Celebrating 10 glorious years 2009-2019

# ANNUAL REPORT

~2018 - 19~

भारतीय प्रौद्योगिकी संस्थान इन्दौर

Indian Institute of Technology Indore

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# Director's Message

The tenth anniversary of IIT Indore has witnessed consolidation of its position nationally as a top institute in the country and globally as one of the fastest-growing institutions. All of the hard work put in by dedicated scholars of the Institute over the last decade is clear in the steepest growth trajectories amongst all institutions around the world, and our congratulations go to all of them. Also, the model set by them will set an example for others to follow and work towards attaining excellence in their endeavours of teaching and research. Our researchers continue with their ground-breaking discoveries, as observed in the quality of publications and impressive citations. The vision of the Institute to engage undergraduates in long-term research projects in a way not done anywhere else in the country has paid dividends in producing graduates who are well-equipped to take up projects and enhancing the research output. So has the Institute's policy of stringent progress review of the doctoral thesis.

Challenges for the institute, however, exist, if it is to make a mark internationally. Lessons learned from the older IITs must not be underestimated, but rather taken in a healthy spirit to improve and take the Institute to greater heights. A major challenge is to work hard to retain the unique autonomous governance system bestowed to the IIT system. Further, in the present global context, the Institute's chosen path in promoting interdisciplinary research in frontline areas with extensive international linkages must be continued in the future. Another challenge is to reverse the rather disappointing industry-academia linkage observed at the national level into one where industry recognises the vast potential of IIT Indore and participates with the Institute in a leading collaborative sense. We are moving into times where global partnerships will be the norm of the day, and the Institute must look into the future with designs to introduce more dual/joint degree programmes with leading institutions from across the world. Academics and research do not recognise boundaries between nations, and therefore, the institute must aspire to internationalise its faculty and student population.

I gratefully acknowledge the hard work put in by all students, staff and faculty members in placing IIT Indore where it is today and extend my heartfelt congratulations.

**Professor Pradeep Mathur**
Director, IIT Indore

# Board of Governors, IIT Indore

## Chairman

**Professor Deepak B. Phatak**
Indian Institute of Technology Indore

## Members

**Professor Pradeep Mathur**
Director, Indian Institute of Technology Indore

**Dr. Sukhbir Singh Sandhu**
Additional Secretary (TE), Govt. of India
Ministry of Human Resource Development

**Mr. Pramod Agarwal**
Principal Secretary
Department of Technical Education & Skill Development,
Govt. of Madhya Pradesh

**Professor Yogesh M. Joshi**
Department of Chemical Engineering,
IIT Kanpur

**Professor Dhananjay V. Bhatt**
Professor & Chairman CCE, Former Dean [Al & RG],
Department of Mechanical Engineering
S. V. National Institute of Technology, Ichchhanath, Surat

**Shri Manoj Kohli**
Executive Chairman
SB Energy (Soft Bank Group) New Delhi

**Dr. Pritee Sharma (Senate Nominee)**
Associate Professor
School of HSS IIT Indore

**Dr. Krushna R. Mavani (Senate Nominee)**
Professor
HoD, Department of Physics, IIT Indore

**Mr. S.P. Hota**
Registrar I/c, (Secretary to BoG)
IIT Indore

# Institute Functionaries

**Director, IIT Indore**
Professor Pradeep Mathur

**Dean, Academic Affairs**
Professor Vimal Bhatia

**Dean, Administration**
Dr. Swadesh Kumar Sahoo

**Dean, Research & Development**
Professor Abhinav Kranti

**Dean, Student Affairs**
Dr. Santosh Kumar Vishvakarma

**Dean, Planning**
Dr. Parasharam M. Shirage

**Dean, International Affairs**
Dr. Kapil Ahuja

**Dean, Faculty Affairs**
Professor Subhendu Rakshit

**Registrar I/c, IIT Indore**
Mr. S. P. Hota

## Associate Deans

| | | |
|---|---|---|
| Academics (PG Programs) | : | Dr. Shaibal Mukherjee |
| Academics (Infrastructure) | : | Dr. Amod C. Umarikar |
| Academics (UG Programs) | : | Dr. Devendra Deshmukh |
| Research and Development- I | : | Dr. Bhupesh Kumar Lad |
| Research and Development- II | : | Dr. Bhargav Vaidya |
| Administration | : | Dr. Somnath Dey |
| Planning | : | Dr. Manish Kumar Goyal |
| Student Affairs | : | Dr. Ajay Kumar Kushwaha |

## Heads of School

| | | |
|---|---|---|
| Humanities and Social Sciences | : | Dr. Sanjram Premjit Khanganba |

## Heads of Departments

| | | |
|---|---|---|
| Computer Science & Engineering | : | Dr. Surya Prakash |
| Electrical Engineering | : | Dr. Vipul Singh |
| Mechanical Engineering | : | Dr. I. A. Palani |
| Chemistry | : | Dr. Amrendra K. Singh |
| Mathematics | : | Dr. Md. Aquil Khan |
| Physics | : | Professor Krushna Mavani |
| Astronomy, Astrophysics and Space Engineering | : | Dr. Abhirup Datta |
| Biosciences and Biomedical Engineering | : | Dr. Hem Chandra Jha |
| Metallurgy Engineering and Materials Science | : | Dr. Parashram M. Shirage |
| Civil Engineering | : | Dr. Neelima Satyam D. |

## Constitution of Senate

**Professor Pradeep Mathur**
Director, IIT Indore and Chairman, Senate

### External Experts

**Professor R. Narsimhan**
Department of Mechanical Engineering,
Indian Institute of Science, Bangalore

**Professor M. K. Surappa**
Department of Materials Engineering,
Indian Institute of Science, Bangalore

**Professor R. Balasubramanian**
Department of Mathematics,
Institute of Mathematical Sciences, Chennai

**Professor Sudhir Chella Rajan**
Department of Humanities and Social Sciences
Indian Institute of Technology Madras, Chennai

