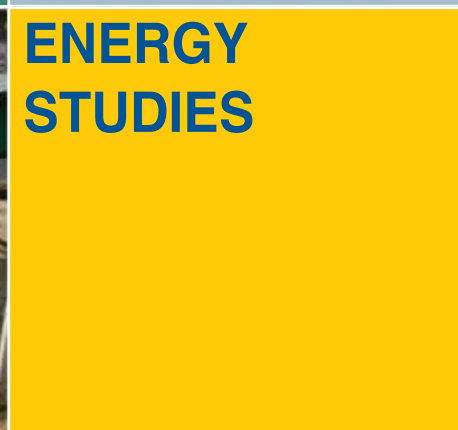
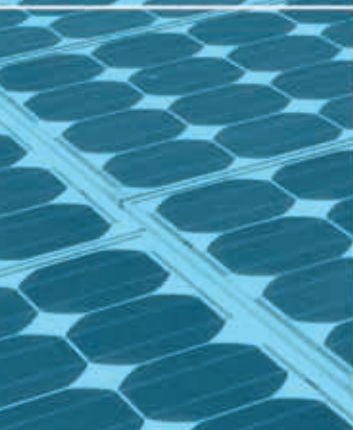
- The center also has the following third-party software packages: MATLAB, Mathematica, Ansys, COMSOL, LabVIEW, etc. available on the CSC webpage.
- The center maintains **local repositories** of several popular open-source and commercial licensed software.
- The CSC has configured **moodle** a public domain course management software, for use by faculty and students for the courses running during the semester.
- IIT Delhi is also a part of **Eduroam**, a global WIFI roaming programme across academic campuses through ERNET India.
- **Own Cloud/Next Cloud**, a file and document sharing utility similar to the popular drop box is also provided for user community. The utility supports storing and sharing of files, images, music and documents, contacts, calendars, tasks etc.
- To facilitate downloads of data files through non-standard ports, **download Server: download.iitd.ac.in** can be used and to facilitate download of huge data for Research, proxy server xen03.iitd.ac.in (Research proxy) can be used. The faculty has been authorized to provide download permissions to their students from the webpage.
- **Virtual web** hosting facility can be used for securely hosting all websites of the form **http://xyz.iitd.ernet.in** which are not maintained by CSC. In addition, CSC maintains large number of websites including IITD main website and some departmental websites.
- **User web pages** is available for the use of faculty and Ph.D. students for hoisting their web-pages on the server web.iitd.ac.in
- To provide **Internet access** to the visitors, the faculty and officers have been authorized to create user account for their visiting faculty/ students.
- To facilitate limited access within IITD, CSC has a separate **web server privateweb.iitd.ernet.in** where users can have their personal web pages.
- **VPN** facility is provided to the users for accessing IITD internal network from outside IIT Delhi. The faculty have been authorized to create cert-keys for their own use and their advisees from the VPN webpage on the CSC website.
- Network Time Protocol (**NTP**) servers are synchronized with standard internet time servers with time drift less than a few milliseconds and can be used by all users.
- MRTG and RRD **Health Graphs** have been provided to see the Status Reports of the various System activities/ Services.
- **SLA** ticketing system - SLA for Networking & SLA for Software have been provided for resolving User problems pertaining to Network and Software issues.



**CENTRE FOR**

**FOR**

**ENERGY  
STUDIES**







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*Professor*

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*Professor*

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**Dibakar Rakshit, Ph.D. (The Univ. of Western Australia)**

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**Kaushik Saha**, Ph.D. (University of Waterloo, Canada)

*Assistant Professor*

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**Debaprasad Sahu**, Ph.D. (IIT Kanpur)

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**R. Uma**, Ph.D. (IIT Delhi)

*Associate Professor*

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**S.K. Tyagi**, Ph.D. (CSS, Meerut)

*Associate Professor*

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**Sandeep Pathak**, Ph.D. (University of Cambridge, U.K.)

*Assistant Professor*

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**Ashu Verma**, Ph.D. (IIT Delhi)

*Associate Professor*

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**T.S. Bhatti**, Ph.D. (IIT Delhi)

*Emeritus Professor*

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**A. Ganguli**, Ph.D. (IISc., Bangalore)

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*Emeritus Professor*

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## INTRODUCTION

Energy forms an integral part of all the scientific and engineering disciplines. Since the demand for energy world-over has been leading to rise of known as well as future sources of energy. Study of energy resources and technologies for their efficient utilization has great impact on economic and social life of a country. Energy experts are needed for developing sustainable solutions for meeting energy demand without adversely affecting the environment. Centre of Energy Studies has mandated itself in training and research in Energy Engineering for serving the energy needs of the country with special emphasis on energy efficiency, renewable and alternative energy technologies and energy-environment interaction.

## ACADEMIC PROGRAMMES

### UNDERGRADUATE

The Centre is offering several electives in the emerging areas of Energy and Environment for UG students as open category courses.

### POSTGRADUATE

The Centre offers the following post-graduate programmes, as full-time/part-time programme for Engineering graduates and Science post-graduates, leading to the award of M. Tech. Degree:

- M.Tech. in Energy Studies
- M. Tech. in Energy & Environment Technologies and Management
- M. Tech. in Renewable Energy Technologies and Management (sponsored students only)
- Ph.D.

## RESEARCH AREAS

The major research groups of the centre are:

- Electrical Power and Renewable Energy Systems
- Plasma Science and Technology
- Solar-Thermal
- Energy Storage
- Internal Combustion Engines and Alternative Fuels
- Solar-Photovoltaics
- Wind and Hydro
- Energy Systems Simulation

The focused topics of doctoral and post-doctoral studies as well as sponsored research at the centre are:

- **Renewable Energy Technologies (Solar Photovoltaics, Solar Thermal, Biomass and Wind:** Solar, wind, biomass, water and other energy sources are cleaner and perennial energy sources which the nature has provided for the use of mankind. The Centre has done extensive work on solar thermal technologies and solar photovoltaic systems. Design of solar hot water systems, dryers, space heating/cooling systems, thermal power generation and industrial process heating systems is performed by using state-of-art software. Studies on developing clean and efficient biomass cookstoves have also been initiated.

The focus of the photovoltaics group has been on thin film based (2nd generation) and Dye-sensitized, Organic and Perovskite (3<sup>rd</sup> generation) solar cells fabrication and device analysis. The nanocrystalline materials for photo-electrochemical and organic solar cells are being developed. The studies also include implementation of nanophotonics concepts for enhancing solar cell performance, and silicon heterojunction solar cells based on amorphous silicon/crystalline silicon and carrier-selective contacts; perovskite-based photovoltaic devices and their long-term stability; understanding the correlation between photo-physical properties and microstructural properties of semiconducting thin films. Development of novel materials for low-cost and high-performance photovoltaic devices is also under progress.

Under organic solar cells, use of organic polymers and other related hybrid semiconducting materials to maximize efficiency in the collection and harvesting of solar energy is being studied. The research group mainly focuses on the physics, material science and device engineering with the aim to develop innovations that will lead to the better device performance and higher device energy efficiencies.

The solar-biomass-hybrid laboratory has the mandate for solar and biomass-hybrid applications including but not limited to heating, cooling, cooking and desalination. Some of the experimental setups such as, vapor compression heat pump, thermoelectric-cooler-generator (TEC/TEG) and biomass combustion device testing facilities are available for both M.Tech. and Ph.D. students. The required instruments like the portable gas analyzer, particulate matter analyzer (PM2.5 and PM1.0) bomb calorimeter and microbalance were procured during the last three years. The R&D works in the area of solar-biomass-hybrid refrigeration, biomass-solar-desalination, vapor adsorption, clean biomass combustion for cooling, heating, cooking, desalination, and other industrial applications is on-going.

The focus of the research in hydropower is to investigate the off-design and transient operations of the hydraulic turbines. The main objective of the study is to understand the flow dynamics inside the turbine using both experimental and numerical techniques during steady-state and transient operating conditions. The study also includes the investigations of cavitation and sand erosion in hydraulic turbines.

The wind energy is considered as one of the first kind of renewable energy sources after the evolution of the solar energy. Exergies in the wind power generation gains greater interests to the researchers in past few decades. Both HAWT and VAWT exhibited a remarkable and comparable performance. The research on the wind turbine focuses on performance enhancement and understanding of the mechanism of flow using experimental and numerical techniques.

- **Internal Combustion Engines and Alternative Fuels:** Globally, conscious efforts are being made to undertake research and development activities to facilitate transition towards low carbon options in all sectors of the economy. Promoting the use of alternative fuels as clean fuel in internal combustion engines/vehicles for transportation as well as for power generation is an important initiative in this context. The cutting-edge technologies for utilization of alternative fuels including methanol, ethanol, biogas, hydrogen, biodiesel and dimethyl ether in internal combustion engines are being developed. Life-cycle analysis and Greenhouse gases

of alternative fuels are being studied for screening of sustainable fuels for internal combustion engines. The hybrid technologies including IC Engines with Electric System, IC Engines with Fuel cells and IC Engines with renewable energy system are being studied. A strong research linkage with oil & gas industries and automotive engine manufacturers is fostered to develop the required technologies. The further research work is focused towards achieving sustainable energy and environment.

- **Energy Conservation and Management:** One of the main aims of buildings is to provide internal environment where one can have visual as well as thermal comfort. This is partly provided by an energy efficient building design and/or by providing energy efficient end use devices. By using sophisticated computer modelling, the building group in the Centre assists the architects to arrive at an optimum design to achieve better day lighting and minimize the air conditioning load. Additionally, the group can also undertake the design and fabrication of building automation systems to reduce energy related operating costs.

Thermal Energy Storage Studies pertaining to adequate façade to contrive a comfortable indoor environment with reduced active HVAC power requirements are carried out at Centre for Energy Studies. This basically aims at designing thermally conducive environment for hot climatic conditions through deployment of phase change materials (PCMs) in building envelopes that can store the excess incoming heat through the envelope as latent heat (at constant temperature) and later release the stored heat to the colder ambient at night. In cold regions, PCMs packed under building floor can maintain a comfortable floor temperature for a long time by gradually releasing latent heat while undergoing phase change.

Besides this medium temperature range thermal energy storage system designs for perennial supply of thermal energy, required for non-conventional refrigeration and cooling system are also studied. Recently Centre for Energy Studies started exploring ultra-high temperature thermal energy storage systems to store electrical spillage as ordained by the concept of thermal batteries.

The research activities, related to battery storage, that will be undertaken at CES will specifically focus on enhancing the energy storage capabilities of the electrochemical energy storage devices, such as lithium ion batteries, sodium-sulfur or lithium-sulfur batteries, and advanced batteries by employing nanoscale materials. These energy storage technologies would be used in combination with renewable energy sources (e.g., solar PV), and also to power electric vehicles, thus cutting down overall greenhouse gas emission and, thereby reducing global warming. The energy storage technologies that I am developing will be one of the vital components for the future of a “clean energy landscape”. Besides electrochemical energy storage devices, flexible and stretchable chemically and electrochemically active devices will also be developed to sense and monitor environmental degradation.

- **Fuel Technology:** The major challenge in effective utilization of Indian coals has all along been its high mineral content. In this context, initiatives have been taken at the IIT Delhi resulting in solubilization of the major part of the coal substance by extraction at the atmospheric pressure with combinations of polar organic solvents which are recycled. The extract is zero ash and can be treated as organic feedstock for further processing.



This process has been termed as organo-refining of coals contributing to the development of clean coal technology potentially useful for the coal based power generation and for steel power plants. Bioleaching and bio-solubilization have also been found suitable to diminish the coal. Other activities include conversion of coal to liquid, utilization of coal extracts for value added end-uses such as a chemical feedstock, conversion of the products of coal gasification to synthetic natural gas methane, coal desulfurization etc.

- **Electrical Power and Renewable Energy Systems (EPRES):** The growing capacity of renewable energy based installations makes it necessary to develop efficient operation and control techniques to analyse and optimize the unbalanced distribution/transmission network. The intermittent nature and forecast uncertainties in renewable energy sources and loads must be considered in any analysis and design. The holistic grid/micro developments utilizing the energy management systems incorporating resource, demand side management, cloud/shared storage, effective use of battery/PV inverters, mobile loads in terms of electric vehicles etc. will lead to more certain and robust electrical systems. Many of the villages in India are electrified but have limited availability of the electricity. To address the technical challenges with respect to present and near-future scenario of the Nation, following research areas are the key focus of EPRES group:
  - » Development of energy management systems (EMS) for microgrid operations, buildings.
  - » Design and development of tools and techniques for distribution system operators (DSO) operation for LV/MV unbalanced distribution networks, power electronics based interconnects, Renewable based Multiple Distributed Generations, Electric Vehicles, etc.
  - » Development of Power Converters for small, medium and high-power applications in Renewable energy.
  - » Development of controls strategies for load frequency, voltage control and controller test facility for various types of micro-grids.
- **Plasma Science and Technology:** The plasma laboratory at IIT Delhi is a joint activity of CES and Physics Department with thrust on different types of plasma sources of relevance to the plasma processing industry. The chief mandate of this laboratory has been to investigate various types of plasma sources, notably the electron cyclotron resonance (ECR) sources, helicon plasma sources, RF and DC plasma sources with emphasis in the recent past being on applications of these sources for national / industrial / societal benefit. A high point in the lab's achievements is the work done on large volume ECR plasmas which has two patents. Extensive theoretical work has been undertaken on waves, instabilities in the ionosphere magnetosphere and laboratory (fusion) plasmas. Significant work on nonlinear dynamics of plasmas including self organization and chaos to study plasma behaviour at high power particularly in fusion phenomenon has also been carried out.

## ▶ LABORATORY FACILITIES

Facilities are available in the Centre for education and training as well as for facilitating industry-academia interaction.

- **Renewable Energy:** Thin Film Deposition Facility, temperature Dependant I-V Characterization of Solar

Cells using Solar Simulator, Quantum efficiency measurement system, Impedance and capacitance-voltage measurement System, Excitonic Solar Cell Fabrication Facility, Carrier Mobility Measurement Set-up, Time Resolved Photoluminescence Set-up, 25 kWp Roof Top Photovoltaic Generator, Thermal Conductivity Analyzer, U Value Measurements, Alphascope and Emissometer, Solar Transmittance Measurements, Fuel Technology, Gas Chromatograph: Gas Analyzer, Proximate Analysis of Fuels, UV-Visible Spectrophotometer, Bomb Calorimeter, Pyrolyzer, Pyrheliometer with Sun-Tracker.

- **Electrical Power and Renewable Energy Systems:** HVDC & AC transmission system, Real Time Monitoring of Micro Alternators, Vertical Axis Wind Turbine Power Generation, Micro-Hydro Power Generation, Long Transmission Line Models, Wind/Solar emulator, Lab view based real time monitoring system. DSPACE based development platform for power-converters.
- **Internal Combustion Engines and Alternative Fuels:** Facility to measure flame kernel growth, backfire, injection, ignition, combustion, performance and emissions characteristics of internal combustion engines for alternative fuels; Instruments include Non-dispersive Infrared (NDIR) analyzer, FTIR analyzer, smoke meter, piezo-electric transducer, optical encoder and sensor and combustion analyser; Advanced facilities include Research Engine, Backfire measurement in hydrogen fuelled engine, CRDI Engine test rig, hydrogen engine test rig, DME fuelled engine test rig, RCCI/HCCI combustion engine, methanol fuelled test rig with oxygen-combustion; Computational facility such as simulation/computational Fluid Dynamics software to study the important engine processes including backfire, injection, spray, ignition, combustion and emissions.
- **Plasma Science and Technology:** Plasma sources of different kind, viz. ECR (electron cyclotron resonance), RF (radio frequency), DC (direct current) etc. A Compact ECR Plasma Source (CEPS) for producing high density plasma; Large Volume Plasma System (LVPS) using multiple CEPS, for plasma processing application; Automated Langmuir probe system for plasma characterization; High resolution spectrometer for study of plasma emission spectroscopy; Microwave and RF atmospheric plasma jet, Plasma Simulation Facilities.
- **Energy Efficiency and Conservation and Energy Simulation:** Portable energy audit instruments like temperature, humidity, velocity meters, surface temperature reading instruments, clamp type voltmeter, ammeter and power factor meter. A collection of excellent software backed by a comprehensive data base. The software packages can be used for Energy Efficient Building Design, Solar Photovoltaic and Solar Thermal System Design, Hybrid System Design and Calculation of AC loads. Optimal Power System Expansion Model including the Environmental Impacts and Design and Analysis of Electrostatic Monitoring Precipitator.
- **Energy Systems Simulations:** Simulations play a vital role in the research of energy studies at CES. Computer simulations are used by the faculty members from Electrical and Power Systems, Plasma Science and Technology, Solar Thermal, Internal Combustion Engines and Automotive Sprays research groups. High-end workstations and desktops are available at the computational laboratory of the CES. CES faculty members have also initiated integrating Artificial Intelligence with their simulation framework for further advancement in the predictions and analysis of performance of energy systems.



**NATIONAL  
RESOURCE  
CENTRE**

**FOR**

**VALUE  
EDUCATION IN  
ENGINEERING**



**Rahul Garg, Ph.D. (IIT Delhi)**

*Professor*

Machine Learning, Big Data Analytics, Neuroimaging, High Performance Computing.

## HEAD OF THE CENTRE

**Sneh Anand, Ph.D. (IIT Delhi)**

Biomedical Engineering

**Shubhendu Bhasin, Ph.D. (Univ. of Florida)**

Electrical Engineering

**G. Bhuvaneswari, Ph.D. (IIT Madras)**

Electrical Engineering

**P.R. Bijwe, Ph.D. (IIT Delhi)**

Electrical Engineering

**Nomesh Bolia, Ph.D. (Univ. of North Carolina)**

Mechanical Engineering

**Niladri Chatterjee, Ph.D. (Univ. of London)**

Mathematics

**Harish Chaudhary, Ph.D. (IIT Delhi)**

Management Studies

**V.M. Chariar, Ph.D. (IIT Delhi)**

CRDT

**Devendra K. Dubey, Ph.D. (Purdue University)**

Mechanical Engineering

**Sangeeta Kohli, Ph.D. (IISc., Bangalore)**

Mechanical Engineering

**Amit Gupta, Ph.D. (Univ. of Central Florida)**

Mechanical Engineering

**S.K. Gupta, Ph.D. (IIT Delhi)**

Chemical Engineering

**Amit Kumar Jain, Ph.D. (IIT Guwahati)**

Electrical Engineering

**Manjeet Jassal, Ph.D. (IIT Delhi)**

Textile and Fibre Engineering

**Saroj Kaushik, Ph.D. (IIT Delhi)**

Computer Science and Engineering

**Jyoti Kumar, Ph.D. (IIT Delhi)**

IDDC

**Anushree Malik, Ph.D. (IIT Delhi)**

CRDT

**Samrat Mukhopadhyay, Ph.D. (IIT Delhi)**

Textile and Fibre Engineering

**Bhanu Nandan, Ph.D. (Kanpur Univ.)**

Textile and Fibre Engineering

**Rajesh Prasad, Ph.D. (Cambridge Univ.)**

Applied Mechanics

**Rajendra Prasad, Ph.D. (IIT Delhi)**

CRDT

**P.V. Madhusudan Rao, Ph.D. (IIT Kanpur)**

Mechanical Engineering

**M.R. Ravi, Ph.D. (IISc., Bangalore)**

Mechanical Engineering

**Anjan Ray, Ph.D. (Michigan State Univ.)**

Mechanical Engineering

**Jayshree Santosh, Ph.D. (IIT Delhi)**

Computer Service Centre

**S.K. Saha, Ph.D. (McGill Univ.)**

Mechanical Engineering

**Kiran Seth, Ph.D. (Columbia Univ.)**

Mechanical Engineering

**Kamlesh Singh, Ph.D. (Univ. of Rajasthan)**

Humanities & Social Sciences

**Parag Singla, Ph.D. (Washington Seattle Univ.)**

Computer Science and Engineering

**D. Sundar, Ph.D. (Pondicherry Univ.)**

Biochemical and Biomedical Engineering

**Rajiv K. Srivastava, Ph.D. (KTH, Sweden)**

Textile and Fibre Engineering

**Santosh Satya, Ph.D. (IIT Delhi)**

CRDT

**V.K. Vijay, Ph.D. (IIT Delhi)**

CRDT

## INTRODUCTION

National Resource Centre for Value Education in Engineering (NRCVVE) was setup in 2001. The role of the Centre is to create awareness in the technical community about human values. Accordingly, the mandate of NRCVVE is to identify, develop and disseminate techniques by which engineering students and practicing engineers can be motivated to imbibe human values and appreciate their impact on technology development, professional ethics and human welfare.

## ACADEMIC PROGRAMMES

The Centre offers elective courses for UG and PG students. The Centre runs a Ph.D. programme to support interdisciplinary research on topics that pertain to the impact of science and technology on human values and professional ethics and vice-versa. The Centre also provides a platform for faculty from across the institute to engage with students through projects, courses and other activities so as to develop better understanding of issues related to human values and technology. The Centre acts as a catalyst in the activity of sensitizing the campus community at large to these issues through lectures by eminent personalities. It also organizes several workshops on meditation, self-enquiry and the like for students and other campus residents.

## RESEARCH AREAS

The Centre supports research primarily through its Ph.D. program in the following areas:

- **Holistic Health and Wellness:** All issues pertaining to holistic view of individual's health and wellness. These include modern scientific research on proven mind-body techniques for physical and mental health, such as Mindfulness, Yoga, Tai-Chi, Qi-Gong, Ayurveda, Holistic nutrition and others. Yogic Neuroscience, Indian Psychology, Cognitive Sciences, Clinical trials on Yoga and Ayurveda, fMRI-based Neuroimaging (fMRI), EEG, MEG, PET, fNIRS.
- **Leadership for Sustainable Development:** Various aspects of holistic and sustainable development. Notions of development which go beyond purely material well-being, and consider other aspects of human/societal well-being such as intellectual, emotional and overall happiness. Notions of development which encompass sustained co-existence among human-beings as well as with nature. How to create leadership (in various walks of life - especially in engineering/technology) for taking forward these alternate views on development.
- **Inner Development:** Understanding first person mental phenomena, especially those pertaining to Meditation, Mindfulness and Contemplation in a rigorous academic framework. Theoretical frameworks for alternative worldview based on deep contemplative insights. Teaching and research on first person mental phenomena through accurate and reproducible observations.



Inner and Outer Harmony through Music and Arts. Classical music, dance and art forms that promote introspection, concentration, various aspects of self-awareness and devotion. Evolution of parallel streams of classical music in India. Development of classical art forms through folk art forms. Societal awareness through classical music. Streams of thought in classical music. Connections between carnatic music and sufism. Technology-based analysis and dissemination of music.

- **Value Education and Technology:** Teaching the teachers, tools and techniques for inculcating value education to students, especially at tertiary level of science and engineering. Research on effectiveness of various techniques for value education. Newer models of education. Use of technology for large scale dissemination of knowledge.

## ▶ FACILITIES

The Centre has a unique collection of books and audio-visual material on topics pertaining to science, spirituality, human values and ethics. It also has a meditation room that can accommodate 30 people and is open to students and all campus residents.





# CENTRE FOR RURAL DEVELOPMENT AND TECHNOLOGY



# RURAL DEVELOPMENT AND TECHNOLOGY







**Anushree Malik**, Ph.D. (IIT Delhi)  
*Professor*  
Bioremediation, Waste Water,  
Management, Algal Technologies.

## HEAD OF THE CENTRE



**Ram Chandra**, Ph.D. (IIT Delhi)  
*Assistant Professor*  
Anaerobic Digestion of Various Biomass and Waste.

**Hariprasad P.**, Ph.D. (Univ. of Mysore)  
*Assistant Professor*  
Environmental Biology and  
Biotechnology, Applied Secondary Metabolites



**Vijayaraghavan M. Chariar**, Ph.D. (IIT Delhi)  
*Professor*  
Ecological Sanitation, Design for Sustainability,  
Traditional Knowledge Systems.

**Jatindra K. Sahu**, Ph.D. (IIT Kharagpur)  
*Associate Professor*  
Food Engineering; Green Extraction &  
Encapsulation; Food Tribology;  
Food Safety & Quality.



**Kavya Dashora**, Ph.D. (CAZRI, Jodhpur)  
*Assistant Professor*  
Biosensors, Non-chemical Pest Management,  
Agricultural Technologies, Panchgavya.

**Ajay Saini**, Ph.D. (TISS, Mumbai)  
*Assistant Professor*  
Governmentality Studies, Rural Development,  
Isolated Indigenous Communities, Northeast  
India, Andaman and Nicobar Islands.



**Priyanka Kaushal**, Ph.D. (TU Wien Vienna)  
*Associate Professor*  
Biomass-to-energy, Syngas &  
Polygeneration, Valorization of Waste.

**Sharma Satyawati**, Ph.D. (IIT Delhi)  
*Professor*  
Biomass Utilization and Mushroom  
Cultivation Technology.



**Vivek Kumar**, Ph.D. (IIT Delhi)  
*Professor*  
Paper Technology, Waste Water &  
Ecofriendly Technology.

**V.K. Vijay**, Ph.D. (IIT Delhi)  
*Professor*  
Biogas, Renewable Energy, Rural  
Industrialization, Rural Energy Systems &  
Entrepreneurship.





**Prof. S.N. Naik**, Ph.D. (IIT Delhi)  
*Emeritus Professors*  
 Biofuels, Oils, Fats and Waxes Technology,  
 Extraction of Natural Products &  
 Value Addition of NTFPs.



**Santosh Satya**, Ph.D. (IIT Delhi)  
*Emeritus Professor*  
 Holistic Health, Food Safety and Quality.



**Sunil K. Khare**, Ph.D. (IIT Delhi)  
*Joint Faculty*  
 Department of Chemistry  
 Microbial Screening & Molecular Biology.



**Kamal K. Pant**, Ph.D. (IIT Kanpur)  
*Joint Faculty*  
 Department of Chemical Engineering  
 Green Technologies for Sustainable Energy &  
 Environment.



**Vijay P. Bhatkar**, Ph.D. (IIT Delhi)  
*Honorary Professor*  
 Computer Science and ICT, Rural Development.



**Rajendra Prasad**, Ph.D. (IIT Delhi)  
*Honorary Professor*  
 Biomass Cookstoves.



**Vinod Kumar**, Ph.D. (IIT Delhi)  
*Adjunct Faculty*  
 Centre for Climate and Environmental  
 Protection, Cranfield University, UK



**Ashutosh Murkute**  
*Adjunct Faculty*  
 Principal Scientist ICAR-Central Citrus Research  
 Institute Organic Food Production Certification,  
 Entrepreneur Development.



**Priti Parekh**, Ph.D. (University of Cambridge)  
*Adjunct Faculty*  
 Department of Civil, Environment &  
 Geomatic Engg., University College of London, UK  
 Energy, Environment, Global Health,  
 Human Wellbeing.



**Pooja Ghosh**  
*DST-Inspire Faculty*  
 Solid Waste Management,  
 Bioenergy, Bioremediation,  
 Environmental Toxicology.



**Gowtham HG**  
 IITD - PDF



**Nitya Sharma**  
 IITD - PDF



**Megha Mathur**  
 IITD - PDF



**Rashi Vishwkarma**  
 CSIR- Senior Research Associate

## ▶ INTRODUCTION

The Centre for Rural Development and Technology (CRDT) was established to coordinate and provide inputs for scientific and technological advancements in the rural sector by giving technical back-up for the sustainable rural development.

The guiding mission of CRDT is to sensitize the students towards the pressing societal needs and developing solutions for the same. Special emphasis is on sustainable utilization of resources and close loop recycling technologies. The centre aims to generate a sustainable technology base through synergy of modern S&T interventions and Traditional Knowledge. The centre undertakes appropriate teaching, research, technology dissemination and outreach related activities, and network with other technical institutions, grass root organizations, government agencies, and rural industries, for improving living conditions and generating livelihood.

## ▶ ACADEMIC PROGRAMMES

### UNDERGRADUATE

The centre offers many elective courses to undergraduate students.

### POSTGRADUATE

The Centre offers twenty-nine courses with strong lab or field component to postgraduate students as electives. Our basket of academic courses is designed to provide wide range of courses spanning over Rural Resources, Governance, Traditional and Emerging Technologies and Natural Product Development.

### Ph.D.

CRDT has a pool of over 121 research scholars working on diverse aspects of rural development and technology. Scholars are rigorously trained in subject/research and evaluated on a continuous basis to carve future leaders in variety of professions such as academia, industry, developmental organizations, entrepreneurship or think tanks.

## ▶ RESEARCH AREAS

The main research areas of the centre are:

- **Rural Resources, Energy & Environment:** Rural energy systems, biogas production, enrichment and bottling, algal biofuels/biorefinery, biodiesel, biomass gasifiers, biomass cookstoves, engine conversion kits, picohydel systems, environment and climate change, monitoring, bioremediation and detoxification of environmental contaminants, Solid-liquid waste treatment & valorization, life cycle assessment, etc.
- **Local Governance, Social Systems & Grassroot Innovations:** Rural Infrastructure, Design for sustainability, green product development, Traditional Knowledge & Values, Ecological sanitation and nutrients recovery,



Rural Development and Governance, culture and indigenous people, Agri/artisanal tools and livelihoods, Rural Planning and Entrepreneurship Development, etc.

- **Microbio, Nano & Biomass Technologies in Rural Settings:** Sustainable biomass production, conversion and utilization, rapid composting & biomanures, bioinoculants and biopesticides, applied secondary metabolites, environmental biotechnology, bio-economy and panchgavya, nanotechnology, blockchain technology in agriculture, etc.
- **Food, Health and Nutrition:** Green extraction, encapsulation and value addition of bioactive, 3-D food printing, food tribology, sustainable food production systems, food quality and safety, bioformulations for stored food products, value addition of non-timber forest, Medicinal and nutraceutical mushrooms, medicinal and aromatic plants and herbs, post-harvest technology, agro-waste management.

CRDT has successfully completed and demonstrated several extramural sponsored R&D projects and industrial consultancies funded by various national and international agencies. Currently, there are 43 sponsored research and extension projects ongoing in the Centre with a total budget of ₹13,312 lakhs. Besides CRDT has a strong presence on International platforms through sustained bilateral/multilateral international collaborations. In the last five years, CRDT has to its credit over 237 high impact journal publications, 13 books, 28 patents and 3 start-ups.

CRDT also uses the social entrepreneurship route as a mechanism for creating impact in several areas. The Centre regularly offers Short-Term Courses as well as Training Programmes for both national and international participants with background in community development, research, policy making, entrepreneurship and governance. CRDT plays a lead role in coordinating pan-India initiatives such as the Unnat Bharat Abhiyan (UBA). UBA, a flagship programme of Ministry of the Human Resource Development, aims to bring a transformational change in rural development by active participation of higher academic institutions with local communities, and reorientation of academic curricula and R&D design of knowledge institutions in the country. The wide network originating from such efforts provides CRDT a unique platform for consultation and dissemination.

## LABORATORY FACILITIES

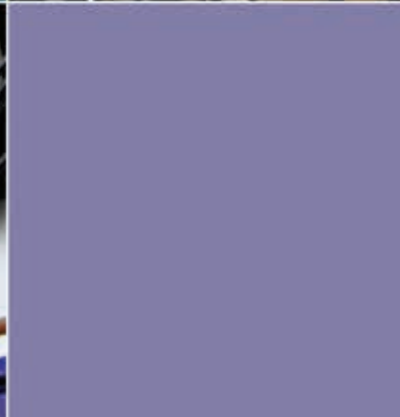
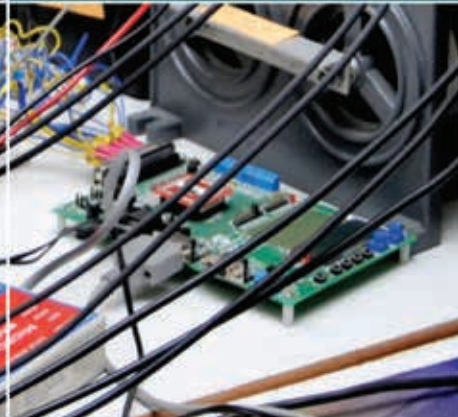
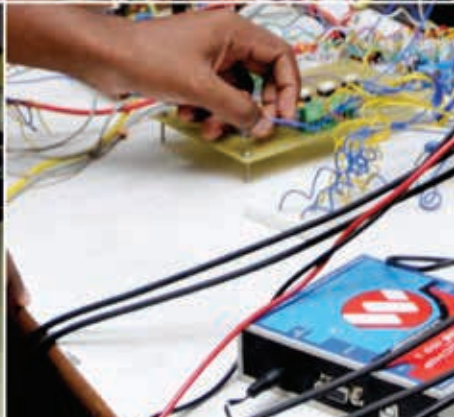
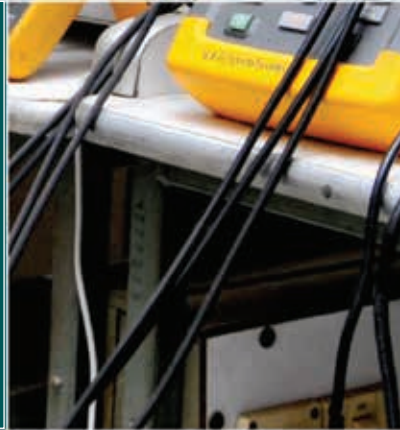
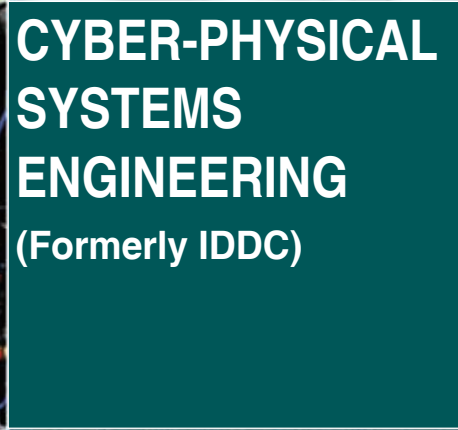
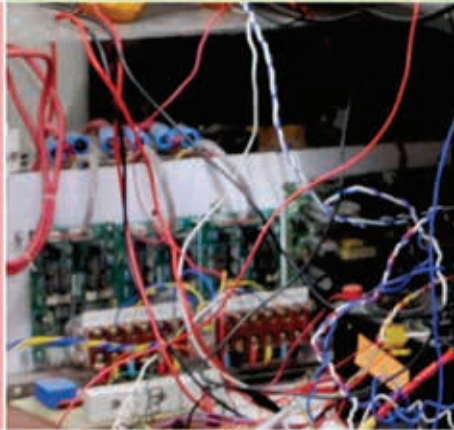
The Centre has established need based academic and core research labs equipped with some state-of-the-art research equipment. The Centre has a privilege of 7 acres of open land space inside IIT Delhi campus (Mahatma Gandhi Gramodaya Parisar) to enable the pilot testing of technologies before making tangible contributions on land.

The major research laboratories are:

- Applied Microbiology Lab
- Agro Ecology Lab
- Agro-Forest Products Processing Lab
- Applied Biomass Lab

- Agricultural Nano-biotechnology Lab
- Biogas Research Lab & Test Centre
- Biochemical Lab
- Cook-stove Lab
- Food and Bioprocess Engineering Lab
- Supercritical Fluid Extraction Lab
- Air Quality Lab
- Biomass Lab
- Biogas Enrichment and Bottling Lab
- Environmental Biotechnology Lab
- Frugal Innovation Lab
- Regional Testing and Knowledge Centre for Clean Cook-stoves







**Subrat Kar**, Ph.D. (IISc, Bangalore)

*Professor*

Optics, Embedded Telecom Systems, Telecom Transmission and Switching, Automotive Networks, Wildlife, High Altitude Research, Deep Space Communication, Bio-Medical Instrumentation.

## HEAD OF THE CENTRE



**Satish Kumar Dubey**, Ph.D. (IIT Delhi)

*Assistant Professor*

Digital Holography, Laser based Instrumentation for Measurement and Monitoring Systems, Designs and Development of Opto-electronic Sensors.

**D.T. Shahani**, Ph.D. (IIT Delhi)

*Honorary Professor*

Electronic Instrumentation, Electro-magnetics, Antennas.



**Gufran Sayeed Khan**, Ph.D. (University of Erlangen-Nuremberg, Germany)

*Associate Professor*

Optical Instrumentation, Applied Optics, Interferometry, X-Ray Optics, Diffractive Optical Elements, Computer Generated Holography, Computer Controlled Polishing, Diamond Turning.

**A.L. Vyas**, Ph.D. (IIT Delhi)

*Visiting Faculty*

Electronic and Ultrasonic Instrumentation, Signal Processing, Sonar Systems, Transducer Design.



**Chandra Shakher**, Ph.D. (IIT Madras)

*Honorary Professor*

Holography, Holographic Optical Elements, Fibre-optic Sensors, Optical Instrumentation.

## JOINT FACULTY

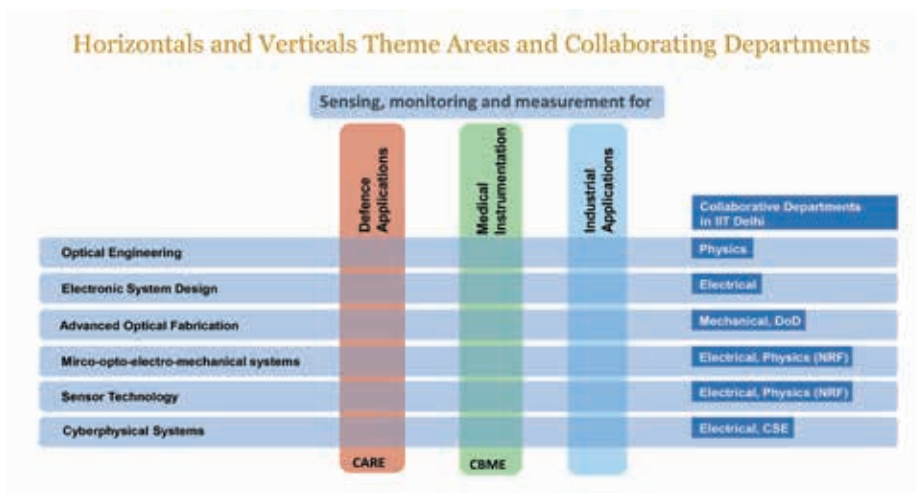
**Joby Joseph**, Ph.D. (IIT Delhi)

**Sunil Kumar**, Ph.D. (IISc, Bangalore)



## INTRODUCTION

The Centre for Sensors, Instrumentation and Cyber-physical System Engineering (SeNSE) - formerly known as Instrument Design Development Centre (IDDC), is an interdisciplinary unit. It offers a M.Tech. course in Instrument Technology and Ph.D. in specialized research areas combining multiple disciplines – microelectronics, optics, electronic circuits and mechanical engineering, to design and develop complete systems. In keeping with modern trends, industrial/societal expectations vis-a-vis the national goals, two more research areas - Sensors Technology and Cyber Physical Systems - have been included in its theme and the centre has been renamed as SeNSE. The Centre has made significant contribution through various sponsored R&D projects in developing Sensors/Systems for defense, medical and industry. It aims to achieve the national goals and foster excellence in state-of-the-art technologies. After its restructuring, SeNSE has six core areas of focus - optical engineering, electronic system design, advanced optical fabrication, micro-opto-electro-mechanical systems, sensor technology and cyber-physical systems- across three application domains - defense, medical and industrial applications.



## ACADEMIC PROGRAMMES

### Interdisciplinary M.Tech. in Instrument Technology

This is an interdisciplinary M.Tech. program, aimed to develop and train the manpower for the industrial needs requiring the knowledge and skills in different disciplines of science and engineering. The Center admits the students from various streams i.e. Electronics/Electrical/Electronics & Communication/Instrumentation, Mechanical engineering and Physics. Apart from theory courses, students also undergo rigorous laboratory courses as part of the hands on training program. This helps them contribute towards sponsored R&D activities via their Masters projects.



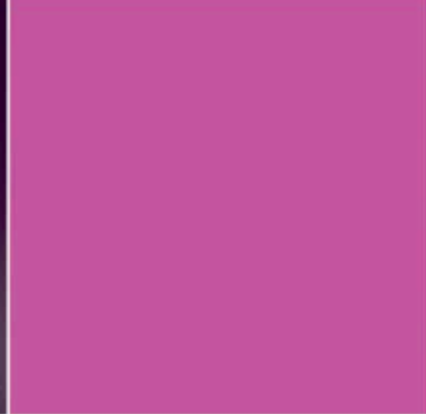
## RESEARCH AREAS

- **Optical Engineering and optical instrumentation systems:** Optical 3-D imaging with emphasis on biomedical application, optical metrology, design and development of opto-electronic/electro-optic sensors, NDT technology.
- **Precision Mechanics:** Precision optical and mechanical fabrication, Mechatronics, Microfluidics, Composite and nanomaterials.
- **Biomedical Instrumentation:** NIR and IR imaging for biomedical application, wearable sensors for health monitoring, design of point of care diagnostic devices.
- **Electronic systems, Instrumentation and Sensors (Integration):** Design of electronic systems, Industrial quality control, signal and image processing, non-destructive testing, Instrumentation and Control.
- **Microelectronics/MOEMS/Sensors Fab:** MEMS/MOEMS based devices and their integration for sensing, design of microelectronic devices.
- **Cyber-physical systems:** Machine Learning and Artificial Intelligence applied to health applications/public health, genetics and biological networks, energy autonomous IoTs, resilient IoT and security of the Internet of Things.

## LABORATORY FACILITIES

- **CAD and Simulation Lab:** Equipped with state of the art machines with CAD and Simulation software to design and simulate various prototypes.
- **Manpower Development in Instrument Technology (MDIT) Lab:** Equipped with best facilities in electronics design and instrumentation.
- **Advanced Instrumentation Lab:** Equipped with complete range of instruments to carry out DSP based system design.
- **Laser Application and Holography Lab:** Equipped with state of the art facility to develop the sensors and Laser based instruments for industrial and medical applications.
- **Optical Metrology Lab:** Works in opto-electronic and opto-mechanical area for precision measurement and monitoring systems.
- **Optical Workshop:** Equipped with fabrication machines and metrology tools for the production of optical elements such as mirrors, retroreflectors, lenses, parabolic optics, prisms and many other components.