### Deans

**Professor Vimal Bhatia**
Dean, Academic Affairs,
Professor, Electrical Engineering

**Dr. Swadesh Kumar Sahoo**
Dean, Administration,
Associate Professor, Mathematics

**Professor Subhendu Rakshit**
Dean, Faculty Affairs,
Professor, Physics

**Dr. Kapil Ahuja**
Dean, International Affairs,
Associate Professor, Computer Science & Engineering

## Deans

**Dr. Parasharam M. Shirage**
Dean, Planning, Associate Professor,
Metallurgy Engineering and Materials Science

**Professor Abhinav Kranti**
Dean, Research and Development,
Professor, Electrical Engineering

**Dr. Santosh Kumar Vishvakarma**
Dean, Student Affairs,
Associate Professor, Electrical Engineering

## Heads

**Dr. Neelima Satyam D**
HOD, Civil Engineering,
Associate Professor, Civil Engineering

**Dr. Surya Prakash**
HOD, Computer Science and Engineering,
Assistant Professor, Computer Science and Engineering

**Dr. Vipul Singh**
HOD, Electrical Engineering,
Associate Professor, Electrical Engineering

**Dr. I. A. Palani**
HOD, Mechanical Engineering,
Associate Professor, Mechanical Engineering

**Dr. Parasharam M. Shirage**
HOD, Metallurgy Engineering and Material Science (MEMS)
Associate Professor, MEMS

**Dr. Hem Chandra Jha**
HOD, Biosciences and Biomedical Engineering (BSBE)
Assistant Professor, BSBE

**Dr. Amrendra Kumar Singh**
HOD, Chemistry, Assistant Professor, Chemistry

**Dr. Md. Aquil Khan**
HOD, Mathematics, Associate Professor, Mathematics

**Professor Krushna R. Mavani**
HOD, Physics, Professor, Physics

**Dr. Abhirup Datta**
HOD, Discipline of Astronomy, Astrophysics and
Space Engineering (DAASE), Associate Professor, DAASE

**Dr. Sanjram Premjit K.**
HOD, School of Humanities and Social Sciences (SHSS)
Associate Professor, Psychology, SHSS

## Professors

**Professor Narendra S. Chaudhari**
Computer Science and Engineering

**Professor Neelesh Kumar Jain**
**Professor Anand Parey**
Mechanical Engineering

**Professor Ram Bilas Pachori**
**Professor Abhinav Kranti**
**Professor Vimal Bhatia**
Electrical Engineering

**Professor Sandeep Chaudhary**
Civil Engineering,

**Professor Avinash Sonawane**
Biosciences and Biomedical Engineering

**Professor Rajneesh Misra**
**Professor Suman Mukhopadhyay**
Chemistry

**Professor Subhendu Rakshit**
**Professor Krushna R. Mavani**
**Professor Sarika Jalan**
Physics

## Other Authorities

**Deputy Librarian**
**Ms. Anjali Bandiwadekar**

**Chief Warden**
**Dr. Dhirendra K. Rai**
Assistant Professor, Metallurgy Engineering
and Materials Science

**Faculty-In-Charge,**
**Training and Placement Office**
**Dr. Abhishek Rajput**
Associate Professor, Civil Engineering

**Alumni Representative**
**Mr. Vibhor Pandhare**

**Mr. Gaurav Khadse**
Academic Secretary, Student Gymkhana

**Mr. Rhythm**
General Secretry, Student Gymkhana

**Secretary, Senate**
**Mr. S. P. Hota**
Registrar I/c, IIT Indore

# Showcasing IIT Indore

In keeping with India's vision to become a world leader in Science and Technology and to usher in a new revolution resulting in an unprecedented economic growth, the Government of India reassessed the need for technical manpower and decided to set-up eight new Indian Institutes of Technology (IITs). IIT Indore was established in July 2009 along with corresponding institutes in Hyderabad, Gandhinagar, Jodhpur, Ropar, Patna and Bhubaneswar.

The Indian Institute of Technology Indore (IITI) is located in the state of Madhya Pradesh. IITI started in a temporary campus at Devi Ahilyabai University's Institute of Engineering and Technology; and under mentorship of IIT Bombay. In 2009, Shri Arjun Singh, the Union Government HRD Minister, laid the foundation of the permanent campus, spread over an area of around 501.42-acre (2.1 $km^2$) at Simrol, about 25 km from the city of Indore.

In a short span of 10 years, IITI has made its presence felt as an important center of research. It has consistently secured the highest *h*-index rating amongst all new IITs and currently has a graduated PhD. student to faculty ratio of 1.19.

IITI has consistently performed well in Institutional rankings. It has been ranked 13$^{th}$ in the Engineering category in the National Institutional Ranking Framework (NIRF) in 2019; the Times Higher Education World University Ranking (THE) awarded it the second rank in India and amongst the top 400 universities in the world. Consequently, in 2019, it emerged as the top ranked IIT in THE's Asia University ranking and secured its place amongst the top 50 Institutions in Asia that same year. The Institute has also secured the 13$^{th}$ rank in the QS India University rankings, 2020.

Figure 1.1: World University Rankings
Source: The Times Higher Education (THE) official website

Figure 1.2: Asia University Rankings
Source: The Times Higher Education (THE) official website

# QS Ranking of Indian Institutions

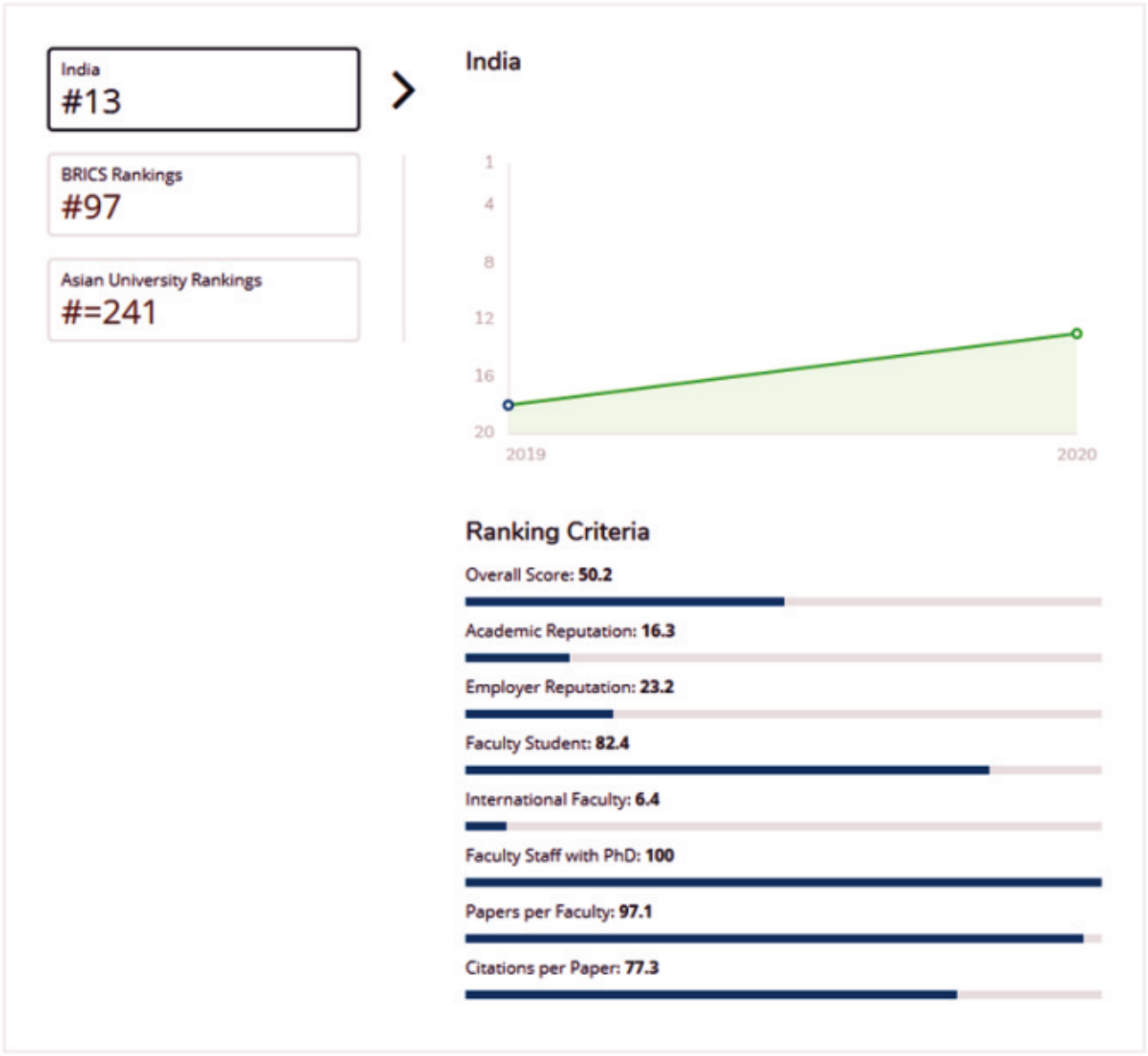



Figure 1.3: QS Ranking of Indian Institution
Source: The QS World University Rankings official website