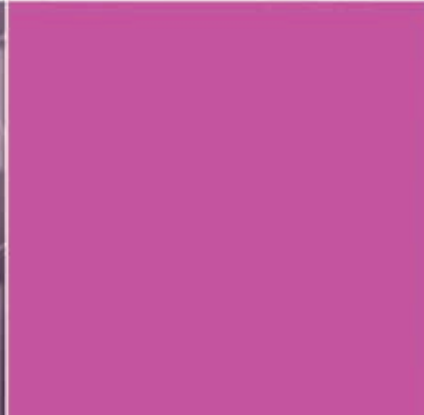


**AMAR NATH  
AND  
SHASHI KHOSLA  
SCHOOL**

**OF**



**INFORMATION  
TECHNOLOGY**





**Preeti Ranjan Panda, Ph.D.** (University of California, Irvine)  
*Professor*  
 Energy-efficient Embedded Systems - architectures and Compilers, Cache Management, 3D and Non-volatile Memory Systems, VLSI Design Automation and Design Methodology.  
*Department of Computer Science & Engineering*

## HEAD OF THE SCHOOL

### SCHOOL FACULTY



**Sorav Bansal, Ph.D.** (Stanford Univ.)  
*Associate Professor (Microsoft Chair)*  
 Programming Languages and Operating Systems.  
*Department of Computer Science & Engineering*



**Sanjiva Prasad, Ph.D.** (Stony Brook Univ.)  
*Professor*  
 Programming Languages and their Semantics; Concurrency Theory; Verification; Proof Theory; Mobile Computation; Formal Foundations of Networks, Including IoT and SDN; Security, especially in Information Flow; Formal Models for Reconfigurable Architectures, Systems Biology, Computational Biology, and Medical Applications of Computing.  
*Department of Computer Science & Engineering*

**Vinay Ribeiro, Ph.D.** (Rice Univ.)  
*Associate Professor*

Computer and Network Security (Blockchain, IoT Security, Ransomware), Wireless Networks, Indoor Positioning and Navigation.  
*Department of Computer Science & Engineering*



**Aaditeshwar Seth, Ph.D.** (Waterloo Univ.)  
*Associate Professor*

Analysis and Presentation of Economic Data, Low-cost Computer Networks and ICT Systems for Rural Areas, Participatory Information Sharing on Social Networks.  
*Department of Computer Science & Engineering*



### ASSOCIATED FACULTY

**A.K. Bhateja, Ph.D.** (IIT Delhi)  
 Cryptology, Artificial Intelligence, Machine Learning, Biometrics, Algorithms.  
*Visiting Professor, Amar Nath and Shashi Khosla School of IT*

**A.P. Prathosh, Ph.D.** (IISc., Bangalore)  
 Vision and Image Processing Audio, Speech and Music Analytics and Learning (deep learning, sequential modelling and transfer learning).  
*Department of Electrical Engineering*

**Anoop Chawla, Ph.D.** (IIT Kanpur)  
 Computer Graphics, Modeling in CAD / CAM / CAE, Vehicle Tracking, Transportation Systems and Automotive Safety.  
*Department of Mechanical Engineering*

**Anshul Kumar, Ph.D.** (IIT Delhi)  
 Embedded System Design, Hardware Software CoDesign, Application Specific Processor Synthesis, VLSI Design Automation, Computer Architecture.  
*Department of Computer Science & Engineering*

**Ashwini Vaidya, Ph.D.** (University of Colorado, Boulder)  
 Event Structures in Language, Multilingual Lexical Resources, Computational and Cognitive Models of Language.  
*Department of Humanities and Social Sciences*

**Bijendra N. Jain, Ph.D.** (Stony Brook University)  
 Ad hoc Networks (higher-layer protocols, 0-configuration), Sensor Networks, and Applications to Disaster Mitigation and Management, High-speed Networks (MPLS, path protection), Network Security.  
*Honorary Professor, Department of Computer Science & Engineering*

**B.K. Panigrahi, Ph.D.** (Sambalpur University)  
 AI and ML Application in Smart Grid. Cyber Security for Smart Grid, Soft Computing, Evolutionary Computing.  
*Department of Electrical Engineering*

**Chetan Arora, Ph.D.** (IIT Delhi)  
 Computer Vision and Machine Learning.  
*Department of Computer Science & Engineering*

**Deepti Gupta, Ph.D.** (IIT Delhi)  
 Textile Chemistry, Antimicrobial Finishing, Anthropometrics and Garment Sizing, Design and Engineering of Functional Clothing, Product Design and Development.  
*Department of Textile Technology*

**Huzur Saran, Ph.D.** (Univ. of California Berkeley)  
 Wireless Networks, Systems & Network Security, Network Performance Analysis. Algorithms.  
*Department of Computer Science & Engineering*

**Jayaram B., Ph.D.** (City University of New York)  
 Biomolecular Modeling and Simulation, Physico-chemical Understanding of Genomic DNA Organization (Chemgenome), Protein Tertiary Structure Prediction via Chemistry and Informatics Based Methods (Bhageerath) and Protein/DNA Targeted Computer Aided Drug Discovery (Sanjeevini).  
*Department of Chemistry*

**Jay Dhariwal, Ph.D.** (IIT Bombay)  
 Mechatronic Design, Design for Built Environment, Data Science and Design, Operations Research, Functional Prototyping, Design of Sustainable Habits, Digital fabrication, Design for Quality of Life, Product Realization, IoT Design, Design for Wellness, Healthcare Design.  
*Department of Design*

**Kolin Paul, Ph.D.** (Bengal Engg. College, Calcutta)

Reconfigurable Computing, Embedded Systems, Affordable and Scalable Healthcare Solutions.  
Department of Computer Science & Engineering

**M. Balakrishnan, Ph.D.** (IIT Delhi)

Assistive Technologies, Embedded Systems, EDA and System Level Design, FPGA Architecture and Tools.  
Department of Computer Science & Engineering

**Mausam, Ph.D.** (Washington, Seattle),

Sequential Decision Making under Uncertainty, AI Applications to Crowd-Sourcing and Education, Natural Language Processing, Markov Decision Processes, Web Information Extraction, Multi-Document Summarization, Automated Planning, Panlingual Machine Translation, Machine Learning, Probabilistic Reasoning, Heuristic Search, Intelligent Information System, Question Answering, Dialog System.  
Department of Computer Science & Engineering

**Maya Ramanath, Ph.D.** (IISc., Bangalore)

Database Systems and Information Retrieval, Semantic Web Data Management, Knowledge Graph Construction and Applications.  
Department of Computer Science & Engineering

**M.P. Gupta, Ph.D.** (IIT Delhi)

Information Systems and ICT Policy.  
Department of Management Studies

**Niladri Chatterjee, Ph.D.** (University of London)

Soumitra Dutta Chair Professor of Artificial Intelligence  
Artificial Intelligence, Natural Language Processing, Machine Learning, Data Science, Statistical Modeling, Mathematical Reasoning.  
Department of Mathematics

**Parag Singla, Ph.D.** (Washington, Seattle Univ.)

Machine Learning, Neuro-Symbolic Reasoning, Artificial Intelligence.  
Department of Computer Science & Engineering

**Prem Kumar Kalra, Ph.D.** (EPFL, Switzerland)

Computer Graphics, 3D Animation.  
Department of Computer Science & Engineering

**P.V.M. Rao, Ph.D.** (IIT Kanpur)

Product Design & Manufacturing, Computer Aided Design & Manufacturing, Design for Product Life-cycle, and Design of Medical & Assistive Devices.  
Department of Mechanical Engineering and Design

**Rahul Garg, Ph.D.** (IIT Delhi)

Brain Imaging and Neuroscience of Yoga, Machine Learning and Big Data Analytics, IT for Society.  
Department of Computer Science & Engineering

**Ramakrishna Ramaswamy, Ph.D.** (Princeton University)

Chaos and Nonlinear Dynamics, Computational and Systems Biology, Nonequilibrium Statistical Mechanics.  
Visiting Professor, Department of Chemistry

**Rijurekha Sen, Ph.D.** (IIT Bombay)

Mobile and Embedded Systems (Hardware Architecture, OS, Sensing, Efficient Processing, Security), Computational Sustainability.  
Department of Computer Science & Engineering

**S.N. Maheshwari, Ph.D.** (Northwestern Univ.)

Algorithms, Parallel Processing, Information Systems.  
Honorary Professor, Department of Computer Science & Engineering

**Santanu Choudhury, Ph.D.** (IIT Kharagpur),

Computer Vision, Multimedia Systems, Computational Intelligence.  
Department of Electrical Engineering

**Saroj Kaushik, Ph.D.** (IIT Delhi)

Current Research Interest: Location Based Services, Social Networks Analysis.  
Other Research Interest: Various Areas of Artificial Intelligence such as E-commerce, Fuzzy Logic, Natural Language Processing, Genetic Algorithms and Knowledge Representation.  
Visiting Professor, Department of Computer Science & Engineering

**Smruti Ranjan Sarangi, Ph.D.** (University of Illinois)

Computer Architecture, Parallel Algorithms, Operating Systems.  
Department of Computer Science & Engineering

**Srikanta Bedathur, Ph.D.** (IISc., Bangalore)

Data Management, Knowledge Discovery and Data Mining, Natural Language Processing.  
Department of Computer Science & Engineering

**Subhashis Banerjee, Ph.D.** (IISc., Bangalore)

Computer Vision, Machine Learning, Algorithmic Fairness, Data Privacy.  
Department of Computer Science & Engineering

**Subodh Kumar, Ph.D.** (University of North Carolina)

Computer Graphics, Visualization, Geometry.  
Department of Computer Science & Engineering

**Sumantra Dutta Roy, Ph.D.** (IIT Delhi)

Computer Vision and Image Analysis, Pattern Recognition, Audio Data Retrieval and Analysis, Biometrics and Bioinformatics.  
Department of Electrical Engineering

**Sumeet Agarwal, D.Phil.** (University of Oxford)

Machine Learning, Complex Networks, Systems Biology, Evolution and Evolvability, Computational Linguistics, Cognitive Science, Public Health Informatics.  
Department of Electrical Engineering

**Tapan Kumar Gandhi, Ph.D.** (IIT Delhi)

Computational Neuroscience, Neuro-inspired Engineering, Biomedical Signal and Image Processing, Machine Learning, Assistive Technology.  
Department of Electrical Engineering

## EMERITUS PROFESSOR

**A.K. Gosain, Ph.D.** (IIT Delhi)

Integrated Watershed Modelling, GIS Hydrological Modelling, Irrigation Management, Climate Change, Environmental Impact Assessment.  
Department of Civil Engineering

## ADJUNCT FACULTY

**Anupam Joshi, Ph.D.** (Purdue University)

Security/Trust/Policy Intelligent Networked Systems, Mobile Computing, Artificial Intelligence, Text Analytics.  
University of Maryland, Baltimore County, USA

**Ashish Suri, M.Ch.** (Neurosurgery (AIIMS, Delhi)

Neurosurgery, Skull Base Surgery and Cerebrovascular Surgery, Endoscopic Neurosurgery, Neuro-Oncology, Epilepsy Surgery, Spine, Neurosurgery Skills Training, Neuro-technology: Virtual Reality Simulation and Neurosurgery Instrumentation.  
Professor, Department of Neurosurgery, AIIMS, Delhi

**B. Chandra (Ms.), Ph.D.** (Delhi University)

Deep Learning, Machine Learning, Neuro Computing, Database Management, Data Mining Feature selection of Gene Expression and Crime Mining.

**Manik Verma, D.Phil. in Engineering** (University of Oxford)

Algorithms, Artificial Intelligence, Machine Learning, Computational Advertising and Computer Vision.  
Microsoft Research and Deptt. of Computer Science & Engineering

**Pawan Sinha, Ph.D.** (Massachusetts Institute of Technology)

Vision and Computational Neuroscience.  
Massachusetts Institute of Technology, Cambridge, USA

## ▶ **INTRODUCTION**

The Amar Nath and Shashi Khosla School of Information Technology was established with an endowment from the distinguished IIT Delhi alumnus, Vinod Khosla (B. Tech, EE 1976). The objective of the School is to foster interdisciplinary, goal-oriented research, innovation and post-graduate education in Information Technology. The School undertakes research in several interdisciplinary areas where there is a significant application of Information Technologies. The School has its own supporting staff and students, and its own joint faculty but encourages the participation of faculty members and students from other departments who have an interest in novel applications of computing sciences and technologies.

## ▶ **ACADEMIC PROGRAMMES**

### **POSTGRADUATE**

The School offers Ph.D. and M.S. (Research) programmes in Information Technology.

The M.S. (Research) programme is a 2 year inter-disciplinary programme that admits students with various backgrounds. The school also develops and offers academic courses in a variety of application areas, for which interested students from diverse disciplines may enroll.

## ▶ **RESEARCH AREAS**

Doctoral research is being carried out in:

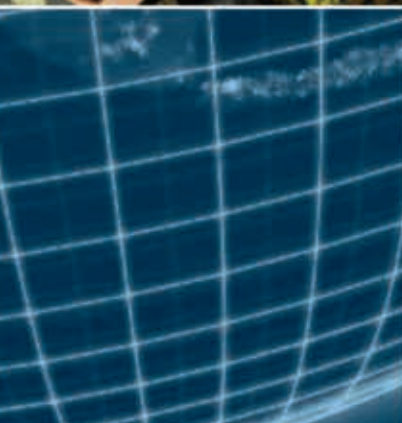
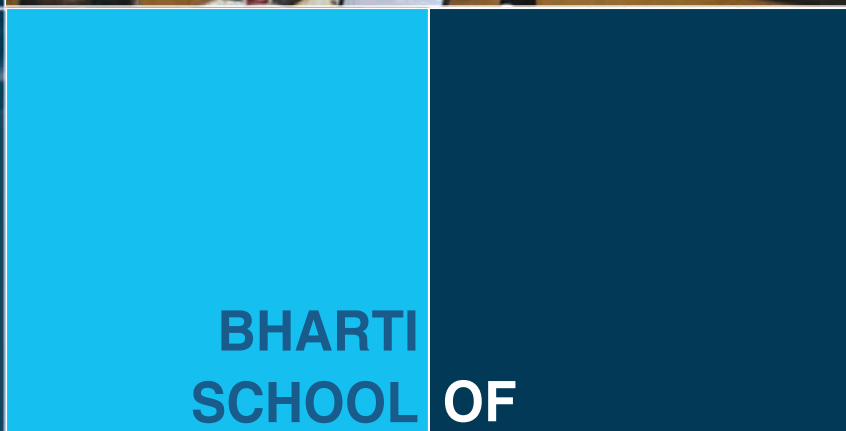
Scalable & Dependable Computing, Information Security, Biometrics, Information Storage and Retrieval, Data Analytics, Social Network Analysis, High Speed Networks, Sensor Networks, Mobile and Web Based Computing, Multimedia Systems, Embedded Systems, VLSI Design Automation, Internet of Things, Image Processing, Computer Vision, Robotics and Intelligent Systems, Medical Applications of IT, Computational and Systems Biology, Computational Neuroscience and Neuroimaging, Assistive Technologies, Human Computer Interfaces, Information and Communication Technologies for Development, Data Science for Development, Computational Sustainability, Geographical Information Systems, Blockchain Technologies, Location Based Services, Other areas aligned with school activities.

## ▶ **LABORATORY FACILITIES**

The School has its own building, which houses specialized laboratories for collaborative and funded research activities.

- Assistech lab
- ICTD lab
- Medical Applications of IT lab
- Mobile & Machine to Machine lab







**Swades De, Ph.D.** (*State Univ. of New York*)

*Professor*

Wireless Communication Networks and Systems,  
Broadband Access and Routing Techniques, Performance  
Modeling and Analysis.

## HEAD OF THE SCHOOL

### Associated from Electrical Engineering Department

**Prathosh A.P.**, Ph.D. (*IISc., Bangalore*)

**Manav Bhatnagar**, Ph.D. (*Oslo University*)

**Ranjan Bose**, Ph.D. (*University of Pennsylvania*)

**Santanu Chaudhury**, Ph.D. (*IIT Kharagpur*)

**Subrat Kar**, Ph.D. (*IISc., Bangalore*)

**Harshan Jagadeesh**, Ph.D. (*IISc., Bangalore*)

**S.D. Joshi**, Ph.D. (*IIT Delhi*)

**Ranjan K. Mallik**, Ph.D. (*Univ. of Southern California*)

**Saif K. Mohammed**, Ph.D. (*IISc., Bangalore*)

**B.K. Panigrahi**, Ph.D. (*Sambalpur University*)

**Seshan Srirangarajan**, Ph.D. (*University of Minnesota, USA*)

**Abhishek Dixit**, Ph.D. (*Ghent University, Belgium*)

**Lalan Kumar**, Ph.D. (*IIT, Kanpur*)

**Amol Choudhary**, Ph.D. (*Univ. of Southampton, UK*)

**Arpan Chattopadhyay**, Ph.D. (*IISc., Bangalore*)

**Sukumar Mishra**, Ph.D. (*Sambalpur University*)

**Brejesh Lall**, Ph.D. (*IIT Delhi*)

### Associated from Mathematics Department

**S. Dharmaraja**, Ph.D. (*IIT Madras*)

### Associated from Computer Science and Engineering Department

**Sanjiva Prasad**, Ph.D. (*Stony Brook Univ.*)

**Huzur Saran**, Ph.D. (*University of California*)

**Smruti Ranjan Sarangi**, Ph.D. (*Univ. of Illinois*)

### Associated from Mechanical Engineering Department

**Arnob Ghosh**, Ph.D. (*University of Pennsylvania*)

### Associated from CARE

**Arun Kumar**, Ph.D. (*TIFR, Bombay*)

**Monika Aggarwal**, Ph.D. (*IIT Delhi*)

**Ananjan Basu**, Ph.D. (*University of California*)

### Associated from Management Studies Department

**Seema Sharma**, Ph.D. (*IIT Delhi*)

**Harish Chaudhary**, Ph.D. (*IIT Delhi*)

**Arpan Kumar Kar**, Ph.D. (*XLRI*)

**P. Vigneswara Ilavarasan**, Ph.D. (*IIT Kanpur*)

**Mahim Sagar**, Ph.D. (*IIITM, Gwalior*)

**Ravi Shankar**, Ph.D. (*IIT Delhi*)

## ▶ INTRODUCTION

The Bharti School of Telecommunication Technology and Management (BSTTM) functions jointly with the Departments of Electrical Engineering, Computer Science & Engineering, Mechanical Engineering, CARE, Mathematics and Management Studies.

The Bharti School was set-up in the year 2000 through a grant from Bharti Enterprises with the following objectives:

- To be a centre of excellence for education and research relating to all facets of Telecommunication Technology and Management.
- To host state-of-the art laboratories and infrastructures, and a research environment so as to attract the best faculty and students.
- To invite and encourage the best talent in telecommunications to be a part of the activities of the School.
- To run graduate academic programs (including M.S., M.Tech., MBA, Ph.D.) in collaboration with the various Departments and Centres at IIT Delhi.
- To run continuing education programs for personnel of the Telecom Industry.

## ▶ ACADEMIC PROGRAMMES

The school offers the following post-graduate programmes:

### **Master of Technology (JTM)**

The M.Tech. (Telecom Technology and Management) programme is of 2 years (4 semester) duration. It is a full-time programme with classes during the normal working hours. Part-time and Sponsored M.Tech. is also there, but at present there are no students under this programme.

### **Master of Science (Research) (BSY)**

M.S.(R) is a two-year programme for full-time students and three-year programme for part-time students. Its emphasis is on research, with the thesis carrying 2/3rd of the credits.

### **Doctor of Philosophy (BSZ)**

Ph.D. full-time admissions are based on performance in M.Tech./B.Tech. as well as GATE Scores. Part-time admissions require 2 years' experience in lieu of GATE scores.

### **Master of Business Administration (SMT)**

The MBA (with focus on Telecom Systems Management) is a 2 years (4 semesters) programme. It is designed to be convenient for practising professionals, with most classes scheduled in the morning or evening.

## RESEARCH LABS

- **Research Scholar Lab:** The research group focuses on performance analysis of wireless communication systems which is helpful in practical link design. Specifically, the work is on Cognitive radio, and Smart grid technologies, Visible Light Communication (VLC), Free Space Optical (FSO) communication over large Multi-Input-Multi-Output (MIMO) systems. These technologies play an important role in enabling 5G communication. Another area is, providing routing solutions and designing protocols for best path selection to enable wireless data transfer with high coding and diversity gain. In 5G wireless networks, energy saving is an important area of research, for increasing lifetime of the devices and networks. The activities are aimed at addressing various security issues arising due to a presence of energy harvesting nodes in the network. For indoor communication in future 5G networks, VLC and FSO technologies provide enhanced data rates, high energy efficiency at lower costs. Work on optimizing power allocation in FSO for different channel models by exploiting channel state information is also done in this lab.

Underwater acoustic channels are generally recognized as one of the most difficult communication media in use today. Random fluctuations, large delay and Doppler spread, small bandwidth of the acoustic signal and frequency dependent absorption make this channel extremely complex. The advent of vector sensor recently has provided an opportunity to correct this bleak scenario to some extent. In our research, we emphasize on performance analysis of underwater acoustic communication system such as capacity, BER, outage probability and system design by using vector sensors. In this lab, we are also planning to work on underwater optical and hybrid (acoustic and optical) communication.

Security is non-negotiable and reliability is vital when it comes to defense applications. We are also developing a scheme for identification of the channel coding type and estimation of channel coding parameters of an intercepted demodulated satellite signal in collaboration with DRDO.

- **Pervasive Telecom Lab:** The pervasive telecom lab hosts several unique research initiatives. Central to the theme is the idea that telecom devices can be made ubiquitous, and deployed in numbers which are so large that data they gather is at a very high resolution. This data may be multi-dimensional but even with two dimensions - of space and time - it is extremely useful. The resulting Internet of Things and the Big Data flowing there from requires innovations in protocol stacks, hardware at layers 1, 2 and 3 in large distributed back-end repositories and in inference engines for the analytics. We have provisioned cloud repositories and have web-enabled several application domains such as healthcare, agriculture and animal management.
- **Internet of Things (IoT) Lab:** IOT lab aims at improving the quality of life of students through technology by bringing end to end multi- disciplinary researches to a single place.

With increase in machine to machine communication, IOT along with virtualization Technology aims to establish:

- » A heterogeneous network where any device can plug in and starts using the services hosted by cloud service provider.
- » Main research area is implementing a generic protocol where any remote device like smart car, smart phone, industrial instruments like sensors, etc. can connect to cloud server and can be managed centrally.

Besides this research work is going on: 1. For developing a smart building concept utilizing location sensors and smart devices, 2. Implementing and demonstrating security aspects of 5G networks.

- **Next Generation Wireless Communication Lab:** The “Next Generation Wireless Communication Laboratory” is focused on developing next generation wireless communication technologies (e.g., Large and Massive MIMO technologies, Cognitive Radio technologies, Physical Layer Security, Energy harvesting, Green Communication, Device to Device communication, mmWave communication systems). Emphasis will be on building new wireless communication systems and development of new technologies. Facilities set up in this lab will aid technology development, and bring in large amount of research grants from government and industry. This lab is expected to become a leading wireless communication lab in India. It is expected to help faculty devote more attention to technology development and demonstration without taking away too much time from theoretical research. Through M.Tech./B.Tech. projects, students will also get trained in designing new communication technologies. This will lead to skill development which will satisfy industry needs.
- **Ericsson IITD 5G Centre of Excellence:** Ericsson has set up a Centre of Excellence with 5G/4.5G test bed & Incubation Centre at IIT Delhi which is being used to drive the development of country’s IoT ecosystem on the cellular technology. This program has been conceptualized to fast-track realization of Digital India initiatives and aid application development for Indian start-ups and industries. This centre of excellence enables research and development to explore how some of the country’s key challenges can be addressed with advanced mobile technologies. The whole Test Bed program has a planned duration of 2 years which will be split in two phases. First phase will consist of deployment of LTE-A (4.5G) solution with advanced test cases including use cases for IoT. Second phase will consist of 5G NR deployment and test cases catering to 5G RF characteristics and key use cases like Broadband, beam tracking etc. 4.5G system is already up and running in Centre of Excellence and use cases like water monitoring has already been demonstrated.



Going forward the emphasis is to conceptualize more use cases and run analytics from the cellular IOT use case data which will ensure seamless connectivity for billions of connected devices, machines, and things, supporting consumer, business, and industrial applications. 5G equipment which will be first in India will place India on par with other developed countries in terms of 5G network and application deployment is expected to be installed in Centre of Excellence in Q1/Q2-2018.

- **Advanced Wireless Lab:** Advanced Wireless Laboratory (IIA-107), led by Prof. Manav Bhatnagar, focuses on cutting edge research on next-generation wireless communications, with a primary focus on limited feedback-based wireless communications, free-space optical communication, power line communications (PLC), molecular communications, smart grid communications, satellite communication, and underwater wireless optical communications. The lab engages in research to ensure the security and privacy of wireless communication techniques employed in the aforementioned areas. Research outcomes are disseminated via journal publications, conference presentations, and presentations. Students pursuing Ph.D., M.Tech., and B.Tech. in IIT Delhi implement communication techniques in hardware using USRP kits.
- **Samsung Digital Academy Innovation Lab:** Samsung Innovation Lab is a state of the art research lab of Bharti School, IIT Delhi under supervision on Prof. Brijesh Lall. With many Ph.D. students working in area of Computer Vision, Deep Learning and AI on many novel research ideas for solving novel social as well scientific problems. The lab boasts multiple CUDA capable rack servers, workstations and high end edge computing capabilities required for performing analytics on humongous data that is captured by multiple sensors, cameras etc. A brief description of some of the research activities being performed by the various Ph.D. scholars along with support from PG and UG students follows: Sakshi Ahuja is pursuing her work in brain tumor analysis performing segmentation of tumor from multiple modalities and estimating tumor growth from pre and post-operative brain MRI database using deep learning. Anushikha Singh performs computer aided diagnosis of Pulmonary Tuberculosis for the Indian Subcontinent. This project involves segmentation of lung area in chest X-ray images followed by rib suppression and identification of abnormalities present in different zones of chest X-ray image. Ronak Gupta works on developing novel video compression methods for VR videos. He's also working on problems of detecting Traffic violation by vehicles from videos captured from a camera mounted on a car. One of the sub-problems is to localize and classify the type of vehicles such as car, bus, truck, auto & motorbike, pedestrians which are jaywalking or endangering on the road. Vinay Kaushik is working on developing novel algorithms to map real world terrain using an inexpensive camera in real time for AI based AR/VR apps such as gaming, navigation, automated driving, etc. Aditi is analysing marine environment by detecting and tracking aquatic animals and predicting their long term

behaviour under water. She aims to predict the health of water bodies and also analyse the underwater ecosystem. Piyush is working on characterizing deep networks for better understanding how AI works and how can we make it better. Ayan is developing algorithms for better multirate signal processing. There has also been research in developing saliency based segmentation methods for image retargeting, video super-resolution for future displays, action recognition framework based on compressive sensing using Deep AI. There are several interesting cool projects going on in Samsung Innovation Lab. There's work on Air pollution monitoring and prediction, Agriculture based projects for predicting health and various plant diseases aimed at benefiting farmers in India and smart touch displays for classes. This lab is also part of organizing interesting challenges like Celestini Project India where researchers help undergrads solve real world problems like air pollution, vehicle to vehicle communication and women's safety. The lab works for developing cutting edge technology for solving novel problems in India.

## ▶ LABORATORY FACILITIES

### TEACHING LABS:

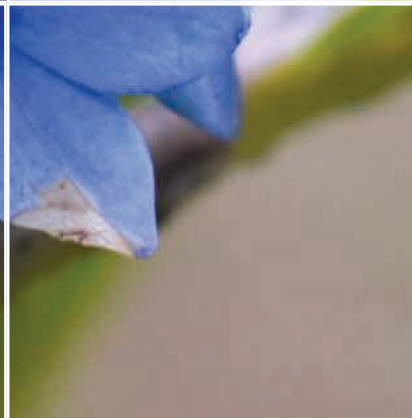
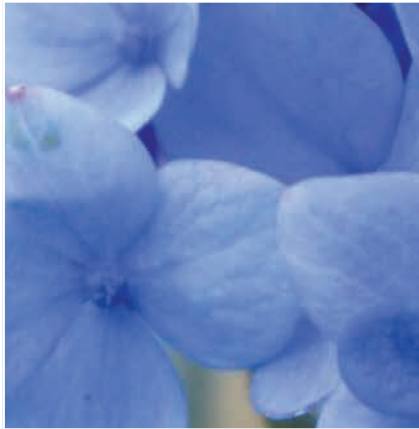
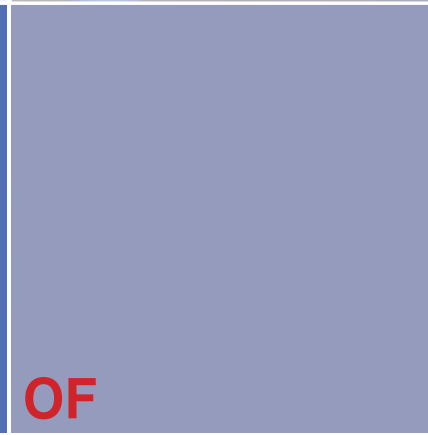
- Telecom Software Lab:** Bharti School first eco-friendly lab - First workspace to adopt all LED/CFL lighting!

This secured access monitored lab is open for student access on 24/7/365 basis and provides 28 dedicated workstations with dual monitors having i7 processors, 15.6 GB memory hard disk drive up to 1TB for computational support to Bharti School Students in their course work. This lab supports free open source software - linux (Ubuntu-16.04) on all workstations and servers.

The other equipment/facilities include providing software support for thin client architecture for entire school and IDE-Forte / Netbeans, Eclipse, UML poseidon, TTCN/MSC, CFSM-Esterel/Polis, ptolemy, Telelogic/DOORS and Telelogic TAU and opnet. In addition, the lab supports the entire Bharti School by hosting 2 x 40 KVA master-slave UPS and hosting and maintaining 25 port network switching racks for Bharti School.
- Wireless Research Lab:** The Lab has following facilities: Spectrum Analysers, Function Generators, Signal Generators, Network Analysers, Antenna Measurement Kits, Simulation Software: CST Microwave Studio, Commsim and EDA, Virtual Wireless Lab.
- Telecom Networks Lab:** This Eco-friendly Lab provides 50 personal dedicated workstations with dual screens for teaching and comprehensive computational support to Bharti School students in their course work. The other equipment/ facilities include tool chains based on Free Open Source Software, FPGA design

tools, V2Pro, Arduino Shields, DSOs with CAN/LIN triggering, NetFPGA based router design, Raspberry Pi Boards, GPS Simulator with Embedded Controller, ESP32 boards, Zybo FPGA boards, Arduino Ethernet Shields, Digital Multi-meters, EFI workstation, ESD workstation with Soldering and De-soldering station, SMD Rework Station, Oscilloscope with FlexRay Trigger Capability, Logic Analyzers , Protocol Analyzers.





**KUSUMA  
SCHOOL**

**OF**

**BIOLOGICAL  
SCIENCES**



**James Gomes, Ph.D. (Tulane Univ.)**  
*Professor*  
Neurodegenerative diseases, systems theory, network biology.

## HEAD OF THE SCHOOL



**Manidipa Banerjee, Ph.D. (UCSD)**  
*Associate Professor*  
Hepatitis A Virus Entry, Using Viruses as Nanoparticles for Drug Delivery.

**Bishwajit Kundu, Ph.D. (Inst. of Microbial Tech.)**  
*Professor*  
Protein Misfolding and Aggregation.



**Tapan K. Chaudhuri, Ph.D. (Bose Institute)**  
*Professor*  
Chaperone Assisted Protein Folding, Protein Engineering and Molecular Biophysics.

**Manoj Menon, Ph.D. (Hanover Medical School, DE)**  
*Assistant Professor*  
Cell Biology and Signalling, Septin Cytoskeleton, Regulation of Autophagy and Cell Death.



**Archana Chugh, Ph.D. (Delhi Univ.)**  
*Associate Professor*  
Cell Penetrating Peptides, Marine Bioprospecting, Plant-based Therapeutics, IPRs and Governance in Naval Life Science Technologies.

**Shilpi Minocha, Ph.D. (University of Zurich)**  
*Assistant Professor*  
Regulation of Gene Expression, Metabolism, Liver Regeneration, Non-alcoholic Fatty Liver Disease, Hepatocellular Carcinoma.



**Chinmoy S. Dey, Ph.D. (Jadavpur Univ.)**  
*Professor*  
Insulin Resistant (Type 2) Diabetes and Leishmaniasis, Signal Transduction.

**Aditya Mittal, Ph.D. (Drexel Univ.)**  
*Professor*  
Kinetics and Self Assembly in Biological Systems.



**B. Jayaram, Ph.D. (City Univ. NY)**  
*Professor*  
Computational Biology, Molecular Design.

**Amitabha Mukhopadhyay, Ph.D. (Inst. of Microbial Tech.)**  
*Professor*  
Modulation of Host Intracellular Trafficking by Pathogens.







**Tapan K. Nayak**, *Ph.D. (IISc.)*  
*Assistant Professor*  
Ion Channel and Receptor Biology.



**Vivekanandan Perumal**, *Ph.D. (CMC Vellore)*  
*Associate Professor*  
Hepatitis B Virus, Hepatocellular Carcinoma,  
microRNA in Liver Cancer, G-quadruplexes in Virus  
Genomes.

**Ashok K. Patel**, *Ph.D. (IMS, BHU)*  
*Assistant Professor*  
Biomolecular X-Ray Crystallography,  
Molecular and Structural Virology,  
Chromatin Remodeling and Diseases.



**Anita Roy**, *Ph.D. (Saha Institute of Nuclear  
Physics)*  
*Assistant Professor*  
Myeloid Hematopoiesis, Megakaryopoiesis and  
Platelet Biology, Myeloid Leukemia.



## INTRODUCTION

The School of Biological Sciences at Indian Institute of Technology Delhi was established in December 2008, with a vision to promote innovative interdisciplinary research by interfacing modern biology with applied engineering sciences, and to train scholars to be the next generation scientists capable of addressing problems affecting human health and welfare.

The establishment of the School was guided by a National Advisory Committee (NAC) co-chaired by Prof. Surendra Prasad, former Director IIT Delhi and Prof. M. Vijayan, Indian Institute of Science (IISc), Bangalore. The mandate of the School is to work in the broad thematic areas of infectious diseases and non-communicable disorders.

Currently, the School has 15 faculty members, 102 students and 11 postdoctoral fellows conducting inter- and multi-disciplinary research at molecular, structural and systems levels. In addition to a vibrant Ph.D. programme, the School offers an M.S. (Research) course, and a Minor degree programme in Biological Sciences for IIT Delhi B.Tech. students. 48 students have graduated with PhDs, and 06 students have graduated with M.S. (Research) degrees. The School has advanced equipment facilities and is funded by IIT-Delhi, Kusuma Trust, DST, DBT, ICMR etc.

**Vision:** To become the pioneers of modern interdisciplinary biological sciences by integrating emerging disciplines with biological sciences, and to nurture and sustain a vibrant comprehensive programme in research and instruction.

**Mission:** Promoting goal-oriented innovative interdisciplinary research by interfacing modern biology with applied engineering sciences to address problems affecting human health and welfare, and training scholars to be the next generation scientists.

## ACADEMIC PROGRAMMES

Currently, the School offers a Ph.D. Programme M.S. (Research) and a Minor Area option in Biological Sciences for undergraduate students. The key strengths of these programmes are their multi- and inter-disciplinary perspective of biological sciences. The flagship UG course of the School is SBL 100: Introductory Biology for Engineers, a core requirement for all incoming UG students. This course, with a laboratory component, is aimed at introducing students to modern biology with an emphasis on evolution of biology as a multi-disciplinary field. Students are made aware of application of engineering principles in biology and how to engineer robust solutions inspired by biological examples.

**Ph.D. Programme:** In general, there will be no restriction on the background of the student in terms of the qualifying degree. However, it is expected that the student's prior academic career will demonstrate interest in the broad field of biological sciences. A student applying to the programme can have a B.Tech., B.E., M.Tech., M.E., M.Sc. or M.S. in any discipline of science and engineering. Interested/deserving candidates are encouraged to apply as per the procedures at the IIT Delhi admissions website. Selection of Ph.D. students is based on a written test (for

the eligible applicants) followed by an interview (of those screened from the written test). The written test will examine the analytical ability of students with examples from biology, and does not require memorization of any biological terminologies. A sample question paper is available on the School's website.

After admission to the Ph.D. programme, the background needed for carrying out research work by the students will be developed through a selection of courses from those developed for this Ph.D. programme, and from existing courses in the Institute. The courses for the Ph.D. programme will be evolving continuously with the aim of training the next generation of researchers in biological sciences. These courses will bring together a combination of experiment and theory for understanding how biological systems work from the cellular to the systems level.

**Minor Area Programme:** Academia and industry are realizing the rapid transformation of society driven by bio-based economy. The impact of biological sciences on all aspects of human life, particularly, healthcare and utilization of biodiversity for sustainable future, is evident. The creation of new technology and its management will need a new genre of skilled human resources knowledgeable in the field of biological sciences. Emerging technologies are now being created where biology meets the engineering sciences, physics, chemistry, computer science and mathematics. Engineering new materials and devices inspired by nature, engineering drug delivery systems are but a few of a plethora of opportunities arising at the interface of biological sciences. Keeping in view, the potential of biological sciences in various spheres of life, the School of Biological Sciences has floated a Minor Area programme for undergraduate students. Through this programme, a student will discover biology from an engineering science viewpoint. A student will have the opportunity to explore a variety of areas within the diverse field of biological sciences or specialize in a certain aspect of biological sciences by choosing courses in an area of interest.

## ▶ DOCTORAL

In general, there will be no restriction on the background of the student in terms of the qualifying degree. However, it is expected that the student's prior academic career will demonstrate interest in the broad field of biological sciences. A student applying to the programme can have a B.Tech., B.E., M.Tech., M.E., M.Sc. or M.S. in any discipline of science and engineering. Interested/deserving candidates are encouraged to apply as per the procedures at the IIT Delhi admissions website.

The background needed for carrying out research work by the students will be developed through a selection of courses from those developed for this Ph.D. programme, and from existing courses in the Institute. The courses for the Ph.D. programme will be evolving continuously with the aim of training the next generation of researchers in biological sciences. These courses will bring together a combination of experiment and theory for understanding how biological systems work from the cellular to the systems level.

## **M.S. (RESEARCH)**

The M.S. (Research) programme was initiated to enhance existing teaching and research activities being carried out by the School. Students will be trained on newer technologies currently desirable in the industry and academia. The technological focus on the M.S. (Research) programme would be to provide students with practical knowledge.

The School will admit students from different academic backgrounds and levels of preparation. The board guidelines for admission are:

- i) Bachelor's or Master's degree in any engineering discipline.
- ii) Bachelor's (four - year programme) or Master's degree in any Chemistry, Physics, Mathematics or Life Sciences.

The admission will be according to Institute rules once a year. A student may enroll as a full-time or a part-time candidate. Student admitted to the programme will be assigned course work according to the requirements of the research problem. The credits and the minimum CGPA requirements will be according to the Institute rules. The courses will be awarded to build the student's background and to impart knowledge in specific area. The student must take the all courses under the compulsory category and the remaining credits from the other courses of the School or relevant courses from the Institute. The research problems will be given by the faculty from their area of expertise. The student will complete the problem assigned by the supervisor, execute the research work and write a thesis that merits the award of M.S. (Research) degree.

## **LABORATORY FACILITIES**

The school has all facilities to carry out research in biological sciences. These include:

- Spectrophotometers
- Refrigerated tabletop centrifuges
- Ultracentrifuges
- Fast protein liquid chromatography (FPLC) and high pressure liquid Chromatography (HPLC) systems
- Gel imaging and documentation equipment
- PhosphorImager
- Cell culture facilities including hoods
- Incubators and inverted microscope
- CD machine
- Fluorimeter

- Real time PCR system for quantification of nucleic acids
- ELISA washers and readers
- Confocal microscope for advanced cell biological studies

The new major equipment include:

- FACS Aria III
- Microarray platform comprising of Affymetrix system Gene chip 7G
- Gene chip Scanner 3000 7G
- Gene chip Fluidics Station
- Gene chip Hybridization Oven
- Real time PCR system (MX3000P)
- Lab chip GX
- Zephyr genomics workstation
- Cryo-EM system

In addition to all these, the school has access of a range of software licensed by the Institute for teaching and research. It has inter- and intra-net and dedicated access to the supercomputing computing facility of IIT Delhi.







The view from quadrangle of the School building



SCHOOL OF

INTERDISCIPLINARY  
RESEARCH



**Rajendra Singh, Ph.D. (Jawaharlal Nehru Univ.)**

*Professor*

Semiconductor Materials and Processing,  
Wide Band Gap Semiconductor, Semiconductor  
Nano-wires, Semiconductor Wafer Bonding.

**HEAD OF THE SCHOOL**

## ASSOCIATED FACULTY MEMBERS

**Shaikh Z. Ahammad, Ph.D. (IIT Delhi)**

*Biochemical Engineering and Biotechnology*

**R. Alagirusamy, Ph.D. (Georgia University)**

*Textile and Fibre Engineering*

**S. Wazed Ali, Ph.D. (IIT Delhi)**

*Textile and Fibre Engineering*

**Varsha Banerjee, Ph.D. (IISc., Bangalore)**

*Physics*

**Suddhasatwa Basu, Ph.D. (IISc., Bangalore)**

*Chemical Engineering*

**Naresh Bhatnagar, Ph.D. (IIT Bombay)**

*Mechanical Engineering*

**Tanusree Chakraborty, Ph.D. (Purdue University)**

*Civil Engineering*

**Sumedha Chakma, Ph.D. (IIT Delhi)**

*Civil Engineering*

**Apurba Das, Ph.D. (IIT Delh)**

*Textile and Fibre Engineering*

**Ashish K. Darpe, Ph.D. (IIT Delhi)**

*Mechanical Engineering*

**Anupam Dewan, Ph.D. (IISc., Bangalore)**

*Applied Mechanics*

**Sanjay Dhir, Fellow, Ph.D. (IIM, Lucknow)**

*Management Studies*

**James Gomes, Ph.D. (Tulane University)**

*Biological Sciences*

**Amit Gupta, Ph.D. (University of Central Florida)**

*Mechanical Engineering*

**B. Jayaram, Ph.D. (City University NY)**

*Chemistry*

**Sandeep Kumar Jha, Ph.D. (Bhabha Atomic Research**

*Centre, Mumbai)*

*Biomedical Engineering*

**Bipin Kumar, Ph.D. (IIT Delh)**

*Textile and Fibre Engineering*

**Puneet Mahajan, Ph.D. (Montana State University)**

*Applied Mechanics*

**Vasant Matsagar, Ph.D. (IIT Bombay)**

*Civil Engineering*

**Bhanu Nandan, Ph.D. (MSRDE, Kanpur University)**

*Textile and Fibre Engineering*

**Sanjay Puri, Ph.D. (University of Illinois)**

*School of Physical Sciences, JNU*

**Anurag S. Rathore, Ph.D. (Yale University)**

*Chemical Engineering*

**Sandeep Sahany, Ph.D. (IISc., Bangalore)**

*Atmospheric Sciences*

**Satinder P. Singh, Ph.D. (IIT Delhi)**

*Mechanical Engineering*

**Bijay P. Tripathi, Ph.D. (CSMCRI, Bhavnagar)**

*Materials Science & Engineering*

## ▶ INTRODUCTION

The School was founded in October 2017 with the objective to actively encourage our researchers and students to stretch their boundaries and to collaborate with people from other disciplines to help bring broader perspectives and ideas to research problems of different kinds. It is envisioned that the school will not only accelerate growth of interdisciplinary research at IIT Delhi but would enable to engage with faculty across Institutes such as AIIMS, JNU etc. It is expected that over a period of time the School would be able to “seed” a number of inter-disciplinary programmes that are unnoticed today. IIT Delhi already has a number of strategic interdisciplinary research groups working on various issues including a few related to societal problems but with limited scope. We believe that SIRE will serve as an ideal platform for the growing numbers of Centres of excellence and MOUs with other organizations/institutes/research laboratories to undertake problems that require solutions from completely different perspectives.

SIRE is a virtual school. Currently the School runs a Ph.D. program. Shortly, SIRE plans to start M.S. (Research). All faculty who have a registered Ph.D. student at SIRE are faculty members of the School. Currently we have fourteen Ph.D. students registered at this School with twenty five faculty members from ten Departments, two Centres, one School. All areas of science, engineering, humanities and management pursued at IIT Delhi are considered under the umbrella of SIRE. IIT Delhi has signed MOUs with DRDO, AIIMS and JNU, one student is already registered jointly with JNU. Other institutions are invited to participate in this endeavor and sign an MOU with IIT Delhi to enable them to register Ph.D. students at SIRE.