# Month-wise progress of IIT Indore Citations

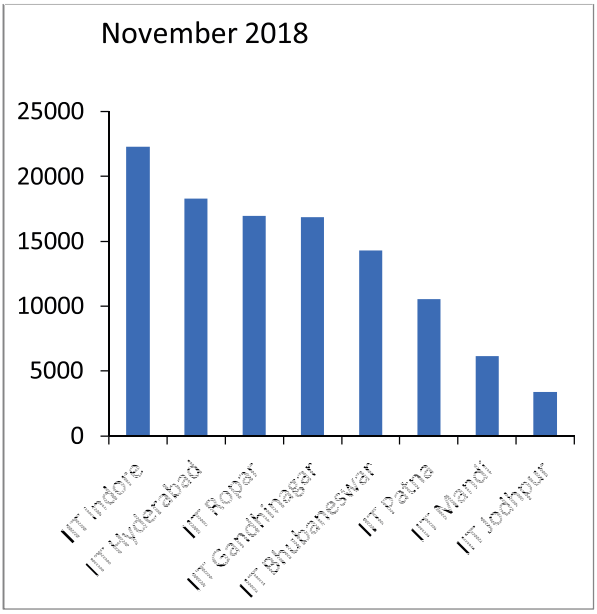



**Figure 2.1 Citations for Nov.2018**

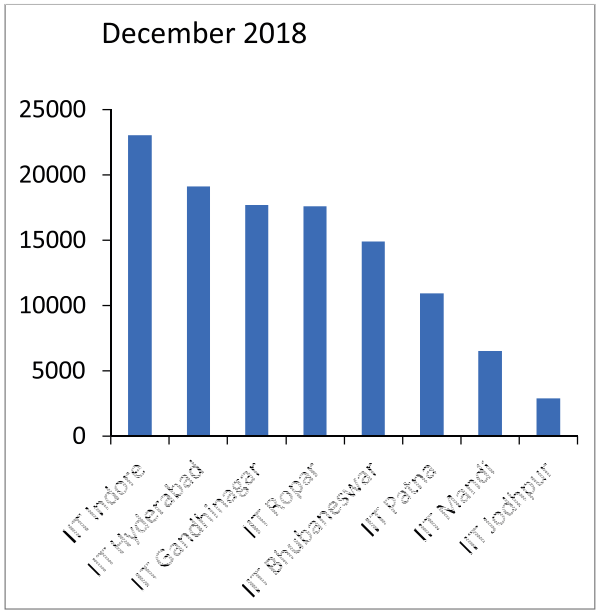



**Figure 2.2 Citations for Dec.2018**

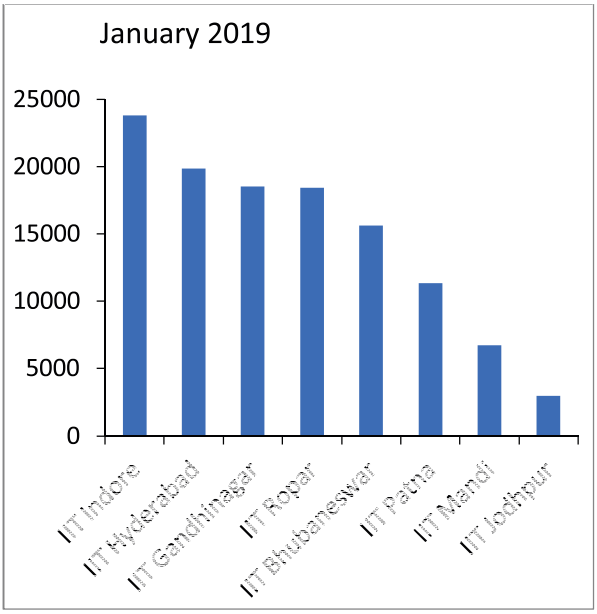



**Figure 2.3 Citations for Jan.2019**

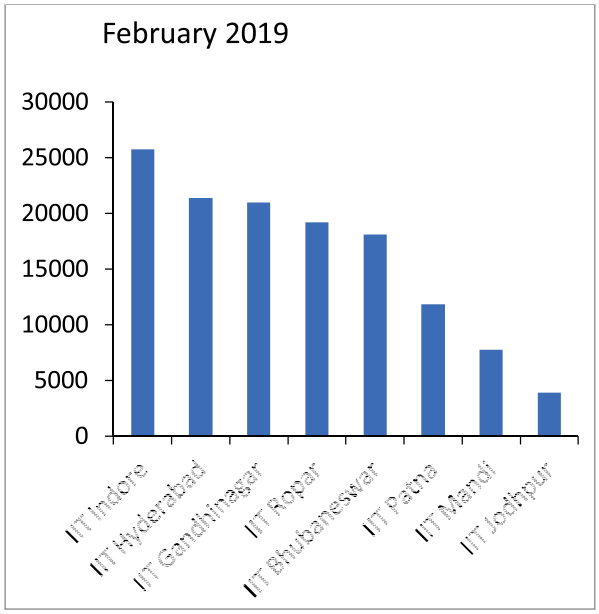



**Figure 2.4 Citations for Feb.2019**

## Month-wise progress of IIT Indore Citations

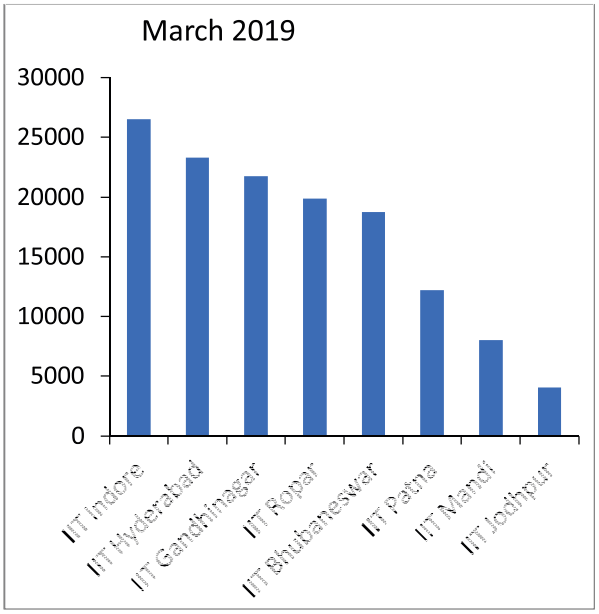



**Figure 2.5 Citations for Mar.2019**

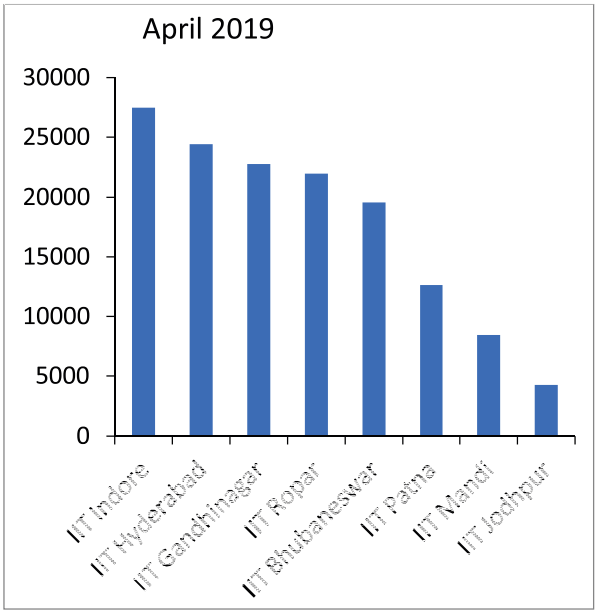



**Figure 2.6 Citations for Apr.2019**

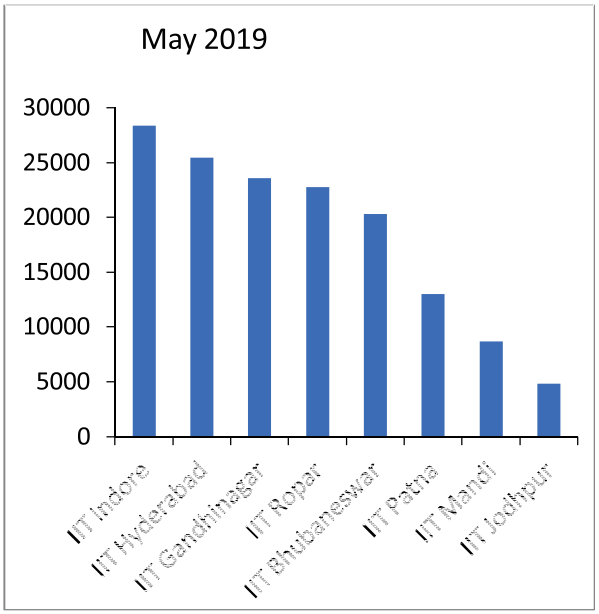



**Figure 2.7 Citations for May.2019**

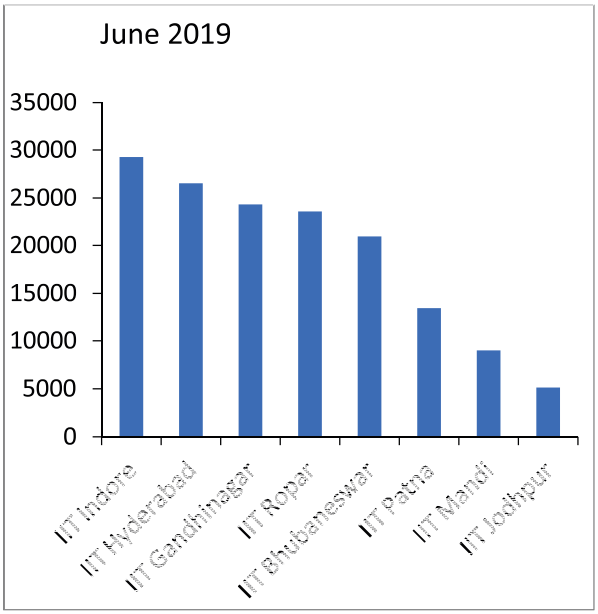



**Figure 2.8 Citations for Jun.2019**

# Month-wise progress of IIT Indore Citations

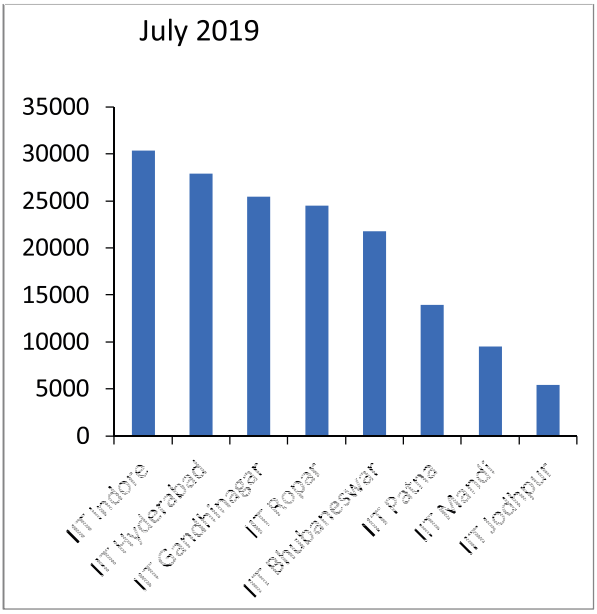



**Figure 2.9 Citations for Jul.2019**

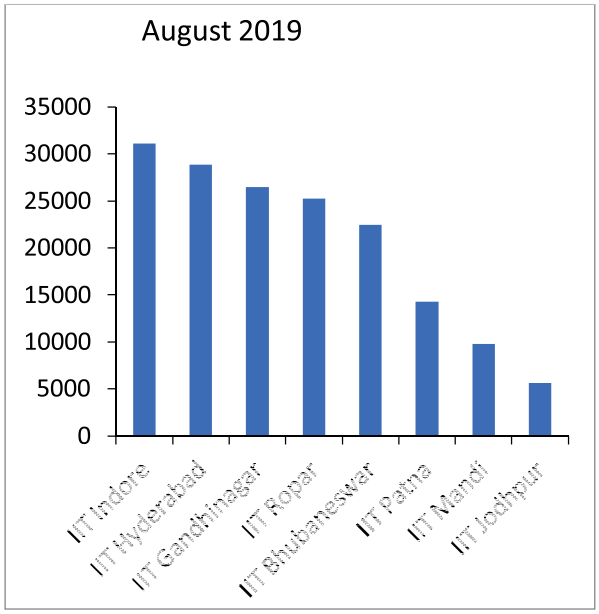



**Figure 2.10 Citations for Aug.2019**

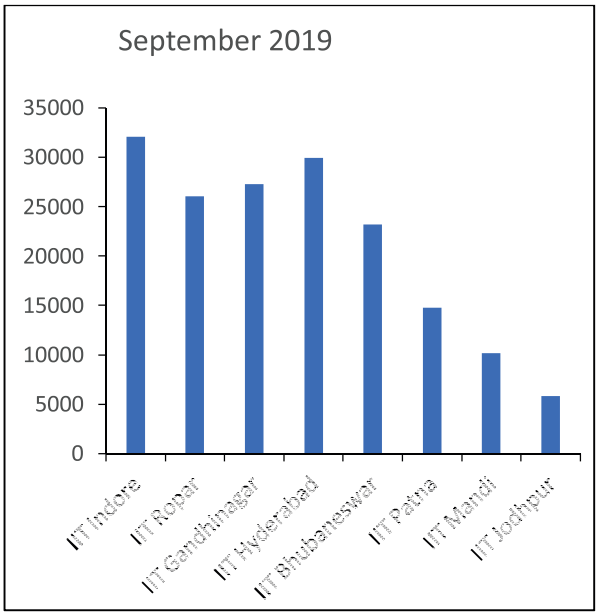



**Figure 2.11 Citations for Sep.2019**

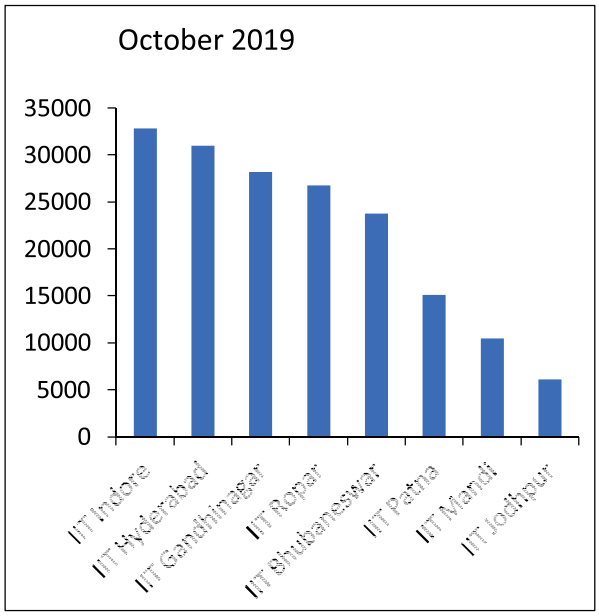



**Figure 2.12 Citations for Oct.2019**

## Citations and *h*-index for IIT Indore for the month of November 2019

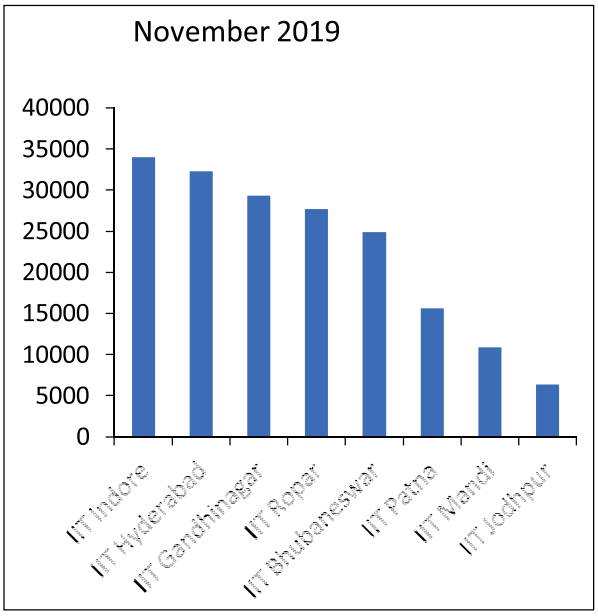



**Figure 2.13 Citations for Nov.2019**

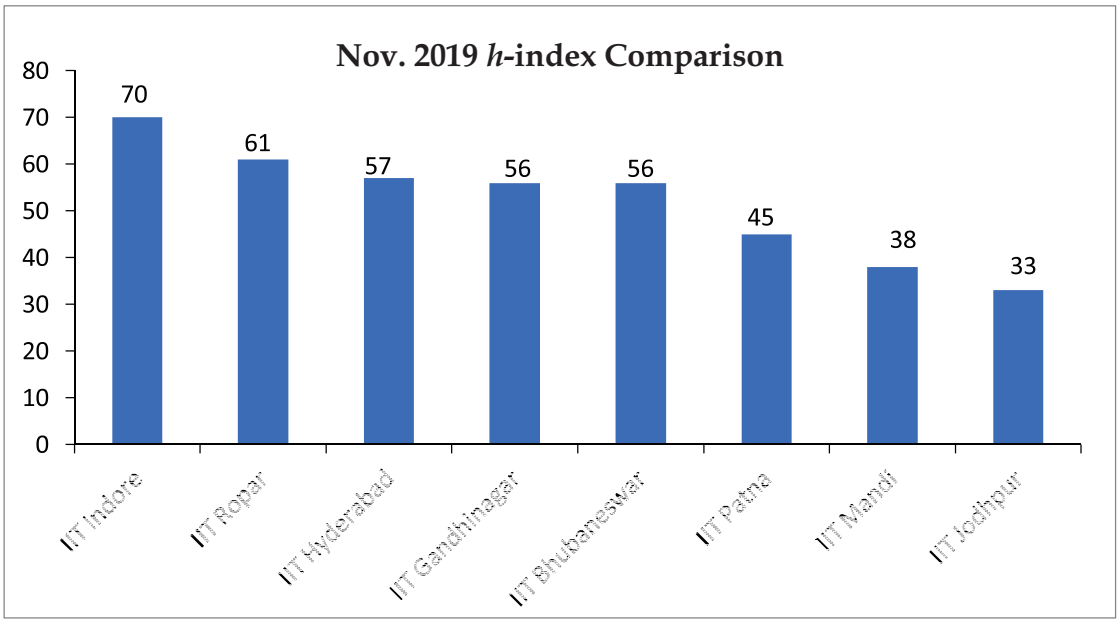



**Figure 3.1 Nov. 2019 *h*-index for IIT Indore**

| Statement showing year-wise average number of graduated Ph.D. students per faculty for the five year | | | | |
|---|---|---|---|---|
| **Year** | **Name of Stream/ Branch** | **No. of Faculty** | **No. of students graduated Ph.D.** | **Average Ph.D. graduated studets per faculty** |
| **2014-15** | Computer Science and Engineering | 77 | 2 | **0.36** |
| | Electrical Engineering | | 7 | |
| | Mechanical Engineering | | 2 | |