## ▶ MISSION AND VISION

IIT Delhi is a research-intensive institute. It has created SIRE to promote interdisciplinary research. Over the past six decades, the institute has established several strong disciplines in the area of engineering, science and humanities. The disciplines will remain a central element of the academic system but SIRE will serve as a catalyst to bring together people from various departments and neighbouring academic institutions and industry to solve complex questions and problems in cross disciplinary research. It will inculcate scientific curiosity, and encourage faculty and students to congregate at the interfaces and frontiers of disciplines and foster new research avenues.





**SCHOOL OF**

**PUBLIC  
POLICY**



**Ambuj Sagar, Ph.D. (Massachusetts Institute of Technology)**  
*Professor*

Science, Technology and Development, Innovation Policy for Meeting Sustainability and Inclusivity Challenges, Energy Innovation Policy and Strategies, Climate Change Policy and Politics, and Higher Education Policy.

## HEAD OF THE SCHOOL



**Soutrik Basu, Ph.D. (Wageningen School of Social Sciences (WASS))**

*Assistant Professor*

Science Policy, Innovation Systems, Agrarian Studies, Agri-innovation, Policy Studies.

**Nandana Sengupta, Ph.D. (Tepper School of Business at Carnegie Mellon University)**

*Assistant Professor*

Econometrics, Machine Learning, Survey Design, Skilling, Indian Labour Market.



**Sanjay Mitra, Ph.D. (JFK School of Govt., Harvard University)**

*Professor of Practice*

Governance and Decentralization, Public Formulation, National Security, Electricity Policy.

**Upasna Sharma, Ph.D. (IIT Bombay)**

*Assistant Professor*

Disaster Risk Reduction and Management, Information and Communication Technologies for Agriculture, Climate Change Adaptation.



## ▶ INTRODUCTION

The School of Public Policy is a newly-established entity in the Indian Institute of Technology Delhi, which is one of India's premier engineering and education and research institutions. The IITD-SPP aims to be an academic centre of excellence for domestic and global policy research, with a particular emphasis on science, technology, innovation (STI), and development that will contribute positively and significantly to national and global policy processes on key issues of importance to India and other countries.

As a premier institute of technology, IIT Delhi is uniquely placed to engage with broader issues relating to science and technology. It has the analytical and quantitative culture needed for engaging in STI policy issues. Furthermore, many faculty members on campus already are engaged in some form or fashion with S&T policy through their own work. As an academic institution, IIT Delhi offers a value-neutral location for engaging with multiple/conflicting perspectives and its high profile also gives it convening power to bring together stakeholders as well as engage with policy makers. The School will also link with emerging programs at IIT Delhi such as those involving design, innovation, and entrepreneurship. Overall, we expect the SPP to add to policy-analytical knowledge and capabilities in the country, with a special, and much-needed, focus on issues with a scientific and technical content, and couple this work to decision-making processes at the local, national, and international levels.

Specific objectives of the IITD-SPP are to:

- Carry out world-class research on a range of topics that relate to the production and use of scientific and technical knowledge for developmental goals in a changing global and domestic context;
- Develop policy proposals to address specific developmental challenges as well as strategies for their implementation;
- Engage with high-level policy makers on 'policy needs', implementation strategy, and monitoring & assessment;
- Promote a public dialogue with citizens, academics, and policy makers on policy and societal implications of major scientific and technological changes;
- Help build local capacity for policy analysis and implementation through the training of the next generation of scholars and practitioners and through the upgrading of the skills of existing personnel; and
- Enhance IIT Delhi's educational offerings, research profile, as well as social impact.

## ▶ ACADEMIC PROGRAMMES

IITD-SPP has conducted its first round of intake for the Ph.D. programme in May 2019. In the near term, once we recruit sufficient faculty, we anticipate the development of a minor in Science, Technology and Public Policy (allowing focus on areas such as Technology and Innovation Policy, Technology and Development, or Law and Technology

(possibly jointly with Humanities and Social Sciences and other departments)), which would involve a structured sequence of courses. Core courses for the minor will be designed in collaboration with various departments to enhance the general education of undergraduate students by ensuring that they have basic exposure to, and familiarity with, policy, legal, and societal aspects of science and technology issues. Courses may also be organized as seminars to provide the opportunity for students to engage in cutting-edge discussions on current public policy topics, e.g., Science, Technology, and Sustainable Development; Industrial Innovation and Organization; Health Systems and Innovations; Science, Technology, and the Future of Agriculture; and Information Infrastructure.

With further recruitment, we also expect eventually to develop a Master's degree in Public Policy (MPP) as well as Executive Education courses for policy-makers as well as other senior personnel from relevant governmental, inter-governmental, and private organizations. Over time, we can also imagine the exploration of a B.Tech.-MPP dual degree programme.

## RESEARCH AREAS

While the School of Public Policy is only just beginning to get off the ground, some faculty members at IIT Delhi have been engaging in STI policy research projects through a major grant from the Department of Science and Technology – the DST-Center for Policy Research – as well as some smaller research grants to individual faculty members. These include studying the productivity of technically-skilled returnees, linkages of MNC R&D centers to the Indian innovation ecosystem, effectiveness of academia-industry knowledge linkages, factors affecting the performance of publicly-funded incubators and ICT-based agro-metrological advisories. We also have contributed to the development of a draft technology-led innovation policy for DST and also held a number of workshops on various topics (such as inclusive innovation and technology assessment).



**INTERDISCIPLINARY**

**RESEARCH  
PROGRAMMES**

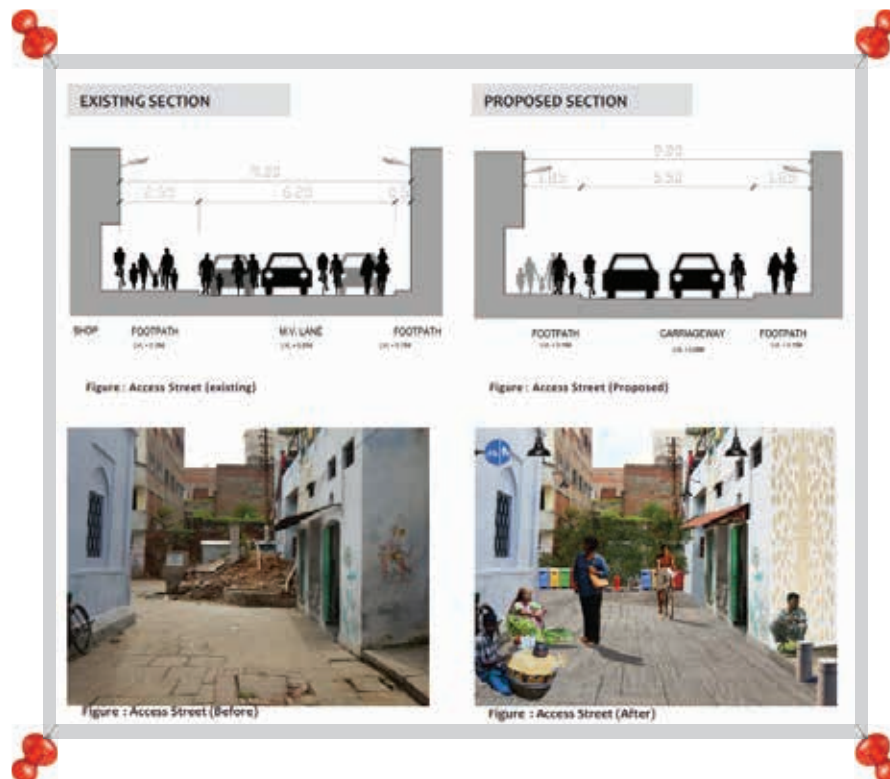


## INTERDISCIPLINARY RESEARCH PROGRAMMES

### Transportation Research And Injury Prevention (TRIPP)

TRIPP is an interdisciplinary programme focussing on the reduction of adverse health effects of road transport. TRIPP attempts to integrate all issues concerned with transportation in order to promote safety, cleaner air, and energy conservation. The Programme is recognized as a Centre of Excellence by the Ministry of Urban Development, Government of India. It is recognized as a WHO Collaborating Centre for research and training in safety technology. It is also recognized as a Centre of Excellence for Research on Future Urban Transport by the Volvo Research Foundation.

The programme has associated faculty from different departments / centres of the institute, viz., Applied Mechanics, Biomedical Engineering, Civil Engineering, Computer Science and Engineering, Mechanical Engineering, Humanities and Social Sciences, Mathematics. Experts from other organizations and hospitals in Delhi are also associated with TRIPP. TRIPP organises short-term courses and workshops on road safety and transport regularly every year.



**The TRIPP research areas are:** Transportation planning and traffic flow analysis for optimising mobility and minimising accidents and pollution; Vehicle crash modelling, road safety studies, safer vehicle and helmet design; Studies related to public transport, traffic management, road design and land use planning; Epidemiology of factors associated with road traffic injuries, injury analysis and pre hospital care; Studies on vehicle technology and engines to minimise fuel consumption and pollution. TRIPP also organises short-term courses and workshops on road safety and transport issues regularly. *For more details visit: <http://tripp.iitd.ac.in/>*

### Associated Faculty Members

- Prof. Kalaga R. Rao, *Civil Engineering - Coordinator*
- Prof. Puneet Mahajan, *Applied Mechanics*
- Prof. Sanjeev Sanghi, *Applied Mechanics*
- Prof. Dinesh Mohan, *Civil Engineering*
- Prof. Geetam Tiwari, *Civil Engineering*
- Prof. Arvind Swamy, *Civil Engineering*
- Prof. K.N. Jha, *Civil Engineering*
- Prof. M. Manoj, *Civil Engineering*
- Prof. S. Banerjee, *Computer Science & Engineering*
- Prof. Ankush Agarwal, *Humanities & Social Sciences*
- Prof. Sourabh Paul, *Humanities & Social Sciences*
- Prof. Ravi Shankar, *Management Studies*
- Prof. N. Chatterjee, *Mathematics Department*
- Prof. Kaushik Mukherjee, *Mechanical Engineering*
- Prof. Anoop Chawla, *Mechanical Engineering*
- Prof. S. Mukhrjee, *Mechanical Engineering*

### VLSI Design Tools and Technology Programme

VLSI Design, Tools, and Technology is an interdisciplinary Masters level programme course offered by IIT Delhi. The course is run by three departments : Electrical, Computer Science and CARE.

This is a completely sponsored programme, in which each candidate is sponsored by an industry or a sponsored research project. Current and past sponsors include Qualcomm, Texas Instruments, Cypress, Cadence, Intel, Analog Devices, Nokia, NXP, Freescale, Mentor Graphics, Nvidia, IBM, and ST Microelectronics.

Streams offered under VDTT are: Embedded Intelligence, ASIC and SoC Design, Micro and Nano Devices.

Scope for projects in analytics and IoT domain. Design your own Application Specific ICs or model your own Semicon devices.

Once admitted, the students study in IIT Delhi for the first three semesters and have to work on a project at the company site in the 4th semester. *For more details visit: <http://vdttd.iitd.ac.in/>*

### Opto-electronics and Optical Communication Research Programme

The programme is focused for research in the field of Fibre Optics and Optical Communication. Main participating departments / centres are Physics, Electrical Engineering, IDDC and CARE. This programme has received fundings

from the Government agencies like MHRD, DST, DIT (formerly DoE), and DoT. In addition, R&D work has also attracted considerable international collaboration from universities in UK, France and National Institute of Standards and Technology in USA. The development work has led to commercialisation of a fibre optic educational kit and an erbium doped fiber amplifier.

**The programme carries research in the following areas**

Analytical and numerical modelling of the propagation characteristics of optical fibres and integrated optical waveguides, design and simulation of novel in-line fibre optic components such as polarizers, directional couplers, and mode filters, characterisation of birefringent fibres, development of optical fibre-based sensors, nonlinear interactions in fibre and integrated optical waveguides, Optical Amplifier, Coherent optical communication, Optical Networks, QoS issues of WDM Networks, SONET / SDH, fiber in Access Networks, Erbium Doped Fibre Amplifiers (EDFA), Raman Fiber Amplifiers, Dispersion Compensating Fibres (DCF), Fibre Bragg Gratings (FBG), fibre optic sensors for civil engineering structures, photonic band gap fibres, free space optical systems, OCDMA systems, etc.

*For more details visit: <http://oeoc.iitd.ac.in/jop/>*





**INTERDISCIPLINARY**

**M.TECH.  
PROGRAMMES**

## ▶ INTERDISCIPLINARY M.TECH. PROGRAMMES

Besides a number of regular courses that are offered at the postgraduate level by the academic departments/centres, the Institute offers Interdisciplinary M.Tech. programmes which are managed by the Programme Executive Committees and Programme Advisory Committees that are constituted by nominating faculty from the concerned departments and centres. Each programme is looked after by the Programme Coordinator who is appointed by the Director.

### **Masters of Technology Programmes**

The institute recognises and actively supports academic activities jointly conducted by faculty across the departments and centres. Such activities encourage teaching, research and industry/professional interactions, these are listed below. The Interdisciplinary Post Graduate programmes are in the following specializations:

**Energy Studies:** This programme introduces students from different backgrounds to various aspects of energy, sources, fuels, energy conversion and energy systems amongst others. Commercial and non-commercial energy sources are covered.

**Industrial Tribology and Maintenance Engineering:** Various basic and applied aspects of tribology, including wear and maintenance engineering are covered in this programme. Students are introduced to diagnostic maintenance, reliability, availability and maintainability engineering as well as failure analysis.

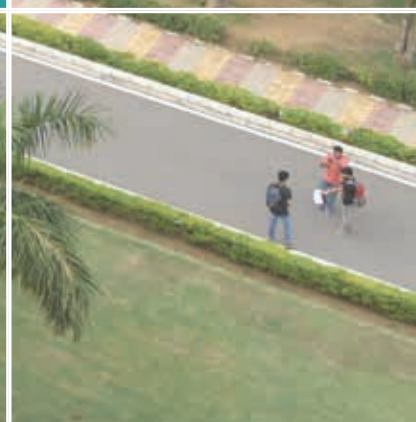
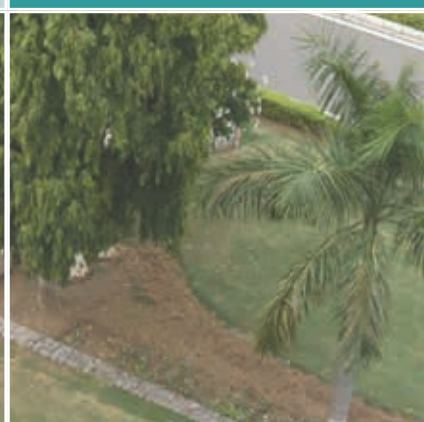
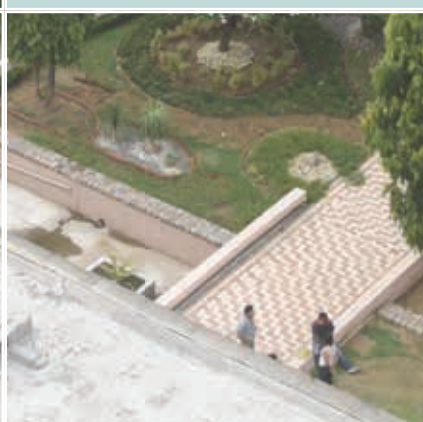
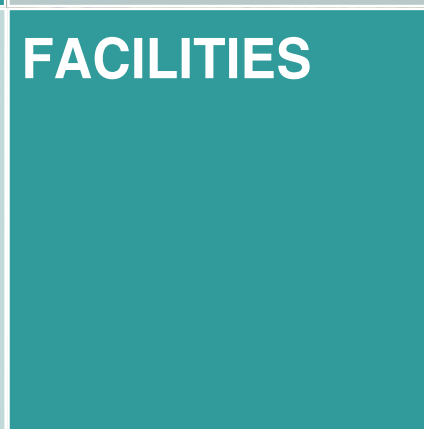
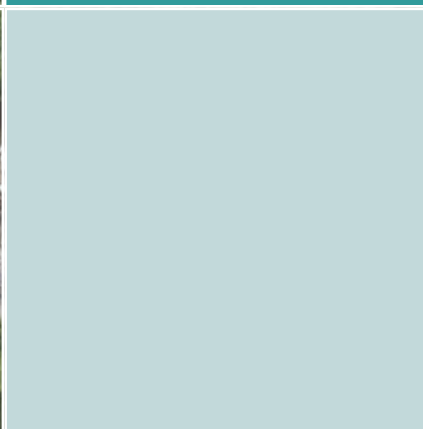
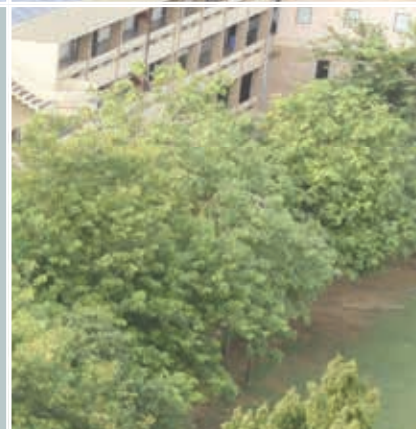
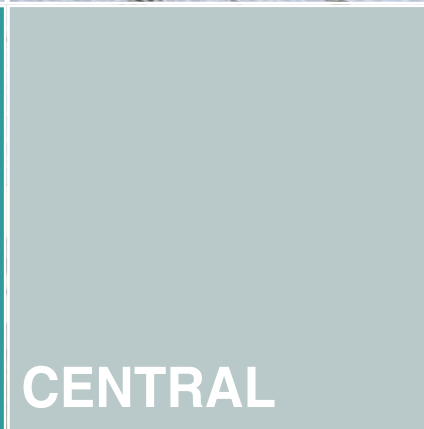
**Instrument Technology:** This programme includes students to various instruments, electronic techniques for signal conditioning and instrument design. The electives cover a wide range of topics in instrumentation, electrical engineering, mechanical engineering and physics.

**Opto-Electronics and Optical Communication:** This programme is jointly offered by physics and electrical engineering departments. The courses cover a wide variety of basic and applied courses in fibre optics, optical-electronics and digital communication.

**VLSI Design Tools and Technology:** This programme is taught by the faculty of computer science and engineering, electrical engineering departments and CARE. The coursework includes courses on MOS, VLSI and VLSI design and VLSI system. The students gain proficiency in the use of state-of-art tools in VLSI design. The programme is largely supported by industries engaged in VLSI design.

**Telecommunication Technology Management:** A set of courses in digital communication and systems, wireless communication and telecommunication management form the core of this programme. Faculty of electrical engineering and management studies departments participate in the teaching of this programme.





## 7. MAJOR CENTRAL FACILITIES

The Institute has following central facilities for smooth functioning of Academics, Research and Outreach.

- Central Research Facility
- Industrial Research and Development (unit)
- Central Workshop
- Nanoscale Research Facility
- Training and Placement (unit)
- Central Library

### 7.1 Central Research Facility (CRF)

#### Purpose and Aim of CRF

Central Research Facility (CRF) is a common instrument and fabrication facility of IIT Delhi created to support students in their research activities. CRF has state-of-the-art analytical and instruments manned by qualified personnel to provide sample testing and analysis to UG, PG, Ph.D. students and other research staff. The facilities are also made available, on payment basis, to other academic and research institutions, industries and organizations in the neighborhood..

The aims of CRF are:

- To provide expertise in the analytical sciences and to facilitate research on the structure and function of molecules and materials.
- To engage in the analytical sciences with student community, government research labs and commercial partners.
- To foster enthusiasm and collaboration in scientific research.
- To strengthen the research-relevant infrastructure of basic science and technology and built a facility having capabilities to carry out research of top international standards.

#### Structure of CRF

The policies and activities of CRF are monitored by Central Facilities Committee (CFC), which is appointed by the Director and is chaired by DD(S&P). The constitution of the current CFC is as under:

Sr. No.	Official	Status	Nominee of
1	Dy. Director (Strategy and Planning)	Chairman	Director
2	Dy. Director (Operations)	Member	Ex-officio
3	Dean (R&D)	Member	Ex-officio
4	Associate Dean Academics (PG Research)	Member	Ex-officio
5	Prof. Bhaskar Mitra (Deptt. of Electrical Engineering)	Member	Director
6	Prof. Tapan K. Nayak (Kusuma School of Biological Sciences)	Member	Director
7	Prof. (Ms.) Jyoti Phirani (Deptt. of Chemical Engineering)	Member	Director
8	Prof. Suresh Neelkantan (Deptt. of Materials Science & Engg.)	Member	Director
9	Prof. Pankaj Srivastava, <i>Head, CRF</i>	Member	Ex-officio
10	Prof. Ashwini Kumar Agarwal, <i>Ex-Head, CRF</i>	Member	Ex-officio
11	Prof. Sameer Sapra, <i>Associate Head, CRF</i>	Member/Convener	Ex-officio

The operations of CRF are managed by Head and Associate Head. They may be contacted at:

#### **Head**

Prof. Pankaj Srivastava (Department of Physics)

**Tel:** +91-11-26596558; **E-mail:** pankajs@physics.iitd.ac.in

#### **Associate Head**

Prof. Sameer Sapra (Department of Chemistry)

**Tel:** +91-11-2659 1561; **E-mail:** sapra@chemistry.iitd.ac.in

#### **Various facilities under CRF**

Institute Central Research Facility is equipped with the following instrument and fabrication facilities.

The facilities under CRF can be categorized under three major categories:

- (A) Electron Microscopy Facilities
- (B) Spectroscopy Facilities
- (C) Other Facilities
- (D) CRF Sonipat Facilities

The details of the facilities are as follows:

#### **A. ELECTRON MICROSCOPY FACILITIES**

Transmission Electron Microscope is a very powerful tool to provide morphologic, compositional and crystallographic information on samples. A high energy beam of electrons in kV is passed through a very thin sample, and the interactions between the electrons and the atoms can be used to observe features such as the crystal structure, dislocations and grain boundaries.

##### **1. Cryo HR-Transmission Electron Microscopy (Cryo HR-TEM)**

The TEM facility at IIT-Delhi consists of a 200 KV TEM, with a high brightness field-emission gun (FEG) source which produces improved sensitivity and resolution (0.1 nm) compared to more traditional thermionic sources like LaB6 or Tungsten filaments. This facility can also be utilized for high resolution analysis of the structure and organization of large biological molecules such as protein complexes, viruses etc through cryoelectron microscopy. Accessory equipment for plunge freezing samples, plasma cleaning grids and holders are available.



*Figure 1 : Cryo HR TEM*



## 2. Transmission Electron Microscopy (TEM)

This facility consists of 120 kV TEM which is optimized for high contrast imaging for biological, low Z, and materials science applications. It is equipped with LaB<sub>6</sub>/Tungsten filaments emitter, latest large-area SDD detectors, compact footprint and simplified GUI with multitouch screen for optimal ease of use.

### Equipment in Facility:

**Microscope:** The JEOL JEM-1400 Plus Transmission Electron Microscope (TEM) features high resolution/high contrast imaging. It has a maximum accelerating voltage of 120 kV, a  $\pm 70$  degrees tilted computer controlled stage. With the JEM-1400Plus, images from the ultra LOWMAG mode (min. mag.  $\times 10$ ) to the MAG mode (max. mag.  $\times 1.2$  M) can be acquired with AMT camera, resulting seamless observation with no switching of cameras or shifting one's gaze to a fluorescent screen. Using the auto montage function (provided as standard) makes it easy to acquire high-precision images of a wide field of view.

**Point and Shoot function:** This function allows the user to move a field of view to target position pointed by clicking on a previously-acquired image. The Point and Shoot function allows users to view a target image without changing optical conditions such as focus or magnification.

**Intelligent Panel:** An advanced-function, simply-designed operation panel was developed. The rich and various patterns on the color display of the organic EL enable to display a function of buttons with easy-to-see and user-friendly accessibility. About 50 kinds of button patterns are provided and the functions of the buttons are customizable on the user's selection.

**Softwares:** TEMCON software is used for measurements.

## 3. High-resolution Transmission Electron Microscopy (HRTEM)

The Tecnai G2 20 is a highly advanced, state-of-the-art transmission electron microscope with an unrivalled task-oriented user interface. It offers high performance with versatility, high productivity with ease of use, and all in a personal environment. The accessories that may be fitted onto these systems (e.g. STEM,



Figure 2 : TEMs in Central Facility and some Images



Figure 3 : Tecnai™ G2 20 HR-TEM

CCD cameras, EDX) are embedded into the user interface, allowing differently experienced operators to fully utilize the functionality of the total system through one coherent interface.

The Tecnai G2 20 is a reliable and versatile instrument which is ideally suited for studying a wide range of general and advanced materials, soft matter, composites, hybrids, tissues and cellular compounds. The flexibility to change the high tension to any other value in a minute helps to operate the Tecnai G2 20 always at optimum experimental conditions.

The combination of high resolution 2D imaging at both ambient conditions, bright-field, dark-field STEM imaging, electron diffraction and detailed microanalysis, makes the Tecnai G2 20 a versatile tool for classical materials science as well as life science applications.

#### 4. Field Emission Scanning Electron Microscope (FESEM) with Oxford-EDX

The Quanta 200 FEG Scanning Electron Microscope (SEM) offers nanometer resolution and a high signal to noise ratio in both regular high vacuum and environmental modes. The EDS consists latest 80 mm<sup>2</sup> SDD detector enables detection of elements under high resolution. Quanta FEG 200 comprises of different types like ETD (Everhart-Thornley detector), Backscattered Electrons Detector (BSED), Large Field Detector (LFD), and Gaseous Secondary Electron Detector (GSED). STEM (Scanning Transmission Electron Microscopy) is also possible to form atomic resolution images and high contrast imaging of biological samples.



Figure 4 : FESEM with EDX

#### 5. Scanning Electron Microscopy (SEM)

Zeiss EVO 50 & EVO18 are versatile analytical electron microscopes with a large specimen chamber. The EVO50 series can handle large specimens at the analytical working distance of 8.5 mm owing to a combination of the inclined detectors and the sharp conical objective lens. The class leading X-ray geometry allows for the addition of an EDS detector. The instrument can achieve 2.0 nm resolution.

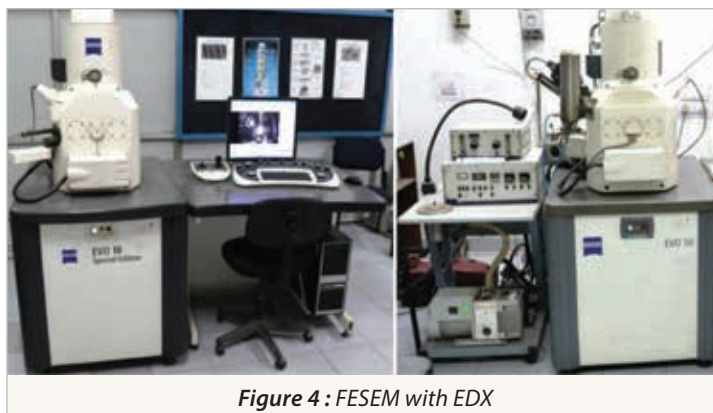
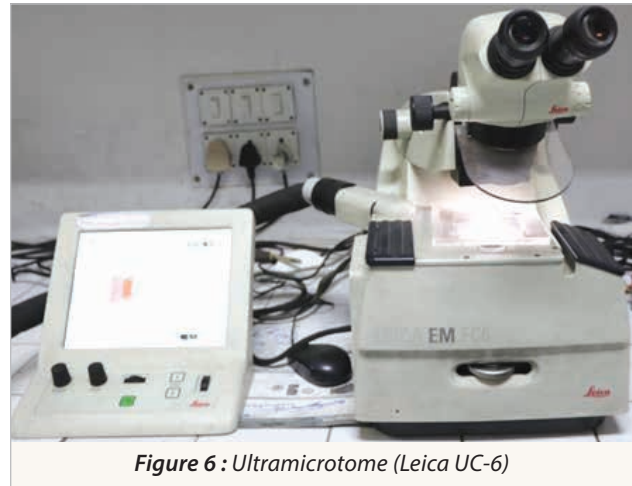


Figure 4 : FESEM with EDX



## 6. Ultramicrotomy

Ultramicrotomy is a method for cutting specimens into extremely thin slices, called ultra-thin sections, which can be studied and documented at different magnifications in a transmission electron microscope. Ultra thin sections of specimens are cut using a specialized instrument called an “ultramicrotome”. The usual thicknesses for transmission electron microscopic examinations range between 20 nm and 150 nm. There are various techniques for preparing such thin samples. Besides ion etching, FIB, tripod polishing and electrochemical processing, ultramicrotomy is a fast and clean method of producing ultra-thin sections of biological samples as well as polymers, rubber, ductile and even hard and brittle materials. A key advantage of ultramicrotomy is the size and homogeneity of the electron-transparent area of specimens prepared with this technique.



*Figure 6 : Ultramicrotome (Leica UC-6)*

## 7. Atom Probe Tomography

Atom probe tomography is a unique characterization technique that facilitates three-dimensional visualization as well as in-depth analysis of nano-scale features at near-atomic scale resolution. APT is fundamentally a time-of-flight (TOF) mass spectrometry technique. The power of APT lies in its ability to tie compositional information to structure. LEAP accomplishes this with high analytical sensitivity which can reach one atomic part per million (appm).

Design and development of materials with tailored properties at the nano scale requires understanding of elemental distribution at the atomic scale. Atom probe tomography with Local Electrode Atom Probe (LEAP) has the capability of characterizing materials ranging from metals, polymers, ceramics, semiconductors and composites, for their elemental distribution in 3D at the atomic scale.



*Figure 7 : Atom Probe Tomography Facility*

The APT facility at IIT Delhi is a part of the National Facility for Atom Probe Tomography (NFAPT) situated at IIT Madras with Nodal Centres at IIT Delhi, IIT Bombay, IIT Kanpur, IIT Kharagpur, IIT Ropar and ARCI.

## B. SPECTROSCOPY FACILITIES

### 1. Nuclear Magnetic Resonance Spectroscopy (300 MHz, 400 MHz and 500 MHz)

NMR spectroscopy is equipped with three superconducting NMR spectrometers operating in the liquids mode. The spectrometers range from 7.05 Tesla (300 MHz <sup>1</sup>H frequency) to 11.74 Tesla (500 MHz <sup>1</sup>H frequency). All three spectrometers are of the Bruker Avance AV-III type and are equipped with broadband probes with a single axis gradient. The 400 MHz spectrometer has an auto sampler for accelerated workflow.



Figure 8 : NMR Instrument

### 2. NMR 400MHz with Liquid and Solid Probe

In JNM-ECA Series (Delta V4.3 -) Delta - 400 MHz- FT-NMR instrument liquid-state NMR as well as solid-state NMR measurement becomes possible. High-Resolution solid-state NMR measurement by techniques such as cross-polarization-magic angle spinning (CP/MAS) method becomes possible when you add optional attachments, such as a probe for the solid-state measurement, to the standard composition of JNM-ECA/ECX series. Multinuclear observation (<sup>31</sup>P-<sup>15</sup>N) measurement and measurement under variable temperature (VT) are also possible in this system.



Figure 9 : NMR 400 MHz

### 3. Inductively Coupled Plasma-Mass Spectrometry (ICP-MS)

Agilent's 7900 ICP-MS has a robust plasma and optional Ultra High Matrix Introduction (UHMI) technology that enable the user to routinely measure samples containing up to 25% total dissolved solids (TDS)—100 times higher than the traditional matrix limit for ICP-MS.

Widest dynamic range—the new orthogonal detector system (ODS) delivers up to 11 orders of magnitude



Figure 10 : ICP-MS system, Agilent 7900

dynamic range from sub-ppt to percent-level concentrations, enabling you to measure trace elements and majors in the same run. Faster analysis of transient signals-with 10,000 separate measurements per second, the 7900 ICP-MS provides short integration times for accurate analysis of transient signals.

#### 4. MALDI-TOF/TOF Mass Spectrometry

Matrix-assisted laser desorption/ionization mass spectrometry (MALDI-MS) emerged as an effective analytical tool use for studying the molecular mass determination, protein identification & characterization, identification of post translational modification, terminal sequencing and more other applications . In general, molecules in the gas phase (or species desorbed from a condensed phase) are ionized, and the ions are then accelerated by an electric field and separated on the basis of their mass-to-charge ratio ( $m/z$ ) and further detected. A time-of-flight (TOF) mass spectrometer separates ions with identical kinetic energy but different  $m/z$ , since lighter ions travel faster than heavier ones. A mass spectrum is a chromatogram presenting the signal intensity (y-axis) versus  $m/z$  (x-axis). Interpretation of the fragmentation patterns and isotopic peaks can provide valuable clues for the structure determination of organic molecules. MALDI provides a 'soft' ionization source that prevents decomposition of fragile biomolecules, producing primarily singly charged, intact protein ions. The ions produced with the MALDI technique are analyzed using a time-of-flight (TOF) mass spectrometer, which is characterized by a high ion throughput and therefore high sensitivity.



*Figure 11 : Bruker UltrafleXtreme MALDI-TOF/TOF Mass Spectrometer*

#### 5. Micro Raman Spectroscopy

Micro-Raman spectrometer, inVia reflex Raman spectroscopy system combined with research grade Leica microscope allows scatter, line, area mapping and confocal depth profiling. Renishaw Raman can be used with two types of lasers- 514nm and 785nm with different magnification lenses. Argon Ion laser 514 nm 20 MW-5000 hours usage. Renishaw Diode laser, solid state Near IR -3000 hour.



*Figure 12 : Raman Spectroscopy*

## 6. Electrospray Ionization- Liquid Chromatography (ESI-LC)-Mass Spectrometry

Electrospray ionization (ESI) is a soft ionization technique to examine proteins using MS and MS/MS. In ESI, charged droplets are produced by passing a solubilized sample through a high voltage needle at atmospheric pressure. Desolvation occurs prior to entrance into the high vacuum of the mass spectrometer. This approach is often coupled with a chromatographic system, typically reverse phase chromatography or capillary electrophoresis, allowing analysis of very complex samples. ESI typically induces a range of charge states. LC-MS is a powerful technique used for many applications which has very high sensitivity and selectivity.

The ESI-MS facility at KSBS, IIT Delhi is a Bruker Electrospray Ionization instrument-amaZon SL Dual Funnel Iontrap bench top with a mass accuracy of 0.1Da. It is connected to a nano-liquid chromatography setup- EASY nLC-II with C18 column to fractionate sample containing mixture of peptides. There is a facility of direct probe injection as well as sample injection through nLC. This instrument is capable of performing analysis of intact proteins, mixtures of proteins and peptides, biomarker studies, identification of post translational modifications, and many more applications.

## 7. FTIR(Fourier Transform Infrared Spectrometer)

The Thermo Scientific™ Nicolet™ iS™50 FT-IR spectrometer alleviates many of these productivity concerns by automating setup of the FT-IR system for multi-spectral range experiments (>20,000 cm<sup>-1</sup> to 80 cm<sup>-1</sup>) and for integrating techniques like FT-Raman, near-IR and mid/far-IR attenuated total reflectance (ATR) into a single workflow.



Figure 13 : ESI-LC- Mass Spectrometry



Figure 14 : FTIR



## 8. Field Emission Scanning Electron Microscope with EDS

The JEOL JSM-7800F Prime is a high resolution SEM that allows for imaging with a spatial resolution down to 0.5 nm. It is especially useful for surface sensitive analysis and analysis of beam sensitive materials as the landing energy of the electrons can be as low as 10 V. The JSM-7800F Prime is equipped with a large specimen chamber that accommodates a wide variety of detectors simultaneously, including: multiple EDS, EBSD, WDS, BSE. Oxford make EDS and EBSD. The EDS consists LN2 free SDD X-max 80 EDS detector enables detection of elements under high resolution. The new Gentle Beam Super High mode (GBSH) enables a bias voltage of up to 5 kV to be applied to the specimen stage, which decreases charging on nonconductive specimens, improves spot size at low kV, enhances surface topography, and enables high resolution imaging at extremely low voltages.

Applications include imaging and analysis of metals, magnetic materials, semiconductors, ceramics, medical devices, and biological specimens.



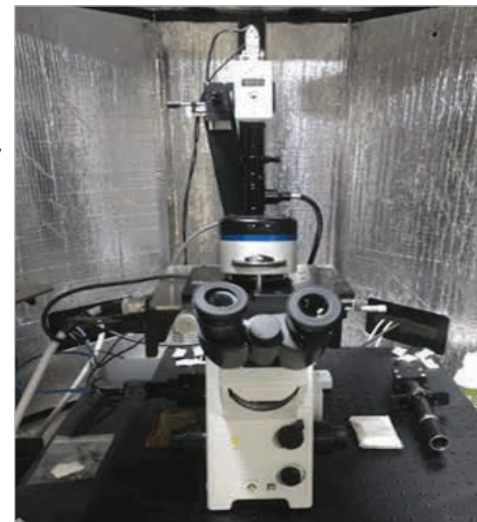
*Figure 15 : Jeol JSM-7800F Prime Field Emission Scanning Electron Microscope (FESEM)*

## 9. Atomic Force Microscope (AFM)

Asylum Research MFP3D-SA is a very versatile atomic force microscope, suitable for use with a wide range of samples and features a vast array of modes. It has a z-range of 40  $\mu\text{m}$  (extended head model) and an 'x' and 'y' movement of up to 90  $\mu\text{m}$  in a closed loop scan. The microscope differs from most others available on the market due to using separate piezos for each plane. This allows for the use of nano-position sensors, minimising hysteresis and creep, whilst also ensuring flat scans. The MFP-3D is able to image conductive, semiconductive and insulating samples in both air and liquid environments. The head can be adjusted to fit a wide range of sample sizes and both top down and bottom up illumination of samples is possible.

Some Features of Asylum Research MFP3D-SA:

- High Precision 3D Motion with Closed - Loop sensors on all three axes.



*Figure 16 : FTIR*



- Z axis: >15 $\mu$ m range; 0.25nm resolution
- X&Y axes: 90 $\mu$ m range; 0.5nm resolution
- Molecular Scale Force Measurements with up to 384x384 array of Force Curves
- Integrated with inverted optical microscope: Olympus IX71
- Heater controller with petri-dish heater which can heat up to 45°C.

## C. OTHER FACILITIES

### 1. Liquid Nitrogen Facility

The Liquid Nitrogen (LN2) facility is involved in-house production of LN2 and its supply to various experimental laboratories of the institute. The current LN2 plant was commissioned by M/s. Stirling Cryogenics & Refrigeration in 1989. The original Model StirLIN-1 was then upgraded in 2006. This increased its production capacity from 6 liters/hr to 10 liters/hr. The plant is able to meet the current Institute's demand of approximate 1500 liters per month.

### 2. Glass Blowing Workshop

Various jobs can be undertaken in the workshop are: – 'T' joints to Mercury Diffusion pumps. Special glass apparatus like McLeod Gauge, B.E.T apparatus, Dewar Flasks, Distillation Unit, Various types of viscometers, All type of Condensers, Multi Necked Flasks, Various types of Adaptors and setting of vacuum lines can be possible.

### 3. 3D Printing

RAISE 3D N2 is a 3D Printer that works on Fused Deposition Modelling (FDM) technology. FDM is a filament-based technology where a temperature-controlled head extrudes a thermoplastic material layer by layer onto a build platform. The build volume is 12in x 12in x 12in (305mm x 305mm x 305mm). The machine has up to 10 micron Z resolution and 12.5 micron X/Y step size to achieve the best print quality and accuracy.



Figure 17 : Liquid Nitrogen Facility



Figure 18 : Glass Blowing Instrument

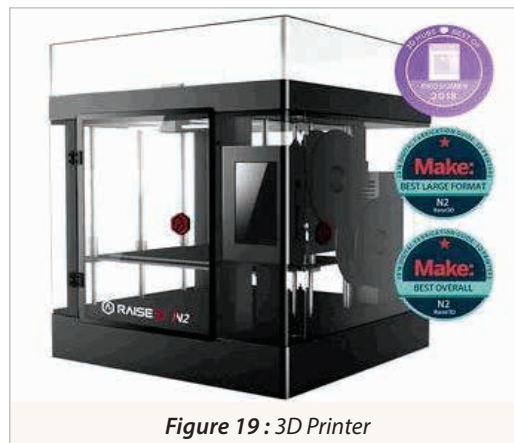


Figure 19 : 3D Printer

#### 4. Laser Cutting

The laser cutting machine (Epilog Helix 24 Laser) provides a wide range of opportunities and possibilities. The Helix's generous 24" x 18" (610 mm x 457 mm) engraving area will allow you to engrave multiple pieces. The laser power is 45W and the maximum thickness of the acrylic sheets that can be cut is 10mm.

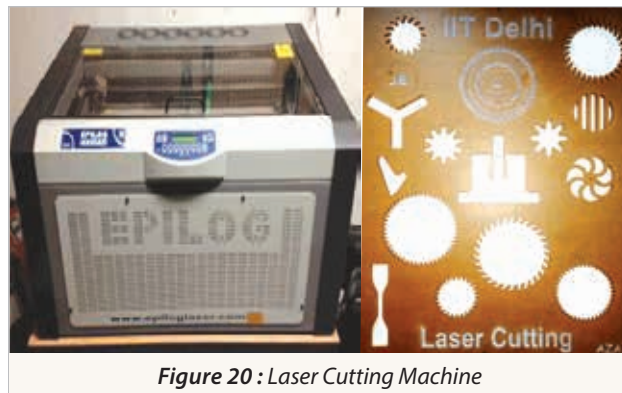


Figure 20 : Laser Cutting Machine

#### D. CRF SONIPAT FACILITIES

Facility Coordinator: Dr. Atul Kumar Singh

##### Building Specifications:

- Total Built up Area is 20,560 Square feet.
- Entire building is divided into 4 clusters; acting as self-sustained independent blocks.
- Each cluster is having 4 labs (520 Sq. ft.; 280 Sq. ft. and 2 labs of 300 Sq. ft. along with utility area of 400 Sq. ft.

Following facilities are operational at present:

##### 1. Physical Property Measurement System (PPMS)

This CFMS is made up of a cryogen free Superconducting magnetic with an integrated Variable Temperature Insert (VTI) surrounding the sample exchange chamber. Helium gas is continuously circulated in VTI by an oil free pump (VTI pump).