| | Chemistry | | 4 | |
| | Physics | | 2 | |
| | Humanities and Social Sciences | | 1 | |
| | | | **18** | |
| **2015-16** | Computer Science and Engineering | 71 | 3 | **0.32** |
| | Electrical Engineering | | 5 | |
| | Mechanical Engineering | | 2 | |
| | Chemistry | | 4 | |
| | Physics | | 2 | |
| | Mathematics | | 1 | |
| | Humanities and Social Sciences | | 3 | |
| | | | **20** | |
| **2016-17** | Electrical Engineering | 90 | 8 | **0.51** |
| | Mechanical Engineering | | 4 | |
| | Chemistry | | 10 | |
| | Physics | | 4 | |
| | Mathematics | | 2 | |
| | Humanities and Social Sciences | | 3 | |
| | Bio-sciences and Bio-medical Engineering | | 1 | |
| | | | **32** | |
| **2017-18** | Computer Science and Engineering | 115 | 2 | **0.74** |
| | Electrical Engineering | | 14 | |
| | Mechanical Engineering | | 8 | |
| | Chemistry | | 14 | |
| | Physics | | 2 | |
| | Mathematics | | 2 | |
| | Humanities and Social Sciences | | 3 | |
| | Bio-sciences and Bio-medical Engineering | | 2 | |
| | Metallurgy Engineering and Materials Science - Materials Science and Engineering) | | 1 | |
| | | | **48** | |
| **2018-19** | Computer Science and Engineering | 127 | 11 | **1.19** |
| | Electrical Engineering | | 21 | |
| | Mechanical Engineering | | 14 | |
| | Chemistry | | 9 | |
| | Physics | | 11 | |
| | Mathematics | | 2 | |
| | Humanities and Social Sciences | | 6 | |
| | Bio-sciences and Bio-medical Engineering | | 3 | |
| | Metallurgy Engineering and Materials Science | | 6 | |
| | | | **83** | |

**Figure 4.1: Graduated PhD students per Faculty**

# Discipline of Astronomy, Astrophysics and Space Engineering (DAASE)

The DAASE was initiated in December 2015. This interdisciplinary division is a unique department among all IITs and offers a dedicated and focused platform to pursue research in Astronomy. It is currently involved in mega-science projects and international collaborations.