##### Specifications:

- T- range: 1.6 – 400 K
- Max. magnetic field:  $\pm 14$  T
- Sample nature: Powder, pellet, thin film, single crystal



Figure 21 : CRF Sonipat Building

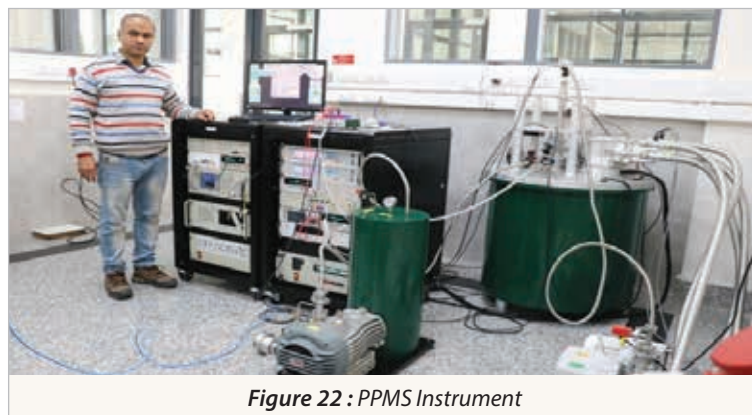


Figure 22 : PPMS Instrument

**Measurement options:**

- Vibrating Sample Magnetometer (VSM)
- DC resistivity
- AC resistivity
- Thermal Transport
- Multisample measurements
- High impedance measurements
- AC susceptibility
- Hall coefficient measurements
- Heat capacity
- Seebeck coefficient measurements
- Leadless Chip Carrier (LCC 20) measurements

**2. X-Ray Diffraction (XRD) Specifications:**

- Goniometer Radius 240m
- Range (depending on accessories)  $-111^\circ < 2\theta < 168^\circ$
- Smallest increment:  $0.0001^\circ$
- Angular reproducibility:  $< 0.0002^\circ$
- X-Ray Source Cu
- 2D detector
- Domed Cooling Stage
- Low temperature Cryostat

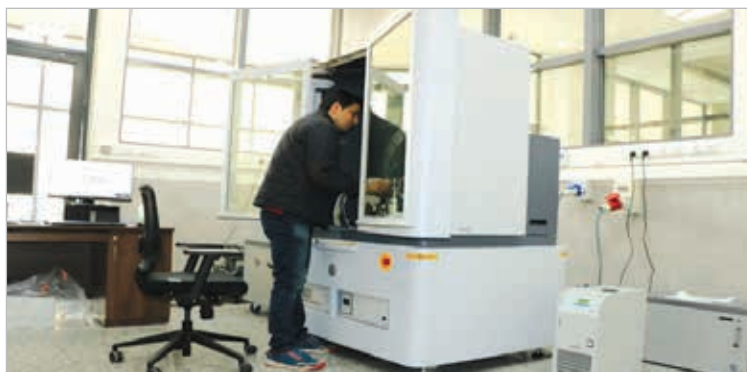


Figure 23 : XRD Instrument

**3. Small Angle X-Ray Scattering (SAXS)****Features:**

- X-Ray with high spectral purity
- Powerful MetalJetmicrofocus
- 1M 2D Eiger HPC Detector
- Automated scatterless beam collimation
- Self alignment with X-Ray beam

*Applications* : Particles Size, Density, Porosity, Pore size, Shape

*Temperature range* :  $-150^\circ\text{C}$  to  $+600^\circ\text{C}$

*Atmosphere* : Air, Vacuum, Inert gas, Humidity



Figure 2 : XRD Instrument

## 7.2 Industrial Research and Development Unit (IRD)

The Indian Institute of Technology Delhi lays a strong emphasis on the Sponsored Research and Industrial interaction. The Industrial Research & Development Unit was specifically set up in the Institute to provide specialized administrative and managerial support for the operation of Sponsored Research Projects, Consultancy Jobs and other related research and development activities. Over the years, the Institute has set up many modern laboratories and supporting infrastructure through these projects. The Institute has given due emphasis to jobs of varied nature like trouble-shooting, product and process development, design checks and investigation of problems of direct relevance to the needs of the country through time-bound Sponsored Research Projects and Consultancy Projects. 316 Sponsored Projects with a funding of ₹344.10 crores were undertaken. Out of these, few projects are worth more than ₹50 crores. In addition, 309 Consultancy Jobs worth ₹21.46 Crores were also undertaken during this period. The Institute is actively involved in collaborative programmes with national and international organizations/universities; the IRD Unit manages these projects and always looks forward for projects of national importance and socially useful projects. IRD has several schemes to encourage research and development among faculty and students.

### IRD Support to Faculty Members within the Institute

- **Research Grant for New Faculty Member:** IRD provides a one-time grant of ₹1 Lakh to each new faculty member who joins the Institute. This Grant has been given to 48 new faculty members during the financial year 2019-2020. This assistance is being given to the new faculty so that they can initiate new projects, which may subsequently be submitted to various funding agencies.
- **Equipment matching grant for New Faculty Member:** IRD provides matching equipment grant to new faculty member for the purchase of equipment sanctioned under a project. Faculty member can avail this grant within 2 years of joining with a ceiling of ₹35 Lakh or an amount equivalent to the funds sanctioned by funding agency for the equipment under the project whichever is lower. Equipment Matching Grants to the tune of ₹372 Lakh have been sanctioned to 18 new faculty members during the financial year 2019-20.
- **Sponsored Research Enhancement Actions (SREA) :** Under SREA (1, 2 & 3) schemes IRD provides support to senior staff to facilitate and enhance sponsored research activities, both in terms of formulating/writing research project proposals and coordinating research projects.

**SREA 1:** Assistance for formulating/writing of major research project proposals involving multiple faculty members from IIT Delhi or involving multiple Institutes with IIT Delhi as the Coordinating Institute. The funds proposed for IIT Delhi should be ₹5 Crore or more. Funds for hiring a Project Consultant for a period of 2 months will be provided by IRD during the project preparation stage.

**SREA 2 :** For a sponsored research project with a funding of ₹2.5 - 5.0 Crore, top-up funds required for hiring one Principle Project Officer for the duration of the project will be provided to the Principal Investigator.



**SREA 3 :** For a sponsored research project with a funding of ₹5 Crore or more, top-up funds required for hiring one Project Consultant for the duration of the project will be provided by IRD.

### **IRD Schemes for Faculty Members**

#### **Faculty Interdisciplinary Research Project (FIRP)**

The FIRP scheme aims to enhance interdisciplinary and collaborative research interest in the Institute. Selected projects are given the seed grant of Rs. 10 Lakh for 2 years. It is expected that the joint research team will submit at least one research project to external funding agency on the completion of 1st year. From 2016 to 2019, 79 FIRP projects have been supported.

As an outcome of FIRP Call-2016 scheme, total 21 research papers have been published in high impact journals, 63 research papers have been presented in various national and international conferences, 8 patents have been processed for filling IP through FITT, and 3 technologies have been transferred. 4 academic- research awards have been received by FIRP projects.

To give opportunity to the new faculty members, First Connect FIRP Project Call-2019 was initiated for the faculty members joining the institute in the last 3 years. Total 23 projects were sanctioned for support.

**Multi-Institutional Faculty Interdisciplinary Research Project (MFIRP):** With an aim to positively and collectively impact society and environment, multi-institute faculty interdisciplinary projects (MFIRP) have been initiated in collaboration with different institutes across India & foreign countries. This initiative is expected to attract strong support from external funding agencies and catalyze cross-research activities between the two Institutions. Overall 63 projects have been funded under this scheme during the FY 2019-2020.

Under this scheme, ₹10 lakh is funded to IITD PI by IRD and the equivalent amount is funded by collaborative Institute to their respective project PI. Amounting to total ₹20 lakh per project for 2 years.

**MFIRP AIIMS-IITD:** Faculty members from IITD-AIIMS formed a cross functional team with an aim of building a more robust Health Care system by Engineering and Technology interventions through 'cross-institutional interactions' between the two premier institutes. 47 projects are on-going under this scheme with an aim to alleviate some of the challenges of the Health Care sector. Interim review of 24 projects of Call-2018 was carried out on 20th February, 2020.

Total 23 new projects under the IITD-AIIMS Call-2019 have been approved for the support in the area of Artificial Intelligence and Robotics for Health Care, Point of Care Diagnostics, Design and Development of Biomedical Devices, and Sensors & Biocompatible Materials.

**MFIRP Indian Council of Agricultural Research (ICAR)-IITD:** In order to harness the advances of science for the welfare of society in the areas of agriculture, faculty members from Indian Council of Agricultural Research; ICAR



and IITD formed a cross-functional team to work together. 10 projects are ongoing to create new avenues for tackling the challenges and developing advanced technologies in the farm sector.

**MFIRP National Institute of Immunology (NII)-IITD:** In the areas of immunology and molecular biology; 5 joint research projects are ongoing between National Institute of Immunology; NII-IITD.

**MFIRP Clemson University, USA-IITD:** 3 collaborative research projects on disease management are ongoing between Clemson University, South Carolina -IITD.

**MFIRP University College London (UCL)-IITD:** 4 collaborative research projects between University College London; UCL-IITD are ongoing for the project duration of one year in the areas of Advanced Materials, Biotechnology and global health & wellbeing and sustainable urban design & waste management.

**MFIRP National Chiao Tung University (NCTU, Taiwan)-IITD:** 18 collaborative projects between National Chiao Tung University; NCTU-IITD under MFIRP scheme are ongoing in areas namely artificial intelligence, Internet of things, cyber security, electrical and electronics, Renewable Energy/Clean Energy, Biotechnology, drug development and biomedical devices.

### **IRD Schemes for Students**

**Student Startup Action & Discover & Learn (1-2-3-4) schemes:** In order to enhance research aptitude among undergraduate & graduate students and increase the component of 'learning by research' IRD Student Startup Action & Discover & Learn (1-2-3-4) schemes were launched from the year 2016 onwards. Currently, 18 IRD Student Startup action projects involving about 34 students and 37 Discover & Learn (1-2-3-4) projects involving about 122 students are ongoing in the various research areas of national interest. Interim review of the ongoing IRD Student Startup Action projects and Discover & Learn projects was conducted on 18th October, 2019.

In call -2019 total 18 projects including 8 Students Startup Action and 10 Discover & Learn projects were approved for the IRD support of ₹2 Lakh per year. In addition to IRD support, 3 Student Startup Action and 6 Discover & Learn projects are mentored and financially supported with ₹2 Lakh per year by industries such as CERCA, ReNEW power, Nokia and Ornate Solar.

**OPEN HOUSE:** Institute has been organizing Open House to exhibit an extensive collection of innovative research and product development projects since last ten consecutive years. The 15th edition of Open



*Review of IRD Student Startup Action & Discover & Learn (1-2-3-4) Projects*



*IIT Delhi students design and commercialized world's first All-terrain and Energy efficient crutches for people with movement disability (Flexmotiv crutches)*

House was held successfully on 20th April, 2019. Open House targets young school students in NCR region and the footfall this year was about 5000 students, researchers and industry personnel participated. Key technologies developed through IRD schemes and sponsored research were showcased. Some of these, viz. Flexmotiv clutches generated lots of interest.

**Summer Undergraduate Research Award (SURA):** SURA scheme encourages Research & Development activities among undergraduate students. The students are encouraged to take initiative in identifying, studying and analysing problems as well as formulating solutions. During the Financial Year 2019-2020, 30 projects have been awarded to the successful students under SURA scheme.

**Assistantships/Fellowships to the Ph.D./M.Tech./M.S.(R) students:** Ph.D./M.Tech./M.S.(R) students drawing their assistantships/fellowships from the projects are to support by IRD to fill the gap period in the assistantship/fellowships. These assistantships will be provided to the students once the projects get over and there is no other project to pay their assistantship. M.Tech./M.S.(R) students can be supported for a maximum gap period of six months and Ph.D. students would be supported for a maximum gap period of one year. 11 Ph.D. students were supported in 2019-20 under this scheme.

**IRD Early-Doc Fellowships:** IRD Early-Doc Fellowships are provided to Ph.D. students after successful completion of Ph.D. Viva Examination. The main objective is to support the Ph.D. Scholar for completing the manuscript writing related to thesis work. A monthly fellowship of ₹40,000/- per month (including HRA) will be given to full time Ph.D. students of IIT Delhi for a maximum period of 3 months w.e.f. the date of his/her Ph.D. Viva. 77 IRD Early-Doc Fellowships requested were approved during financial year 2019-2020.

**Research Excellence Travel Award (RETA):** Highly meritorious Research Scholars (full-time as well as part-time) on IRD/FITT projects can be awarded Research Excellence Travel Award (RETA) amounting to ₹1,50,000/- from IRD promotional funds. RETA can be used only for a single conference travel. Total 49 students were given RETA this year.

**Research Scholar Travel Award (RSTA):** All Research scholars can be awarded a travel grant under "Research Scholar Travel Award" (RSTA) upto a maximum of ₹80,000/- from IRD Research Promotion Fund over and above the initial grant of ₹20,000/- provided by the Institute.

### Joint Doctoral Program (JDP)

Indian Institute of Technology, Delhi (IIT-D) and National Chiao Tung University (NCTU), Taiwan has established academic cooperation through a Joint Doctoral Program (JDP) as a part of agreement signed on 16th May 2019. 15 students have been enrolled in JDP with NCTU.

The major activities that have emerged through this academic cooperation in the project mode through IRD are as follows:



IIT Delhi-NCTU Research Connect Forum 2019

1. Enrolment of Ph.D. students under the Joint Doctoral Programme.
2. Opening and establishment of National Chiao Tung University Liaison Office at IIT Delhi.
3. Rolling-out of NCTU-IIT Delhi Collaborative Project proposal scheme similar to MFIRP programme.
4. Conduct of Joint Workshops program "IITD-NCTU Research connect Forum 2019" was held on November 4, 2019 at IIT Delhi to connect the potential collaborators from faculties of IIT Delhi, NCTU, Industry Partners and the students. Industry experts from two renowned companies in Taiwan- Delta Electronics and Media Tek Electronics gave presentations on the R&D areas they are already working with NCTU. The faculty members also gave few presentations related to their area of research. This forum provided a good opportunity to discuss at length about collaborative research areas between both the academic institutions.

### **National Research Project**

**Uchhatar Avishkar Yojana (UAY):** 12 UAY projects including 9 of UAY Phase I and 3 of UAY Phase II Projects are administratively managed by IRD. These projects are funded 50 % by MHRD, 25 % by Industry and 25 % by respective Ministry. Numerous tasks including project review, project tenure extension, Statement of Expenditure and Utilization Certificate preparation and submission are managed by IRD.

**Impacting Research Innovation and Technology (IMPRINT):** 20 IMPRINT projects including 12 projects of IMPRINT Scheme-1 and 8 projects of IMPRINT Scheme-2 are administratively managed by IRD. These projects are funded MHRD and DST-SERB/DRDO/ICMR/ respective Ministry. IRD supported many tasks including project review, project tenure extension, Statement of Expenditure (SoE) and Utilization Certificate (UC) preparation and submission.

**Grand Challenge Projects:** The objective of the Grand Challenge initiative was to establish new research platforms for strengthening the interface between our R&D activities and to address some of the societal challenges faced by the nation. 4 projects are ongoing in the challenging areas namely, Air pollution control, Electric Vehicles, MBE growth for 2D materials for sensors and optoelectronic devices and diagnostic solution to combat antibacterial resistance were funded by IRD in 2018, In 2019, IRD organized interim review of four grand challenge projects by inviting team of external experts and sharing the interim report provided by project PIs. The project PIs & Co-PIs presented their work in the review meeting held on 28th November, 2019.

Scheme for Promotion of Academic and Research Collaboration (SPARC). Ministry of Human Resource Development (MHRD) initiated SPARC program for research collaboration and academic exchanges with institution from partnering country. IIT Kharagpur is the Nodal Implementing agency of the programme.

During first call in 2018-19, total 16 projects involving, 14 Faculty Members from 9 Departments and Centres. The projects are administrative support and implemented by IRD. Projects under the SPARC program have progressed well including the exchange visits of students and faculty members from both countries.

In the 2nd announcement call during July/August 2019, more than 60 proposals have been received from IITD

faculty members. The evaluation of the project proposals are under- progress at MHRD.

**Centre for Excellence (COEs):** Centre of Excellence at IIT Delhi are specialized in different areas of Scientific research. They are set up by the Industries or Government Institutions or even by the Institute to pursue focused research activities in specialized areas.

14 Centre for Excellence (CoEs) are operational at the Institute in the above areas of waste utilization technologies, artificial intelligence, space technologies, clean air and climate, renewable energy sources, biomedical research, sustainable infrastructure, telecom etc. During FY 2019-2020, 4 more COEs are added, namely, Computational Bioinformatics & Biomedical by OSHL, USA; Waste to Wealth by DESMI, Netherland, Artificial Intelligence by NOKIA and Space Technology by the Indian Space Research Organization (ISRO), Bangalore.



DESMI Centre of Excellence waste to Wealth



IITD-OSHL signed MoU

### Highlights (2019-20)

- 316 Sponsored Projects with a total funding of ₹344.10 Cr were undertaken.
- 309 Consultancy Assignments worth ₹21.46 Crores were undertaken through IRD Unit.
- New Faculty grant to the tune of ₹48 Lacs have been given to new Faculty members (₹1 Lakh per faculty).
- 23 projects are selected for support under the scheme Faculty Interdisciplinary Research Project (FIRP).
- 23 (AIIMS)+ 10 (ICAR)+ 5 (NII)+ 03 (Clemson USA) + 04 (UCL, UK) + 18 (NCTU, Taiwan) = Total 63 projects are selected for support under the scheme under Multi-institutional Faculty Interdisciplinary Research Project (MFIRP) Scheme.
- 18 IRD Student Scheme project including 8 Students Start-up Action and 10 Discover & Learn projects were approved for the IRD support.
- 15 Students were enrolled for joint doctoral program (JDP) with National Chiao Tung University (NCTU), Taiwan.
- **02** technologies were successfully launched from Start-up Action Call-2016.

Significant achievements of 4 Startup action projects of Call 2016 includes development of new products with innovative technologies and a new software. A patent has been filed and 2 companies namely Suxma System

Pvt. Ltd. based on Mastitis detector device by Prof. Subrat Kar and group and FLEXMOTIVTECHNOLOGIES based on Clutches by Prof. Jitendra Khatait have been established and registered. Funding from external agencies have been received in addition to the recognition from Startup India.

- **03** Technologies were transferred from FIRP Call -2016.  
namely (i) A process to produce  $\delta$ -decalactone by integrated fermentation and catalytic processing of biomass  
(ii) Process for the preparation of hydric alcohols and (iii) Conversion of 2-pyrone into 2-nonene-4-one via ring opening and decarboxylation.

### ▶ 7.3 Central Workshop

Central Workshop is one of the pivoting units of the institute which teaches conceptually “how” a product comes to its present form by way of imparting core manufacturing education to all the first year students of IIT Delhi. It also provides product manufacturing support to entire institute community in general and undergraduate students in particular. More than 900 undergraduate students in their first year acquire hands-on manufacturing skills in the Central Workshop. The Central Workshop not only introduces art and science of manufacturing but also infuses confidence to take up product design and manufacturing activities in future. Central Workshop is also a place where B.Tech. students of Mechanical Engineering and B.Tech. students of Production & Industrial Engineering acquire training and knowledge in specialized areas of manufacturing like Metal Casting, Metal Forming, Metal Machining, Welding & Joining, CNC programming and 3D Printing, Plastic Product manufacturing etc. M.Tech. students of Production Engineering also use Central Workshop facilities for their practical classes in various courses as well as for project and research work.

The Central Workshop is fully equipped with latest power tools, equipments and facilities in all areas of manufacturing technologies. It also caters to the fabrication needs of students doing product design & manufacturing courses, minor projects, B.Tech. project, Master’s thesis and Doctoral research. Large number of students use this facility to build products and compete at national and international level product building competitions like Formula student car, mini Baja, Robocon etc. The facility can also be used by external agencies for their manufacturing and training needs during the vacation period.

Central Workshop has undertaken efforts to reorganize, modernize and prepare for continuously changing global manufacturing scenario. Efforts are also on to prepare students for a broader view of manufacturing which involves planning and deploying optimum ways to transform raw material into goods by integration of people, capital, processes, systems and enterprises to deliver products of value to the society.

A new ‘CNC and 3D Printing Lab’ has been added in 2013-14 to imbibe product realization through computer generated geometries. A rapid prototype model can also be visualized by use of state of art 3D Printing technology in this new shop of Central Workshop. Laser cutting facility has also been added recently.



## 7.4 Nanoscale Research Facility (NRF)

The Nanoscale Research Facility (NRF) has been established with the support from Ministry of Electronics and Information Technology (MeitY) and IIT Delhi to support the interdisciplinary research in the area of nanoscience and nanotechnology. The facility consists of class 100/1000 clean rooms with several state of art fabrication/thin film deposition instruments and characterization facilities. The research programme of NRF has been focused on both thematic areas of national importance and basic research with importance to the development of nanoscience and nanotechnology. More than 50 faculty members from different departments/centers of IIT Delhi are participating in cutting edge research at Nanoscale Research Facility. Using the facilities at NRF, several deliverables related with nanophotonics, nanomagnetism, nanomechanics, nanophotovoltaics, nanoelectronics and biosensing have been successfully demonstrated. The current programme of NRF is to develop nanoscale devices for health, agriculture, security and energy sectors. The emphasis is to develop micro/nanoscale devices which can be given to users. It is also planned to explore new concepts/ strategies for developing future potential nanoscale devices.

### Objective of the NRF

- To design, build and demonstrate nanoscale structure & devices.
- To investigate new concepts and fundamentals for nanoscale processes.
- To run and maintain different fabrication and characterization facilities.
- To provide exposure to students to the area of nanotechnology.

### Facilities available

NRF has adequate characterization lab facilities with more than 20 equipments like XRD, SEM, RAMAN, PL, AFM, UV-Vis, FTIR, DLS, GCMS, HPLC, AGM, Semiconductors characterizations and others. There is a fabrication lab with EBL, Maskless lithography, Mask aligner and others. These facilities can be accessed through online booking after registration to NRF website ([nano.iitd.ac.in](http://nano.iitd.ac.in)). Presently more than 1000 users (faculty members and students of different departments and centres) of IIT Delhi are registered for the access to these facilities. These facilities are also open to the other institutes and industries across the country.

### Seminars, visitors and training

Seminars, visitors and training to the students in the area of use of clean room and various facilities are integrated regular feature of NRF. Ph.D./M.Tech./M.Sc./B.Tech. students are quite often given exposure to these facilities at NRF through visits and demonstrations and many of them are given hands on training to run the fabrication and characterization facilities. Every week a talk for clean room and clean room entry test is also conducted. The presence of NRF has facilitated several collaborating projects with foreign countries such as UK, Japan, Singapore, Germany, Norway etc. Time to time, delegations and distinguish scientists from national and international universities have been visiting NRF.

## ▶ 7.5 Office of Carrer Services (OCSs)

OCS interacts actively with industrial, management and research organisations in the country with the dual aim of ensuring that the students are given adequate technical exposure / industrial training and subsequently enabling them to get employment in organisations.

### **Internship**

Students of B.Tech. and Dual Degree Programmes, can opt for practical training/internship during summer vacations/during semesters in partial fulfilment of their Design & Practical Experience (DPE) component requirements. OCS facilitates the placement of students in Industry and Research Laboratories for this purpose.

### **Placement**

An active and dynamic programme of securing jobs for students graduating from the Institute is initiated by inviting industries of repute and other organisations to conduct interviews. Wide publicity of the academic and extra-curricular activities of Students is given to the organisations.

Organisations that have hitherto not participated in Training or Placement of the students are contacted actively.

### **Support Services**

OCS organizes lectures for students to supplement the above information with special talks. Workshops are organized on various subjects such as: career counselling, interviews techniques and modes of communication.

## ▶ 7.6 Central Library

### **Introduction**

The IIT Delhi Library System (<http://library.iitd.ac.in>) comprises of a Central Library and 32 Unit Libraries of Departments, Centres, Schools, etc. that collectively support the teaching, research and extension programmes of the institute. All the students, faculty, and employees of the Institute are entitled to Library facilities. The Alumni of the Institute are also entitled to Library services provided they are members of the Institute's Alumni Association. Similarly, industrial establishments can avail the Library services on taking corporate membership of the Library. Library consultation facilities are extended to faculty, and students of other organizations, and the wards/spouses of IIT faculty and staff on their request. Retired teaching and non-teaching staff members can also avail of the Library facilities. The Library currently has over 9000 registered members.

### **Library Hours**

The Library remains open throughout the year barring six national holidays, namely; Diwali, Dussehra, Holi, Independence Day, Mahatma Gandhi's Birthday, and Republic Day. The book stack area on the 1st floor and the Ground floor are open from 9:00 AM to 9:00 PM (Weekdays), and 10:00 AM to 6:30 PM (Weekends & Holidays). Reading Areas on the ground floor, first floor and 2nd floor remains open 24x7 hrs.

## **Library Resources**

### ***Collections***

The Central Library, IIT Delhi has substantial collections pertaining to physical sciences, engineering, technology, biotechnology, computer and information technology, social sciences, management, etc.

### ***Video Library***

The Library is equipped with a video viewing facility and has a sizeable collection of CDs of video lectures which are kept in the Computer Applications Division of the Central Library for viewing.

### ***Reference Collection***

The Library maintains a separate reference collection consisting of encyclopaedias, dictionaries, handbooks, technical data, almanacs, atlases, bibliographies, etc.

### ***Hindi Collection***

The Central Library has built up a good collection of books in Hindi which include books on various subjects being taught and researched at the institute as well as general reading books.

### ***Electronic Journals and Online Bibliographic Databases***

The institute has access to over 59,000 full-text electronic journals/proceedings/standards and over 15 databases/bibliographic databases from a number of publishers and aggregators through the Direct subscription/access through eShodh Sindhu consortium. The details and links to these electronic journals are available through the Library web site as well through the Library Web OPAC.

### ***Computer and Networking Facilities***

#### ***All Library Services on the Cloud (Baadal)***

The IIT Delhi Library has distinction in fully migrating to the Baadal Cloud. It no more maintains Servers and its Integrated Library Management System, Institutional Repository, Standards, etc. are all accessible from the Cloud which is a rare achievement.

#### ***National Resource Centre in Library and Information Sciences (MHRD, ARPIT), Govt. of India***

The IIT Delhi Library has achieved a rare feat when National Resource Centre in Library and Information Science for offering the MOOCs ARPIT course was awarded to its Central Library with its Librarian & Head as Coordinator. The Library is successfully running the MOOCs/ARPIT on the topic, "Emerging Trends and Technologies in Library and Information Services (ETTLIS)" which received 2980 registrations in this ongoing by: registrations/enrolments in the year 2019-20.

### ***Computerization of In-house Activities***

All in-house activities of the Library, including Acquisition/Collection Development, Cataloguing, Circulation, Serials Control, etc. are fully computerized using LibSys 7, LSmart, and DSpace Software Packages. The Online Public Access Catalogue (OPAC), Discovery Service, Single Window Search Library App can be used to search bibliographic records and full texts available through web-based search interfaces on Intranet as well as on the Internet. The editing and updating activities are done regularly. Besides, the Central Library has two in-house databases for specialized collections. These databases include a Database of Ph.D. theses submitted to the IIT Delhi and Database of research articles by the faculty and researchers of the institute.

The Library uses RFID and bar-code technology for the computerized circulation system. Every document in the Library (except reference sources and bound volumes of journals) bears a RFID tag and bar-code label that facilitates the identification of document in the circulation process. Similarly, all categories of users have an RFID and bar-coded patron card. The Library has developed an in-house facility for tagging and bar coding of books and patron cards

### ***RFID Technology in the Library***

The Central Library is an early adapter of emerging and innovative technologies and has been using RFID technology from 2010. It is the best automation system used worldwide and is an effective way of managing collections of the Library and providing enhanced services to the users having benefits like: self check-out of books, self-check-in (book drop), to control theft, to find misplaced reading material, sorting, inventory accuracy, stock verification procedures, security control, video surveillance, people counter, Smart Card issuance, etc. It is an automatic data capture technology that uses tiny microchips and miniature antennas affixed to documents. RFID plays a vital role in redefining the library processes to make everyone's job easier right from the users to library staff. IIT Delhi library has one of the most successful running RFID implementations of the country.

## 8. ADMINISTRATIVE STRUCTURE

### THE VISITOR

**Shri Ram Nath Kovind** (*Hon'ble President of India*)

### CHAIRMAN, BOARD OF GOVERNORS

**Prof. V. Ramgopal Rao** (*Officiating*)

### DIRECTOR

**Prof. V. Ramgopal Rao**

### DEPUTY DIRECTORS

**Prof. T.C. Kandpal** (*Operations*) and **Prof. Ashok K. Ganguli** (*Strategy and Planning*)

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**Prof. Sudipto Mukherjee** : *Faculty*  
**Prof. Sunil Kumar Khare** : *Research & Development*  
**Prof. Naveen Garg** : *Alumni Affairs & Intl. Programmes*  
**Prof. Rajesh Khanna** : *Student Affairs*  
**Prof. K.C. Iyer** : *Infrastructure*  
**Prof. Kanika T. Bhal (Ms.)** : *Planning*  
**Prof. Anurag Singh Rathore** : *Corporate Relations*

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**Prof. Dipayan Das** : *Faculty*  
**Prof. Sukumar Mishra** : *Research & Development*  
**Prof. B. Kundu** : *Students Events*  
**Prof. Arvind Nema** : *Hostel Management*  
**Prof. Angelie Multani (Ms.)** : *Student Welfare*  
**Prof. Abhijit R. Abhyankar** : *Infrastructure (Electrical)*  
**Prof. J. T. Shahu** : *Infrastructure (Renovation)*  
**Prof. B Premachandran** : *Infrastructure (Maintenance)*

### REGISTRAR

**Dr. Sandeep Chatterjee**



## THE SENATE

### **V. Ramgopal Rao, Chairman**

(Director)

### **Deputy Directors**

T.C. Kandpal (Operations)

Ashok K. Ganguli (Stgy. & Planning)

### **All Professors (or equivalent)**

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K.C. Iyer

S.K. Khare

Sudipto Mukherjee

Rajesh Khanna

Naveen Garg

Kanika T. Bhal (Ms.)

Anurag Singh Rathore

Sukumar Mishra

Bishwajit Kundu

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Puneet Mahajan

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Prashant Mishra

T.R. Sreekrishnan

Atul Narang

Shilpi Sharma

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A.N. Bhaskarwar

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Anil Verma

Sreedevi Upadhyayula (Ms.)

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Suddhasatwa Basu

Anil Jacob Elias

Ravi Shankar

Jai Deo Singh

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Nalin Pant

Siddharth Pandey

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Shashank Deep

Sameer Sapra

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R. Ayothiraman

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R.R. Kalaga

Dev Raj Kaushal

B.J. Alappat

Neeraj Kumar Jha

Gurmail Singh Benipal

Vasant Annasaheb Matsagar

Sanjiva Prasad

Huzur Saran

S. Arun Kumar

Kolin Paul

Amit Kumar

Subodh Kumar

Sandeep Sen

M. Balakrishnan

Mausam

S. Banerjee

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M. Veerachary	S.G. Deshmukh	Pankaj Srivastava
Shankar Prakriya	Anoop Chawla	Sujeet Chaudhary
Manav Bhatnagar	Sanjeev Jain	P. Senthikumar
Brejesh Lall	S.K. Saha	D.S. Mehta
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R.K. Sharma	Sudarsan Ghosh	R. Alagirusamy

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Mangla Joshi (Ms.)  
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Kushal Sen  
Abhijit Majumdar  
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Amit Rawal  
Deepti Gupta (Ms.)  
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Subrat Kar  
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V.K. Agarwal  
Jayashree Bijwe  
Rahul Garg  
P.R. Panda  
Swades De  
Ambuj D. Sagar  
Rajendra Singh  
James Gomes  
Tapan Kumar Chaudhuri  
Aditya Mittal  
Chinmoy Sankar Dey  
Amitabha Mukhopadhyay

### **Three Educationists from Outside IIT Delhi**

Gagandeep Kang  
S.S.V. Ramakumar  
Najma Akhtar

### **Librarian**

Nabi Hasan

### **Head, Central Workshop**

D. Ravi Kumar

### **One of the Wardens**

M.C. Ramteke (Karakoram)

### **Chairman, Grades & Registration (UG/PG)**

Rajiv K. Srivastava

### **Chairman, Time Table Committee (UG/PG)**

Shaikh Z. Ahammad

### **Six Members of the Faculty for their special knowledge**

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Smruti Ranjan Sarangi (CS&E)  
Sumeet Agarwal (EE)  
Nomesh Bhojkumar Bolia (ME)  
Somnath Baidya Roy (CAS)  
Maya Ramanath (Ms.) (SIT)

### **Three Alumni Representatives**

Rohit T. Koshy  
Ravindra Kumar  
Vishal Chadha

### **Four Student Representatives**

Faraz Mazhar (Gen. Secy., SAC)  
Sarthak Kala (Gen. Secy., CAIC)  
Nitika Patwa (Research Scholar)  
Arif Mansoori (M.Tech Student)

### **Registrar**

Sandeep Chatterjee  
(Secretary)

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B.R. Mehta	Industrial Research and Development Board
Shantanu Roy	Board for Academic Programmes

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Jyoti Kumar	Board of Recreational and Creative Activities (BRCA)
Arvind Nema <i>Assoc. Dean, (SA) (HM) Ex-Officio</i>	Board of Hostel Management (BHM)
Angelie Multani (Ms.) <i>Vice-Chairperson</i> <i>Assoc. Dean, (SA) (SW) Ex-Officio</i>	Student Teacher Interaction Committee (STIC)
Pramit K. Chowdhury <i>(President)</i>	Board for Sports Activities (BSA)
Angelie Multani (Ms.) <i>(President)</i> <i>Assoc. Dean, (SA) (SW) Ex-Officio</i>	Board for Students Welfare (BSW)
Sudeep K. Pattanayek	Vice President, BSW & Coordinator, Student Mentorship Programme
V. Perumal	Vice President, BSA
Shashank Bishnoi	Vice President, BRCA
Sandeep Jha	

## LIBRARY

S.P. Singh	Chairman (ACL)
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## OTHERS

Farhana Ibrahim (Ms.)	Advisor, Foreign Students
Samrat Mukhopadhyay	Coordinator, NSS
R.K. Varshney	Advisor, SC/ST Students
D.R. Sahoo	Advisor, Persons with Disabilities (PwD) Students
Brejesh Lall	Coordinator, NCC
Joby Joseph	Coordinator, SC/ST Preparatory Course

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Siddharth Pandey	JEE Chairman (Advanced-2019)
S.P. Singh	Advisory Committee for Library (ACL)
B.S. Panda	Chairman (GATE/JAM-2019)
Angeile Multani (Ms.) <i>President, BSW (Ex-Officio)</i>	Head, Counselling Service
Seema Sharma (Ms.)	Hindi Cell (Head)
Rajeev K. Srivastava	Grades & Registration (UG & PG)
Shaikh Zia Ahammad	Time Table Committee (UG & PG)

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### M.Tech. Programmes

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B.K. Satapathy	Material Sciences & Engineering (DMSE) (formerly CPSE)
Ramesh Narayanan	Energy Studies / Energy & Environment Management (CES)
Shouribrata Chatterjee	VLSI Design, Tools & Technologies (EE/CS&E/CARE)
G.S. Khan	Instrument Technology (IDDC)
Jyoti Kumar	Industrial Design (IDDC)

### M.Tech. and Research Programmes

G.V. Prakash	Opto Electronics & Optical Communications
V. Venkataraman	

### Research Programmes

Anoop Chawla	Transportation Research and Injury Prevention Programme (TRIPP)
Ramachandra Rao Kalaga	

### Others

Mahim Sagar	Quality Improvement Programme/Continuing Education Programme/OCDC
V.K. Vijay	Unnat Bharat Cell (UBC)



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Sitikantha Roy	AFM
B.R. Mehta	Atom Probe Tomography
Bishwajit Kundu	Bio AFM
Manidipa Banejee (Ms.)	Cryo HRTEM
Tapan K. Chaudhuri	ESI-LC-MS
Archana Chugh	FACS
Jayant Jain	FESEM EDS-EBSD
Naresh Bhatnagar	Femto Second Laser Cutting System
Sreedevi Upadhyayula	FTIR (Chemical Engg.)
Shashank Deep	Glass Blowing Workshop
B.R. Mehta	HRTEM
Arun Kumar	ICP-MS
D. Ravi Kumar	Laser Cutting
Pintu Das	Liquid Nitrogen Facility
Bishwajit Kundu	MALDI-MS
S. Nagendran	NMR 300 MHz (Liquid Probe)
S. Nagendran	NMR 500 MHz (Liquid Probe)
Bhanu Nandan	SEM
Ratnamala Chatterjee	SQUID Magnetometer
Pravin P. Ingole	TEM CRF
Josemon Jacob	TEM CPSE
Bhanu Nandan	Ultra Microtome
Bhanu Nandan	XRD
Ashwini K. Agrawal	Under SMITA Res. Lab. (a) Micro Raman Spectroscopy (b) FE SEM + EDS (c) NMR 400 MHz with Liq. and solid probe
XNeeraj Khare	Nanoscale Research Facility

**CENTRAL WORKSHOP**

D. Ravi Kumar      Professor and Head

**CHAIRPERSONS OF OTHER COMMITTEES**

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Shantanu Roy Dean (Acad.)	Institute Lecture Series Committee
Shantanu Roy Dean (Acad.)	Standing Committee for Convocation 2020
Shantanu Roy Dean (Acad.)	Kendriya Vidyalaya Management Committee
Shantanu Roy Dean (Acad.)	Nursery & K.G. School Advisory Committee
K.C. Iyer Dean (Infra.)	Commercial Establishments & Licencing Committee
K.C. Iyer Dean (Infra.)	Commercial Establishments Monitoring Committee
K.C. Iyer Dean (Infra.)	House Allotment Committee
K.C. Iyer Dean (Infra.)	Air-conditioning Committee
V.K. Agarwal (CART)	Hospital Advisory Committee
A.K. Saroha (Chemical Engg.)	Employees Welfare Committee
S.S. Yadav (DMS)	Institute Grievance Committee
T.C. Kandpal D.D. (Operations)	Managing Committee of the Benevolent Fund Scheme
T.C. Kandpal D.D. (Operations)	Executive Committee of IITD Staff Welfare Scheme

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Dinesh Kalyanasundaram	Nilgiri
Sudarshan Ghosh	Aravali
Joyee Ghosh (Ms.)	Kailash
Vivek Kumar	Jwalamukhi
B. Sujin Babu	Shivalik
M.C. Ramteke	Karakoram
Ashok Patel	Vindhyachal
D.R. Sahoo	Nalanda / IP / New Vindhyachal
Priyanka Kaushal (Ms.)	Himadri
Hariprasad Kodamana	Satpura
Sumedha Chakma	Zanskar
D. Sundar	Girnar
Jayant Jain	Udaigiri

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Professor-in-Charge (Guest Houses & Halls)	: J.T. Shahu (Ms.)
Professor-in-Charge (LHC)	: Shaikh Z. Ahammad
Professor-in-Charge (EHLS Unit)	: Nalin Pant

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Head	S. Dharmaraja
------	---------------

## HINDI CELL

Head	Seema Sharma (Ms.)
------	--------------------

## STUDENT COUNSELLING SERVICE

Head	Angelie Multani (Ms.)
------	-----------------------

## COUNSELLOR

Shachi Mathur

## ADMINISTRATIVE COMPUTERISATION SUPPORT SERVICE

Head	Prem Kalra
------	------------

## CVC

Chief Vigilance Officer	Anurag Sharma
-------------------------	---------------

## RTI

Public Information Officer	Shiv Prakash Yadav
First Appellate Authority	Kalyan K. Bhattacharjee
Transparency Officer	Sandeep Chatterjee

## HOSPITAL SERVICES

Head	Lily Khosa
------	------------

## CENTRAL LIBRARY

Librarian & Head	Nabi Hasan
Deputy Librarian	Neeraj Kr. Chaurasia
Assistant Librarian (SS)	Shankar B. Chavan
Assistant Librarian (SS)	Vijay Kr. Verma
Assistant Librarian (SS)	Vanita Khanchandani (Ms.)

**ADMINISTRATION**

Sandeep Chatterjee

M.K. Gulati

K.K. Bhattacharjee

Atul Vyas

Mohd. Shamim

N. Bhaskar

Ramesh Kumar Thareja

Alan V. Sinate

Satish Narayan Tiwari

Mukesh Chand

Raj Kumar Gupta

Deb Ranjan Mukherjee

Sanjay Pande

Amitabh Mukherjee

Suresh Kumar Gohar

Anand Prakash

Rama Sharma (Ms.)

Gokul Dev Bahuguna

Mukesh Khandelwal

G.K. Taneja

K.M. Vijay Kumar

Anuj Gaur

Ashok Kumar

Rafat Jamal

V.K. Bharaj

Prem Kumar Singhat

Brahm Prakash

Raju Ram Parihar

Registrar

Joint Registrar (IRD Accounts)

Joint Registrar (FAA, E-I, RTI, R&amp;I, Travel Desk, Training &amp; Manpower)

Joint Registrar (Academics, Publication Cell)

Deputy Registrar (Accounts)

Deputy Registrar (Health Unit, Legal Cell, Vigilance Matters, Nodal Officer for Public Grievances (PG), Director's Office, Gender Grievances &amp; Related Works)

Assistant Registrar (Recruitment Cell) (On contract)

Assistant Registrar (Store Purchase Section)

Assistant Registrar (On deputation)

Assistant Registrar (SAS)

Assistant Registrar (Accounts)

Assistant Registrar (Accounts)

Assistant Registrar (E-II)

Assistant Registrar (Audit)

Assistant Registrar (Academics - UGS)

Assistant Registrar (Conference, Coordination, Hindi Cell)

Assistant Registrar (IRD)

Assistant Registrar (Legal Cell, Academics - PGS &amp; R)

Institute Engineer (On deputation)

Executive Engineer

Executive Engineer

Executive Engineer

Executive Engineer

Assistant Executive Engineer

Assistant Executive Engineer

Assistant Executive Engineer

Assistant Executive Engineer

Assistant Executive Engineer (on lien)

Pradip Karamarkar	Assistant Executive Engineer
Virbhan Singh	Assistant Executive Engineer
Prem Singh Rawat	Assistant Executive Engineer
Shiv Prakash Yadav	Public Relations Officer
Bhupender Singh	Principal Technical Officer
Uday Dadwal	Technical Officer
Neeraj Kumar	Technical Officer
Lily Khosa (Ms.)	CMO (SAG), (Additional charge, Head, Hospital Services)
Renu Misurya (Ms.)	CMO (SAG)
Ajay Kumar Jain	CMO (SAG)
M.K. Sagar	CMO (SAG)
Anila Khosla (Ms.)	CMO (NFSG)
P.K. Rajesh	Sr. Medical Officer (Homeopathy)
Md. Ashafaque Hussain	Sr. Medical Officer
Sayed Yasmeen Raunaq	Sr. Medical Officer
L. Pangerlemba	Sr. Medical Officer
Rajlaxmi Borah (Ms.)	Medical Officer
Abhishek Gupta	Medical Officer
Shalini Singh (Ms.)	Medical Officer (Dental) (On contract)
Deepak Negi	Sports Officer
Anishya Madan (Ms.)	Industrial Liaison Officer
Shachi Mathur (Ms.)	Student Counsellor
Aakriti Astha (Ms.)	Student Counsellor (On contract) (Consolidated)
Kritika Doval (Ms.)	Student Counsellor (On contract)
Sandeep Sharma	Security Officer, Incharge Transport Unit

# INDIAN INSTITUTE OF TECHNOLOGY DELHI

## THE HONOUR CODE

I ....., Entry No. ....  
do hereby undertake that as a student at IIT Delhi :

1. I will not give or receive aid in examinations; that I will not give or receive unpermitted aid in class work, in preparation of reports, or in any other work that is to be used by the instructor as the basis of grading; and
2. I will do my share and take an active part in seeing to it that others as well as myself uphold the spirit and letter of the Honour Code.

I realise that some examples of misconduct which are regarded as being in violation of the Honour Code include :

- Copying from another's examination paper or allowing another to copy from one's own paper;
- Unpermitted collaboration;
- Plagiarism;
- Revising and resubmitting a marked quiz or examination paper for re-grading without the instructor's knowledge and consent;
- Giving or receiving unpermitted aid on take home examinations;
- Representing as one's own work, the work of another, including information available on the internet;
- Giving or receiving aid on an academic assignment under circumstances in which a reasonable person should have known that such aid was not permitted; and
- Committing a cyber-offence, such as, breaking passwords and accounts, sharing passwords, electronic copying, planting viruses, etc.

I accept that any act of mine that can be considered to be an Honour Code violation will invite disciplinary action.

Date : .....

Student's Signature .....

Name .....

Entry No. ....



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**INDIAN INSTITUTE OF TECHNOLOGY DELHI**

Hauz Khas, New Delhi-110 016 (India)

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