**Achievements/ Accomplishments**

1. Journal papers: 48

   Approved/ ongoing projects: 8 projects with a total grant of Rs. 3.6 cr.
2. A unique Masters programme offering a dedicated platform for training the next generation of astronomers in the era of large surveys and data-intensive research in astronomy. Given India's active participation in seven mega-science projects and dedicated initiative towards a wide range of indigenous space missions, a large pool of skilled human resources is necessary, to which this programme caters.
3. DAASE has been chosen to host IUCAA Centre for Astronomy Research and Development (ICARD) with Dr. Abhirup Datta as the coordinator.
4. Max Planck Partner Group Award with Max Planck Institute for Astronomy Heidelberg on the title: “Simulating AGN Jets in the era of multi-messenger astronomy” (Group Leader: Dr. Bhargav Vaidya) Funds: 100000.0/- Euros
5. Astrosat Workshop DAASE, IIT Indore organised a workshop titled "Multi-wavelength Sky Observations - AstroSat and Beyond" from February 3-9, 2019 in association with TIFR, Mumbai and ASSC, IUCAA, Pune.
6. Lunar Eclipse Observation event: DAASE organized a Lunar Eclipse/copper moon event on January 31, 2018 which saw the participation of 150 students from nearby schools in Indore along with the entire IIT Indore family. We continue to extend our outreach program on all events related to RAA (Rashtriya Avishkar Abhiyan).
7. Bapu Khagol Mela: DAASE organized the 'Bapu Khagol Mela' on December 3, 2018, in collaboration with the Nehru Museum and Library, Delhi and the Public Outreach Committee, Astronomical Society of India. This event marked the celebration of the association of Mahatma Gandhi with Astronomy to commemorate his 150$^{th}$ birth anniversary. 200 students from several public and private schools from in and around Indore took part in this event.
8. Reaching for the Stars - IAU 100 hours of Astronomy: DAASE celebrated 100 years of International Astronomical Union during January 10-12, 2019 by taking a leading part in the 100 hours of Astronomy initiative. A 3-day event entitled "Reaching for the stars" was organized at IIT Indore which involved the participation of 600+ students from within campus, from several schools in the city and from various schools and organizations from nearby villages. Talks, lectures, quiz, activity sessions involving astronomy and night sky watching session with telescopes were conducted as part of this event.

# Biosciences & Biomedical Engineering

The discipline of Biosciences and Biomedical Engineering (BSBE) was initiated in 2012, with a vision of establishing a Centre of Excellence that will focus on human resource development and research in relevant areas. It has separate biohazard, chemical and glassware disposal systems and follows good laboratory practices (GLP) undertaken in each lab depending on the kind of research.

**Achievements/ Accomplishments**

1. Total number of publications: 279
2. Total number of conferences: 15
3. Total number of projects completed: 4
4. Total number of ongoing projects: 31
5. Total number of Patents: 3

**Awards and Recognitions**

**Dr. Mirza Saqib Baig** has been awarded Visiting Professorships to Cambridge University, Technical University Munich (TUM), and the Institute of Microbial Chemistry (IMC), Tokyo, Japan. He also received the TUBITAK International Research Award (2018) by the Scientific and Technological Research Council of Turkey, Ankara, and INSA-International Bilateral Exchange Fellowship (2018), by Indian National Science Academy (INSA), New Delhi.

**Dr. Sharad Gupta's** paper (Ms. Sheeba Rehman, Ms. Advika Gupta, Dr. Debasis Nayak and Dr. Sharad Gupta) received the best poster award in the Indian Society of Oncology-Indian Society of Medical & Pediatric Oncology Conference, held on 1-3 November 2019 in Indore.

**Dr. Kiran Bala** has been awarded the SERB Early Career Research Award (2018).

## Civil Engineering

The B.Tech programme in Civil Engineering began in 2016-17 and the PhD. programme began in 2017-18. Regular discussions take place with industry professionals and other concerned stakeholders for the identification of high need industrial challenges. Research problems are identified by integrating their needs with the approach for sustainable development. To utilize the expertise of other researchers collaborative works are undertaken as practice. As a part of disseminating information and further improvement of collaborative efforts, courses/seminars are also organized.

**Achievements/ Accomplishments**

Journal papers: 9

Recognition/ Membership of Committees: 4

Projects: 4

**Awards and Recognitions**

**Prof Sandeep Choudhary** is currently holding the Chair of "Technical Committee 1: Design" of the Asian Concrete Federation. He has also been a Keynote Speaker and Chief Guest in Valedictory Function for National Conference on Advances in Sustainable Construction Materials held on March 15-16, 2019 at NIT Warangal, India as well as a Keynote Speaker for 9$^{th}$ International Conference on Material Processing and Characterization held on March 08-10, 2019 at GRIET, Hyderabad, India. He is a Core Group member for Development of the Resource Material on Earthquake Engineering formed by National Disaster Management Authority, India and an Independent Expert Committee member for the "National Educational Alliance for Technology (NEAT)" scheme of MHRD, Govt of India.

**Dr. Neelima Satyam** was the Convener, Soil Dynamics and Earthquake Geotechnical Engineering at the 36th International Geological Congress and the International Cooperation by Indian Geotechnical Society.

**Dr. Mohd Farooq Azam** has been a Visiting Professor (April-May, 2019) at the Institute of Geosciences, University of Grenoble, France. His book chapter on Status and change of the HKH Cryosphere, published in Springer Nature has received more than 400,000 downloads since January 2019.

**Dr. Manish Kumar Goyal** has received the Best Theoretical-Oriented Paper Award in American Society of Civil Engineers (ASCE) 2018.

## Computer Science & Engineering

The Discipline of Computer Science and Engineering (CSE) was set up in July 2009. It offers B.Tech and PhD. programmes. The Discipline adopts a modern approach to teaching wherein students have adequate academic freedom to innovate and learn. State-of-the-art facilities including the latest software and advanced hardware are available in various laboratories for the use in both teaching and research. This facilitates adequate implementation of major B.Tech projects as well as for the verification and validation of research results. CSE faculty members have active collaborations with established institutes across the globe (France, Germany, Singapore, Canada, USA etc.).

### Achievements/Accomplishments

1. No. of PhD. students graduated: 21
2. No. of B.Tech students graduated: 277
3. No. of GIAN Course conducted: 09
4. IIT Indore's academic CTF team, ByteBandits, secured 2nd position in India and 16th position globally at CSAW CTF 2018.
5. Impressive performance by IIT Indore at ACM-ICPC 2017, placed 2nd in India and 56th in the world.
6. Journal papers: 164
7. Conference papers: 144
8. Books: 5
9. Book Chapters: 41
10. Technical Reports: 4
11. Projects: 13

### Awards and Recognitions

**Dr. Anirban Sengupta** was awarded the 'IEEE Chester Sall Memorial Consumer Electronics Award - 2020 for outstanding contribution on "DSP Design Protection". He also been elected as Chairman of IEEE Computer Society Technical Committee on VLSI (TC-VLSI) for the Oct 2018 -20 term. In addition, he has also been awarded the IEEE Consumer Electronics Society 'Outstanding Editor Award' for outstanding contributions to the hardware section of the IEEE Consumer Electronics Magazine", IEEE Consumer Electronics Society 'Best Research Award 2018' for outstanding contributions to "Intellectual Property-Based Lossless Image Compression for Camera Systems" in IEEE CEM, 'IEEE Consumer Electronics Society Best Paper Award 2019' in IEEE CE Society's Flagship Conference - 37th IEEE International Conference on Consumer Electronics (ICCE), LV and 'IETE Best Research Award 2018' by IETE Sub-Center, 2018.

**Dr. Somnath Dey's** project entitled "Fingerprint Spoof Buster" by Ram Prakash, Ashwini Jha, Ashutosh Anshul has been selected for the final round of the Samsung Innovation Award.

**Dr. Surya Prakash** has been awarded the prestigious Young Faculty Research Fellowship (YFRF) of Visvesvaraya PhD. scheme of Ministry of Electronics and Information Technology (MeitY), Government of India in January 2019.

**Dr. Aruna Tiwari** received an invitation to conduct a special session on 'Evolutionary Algorithms and Applications' in the 9th International Conference on Soft Computing for Problem Solving (SocProS 2019) at Liverpool Hope University, UK.

## Electrical Engineering

Electrical Engineering was amongst the first disciplines to come into existence in 2009 at IIT Indore. The Discipline offers five different programmes: (1) B. Tech (2) MS (by Research) (3) M. Tech in Communication and Signal Processing, (4) M. Tech in VLSI Design and Nanoelectronics and (5) PhD. in Electrical Engineering. Besides these, 5-year dual B. Tech / M. Tech degree and a dual M. Tech / PhD. degree are also offered. EE faculty members have active collaborations with collaborators from US, France, Germany, Norway, Finland, Singapore, Japan and Russia. PG students are also encouraged to work in collaboration with Indian companies/Institutions abroad to foster cutting edge research. Undergraduate students are given the freedom to choose projects from not just EE but also from disciplines within the Institute.

**Achievements/Accomplishments**

1. The Discipline has filed 23 patents to its credit.
2. Many undergraduate students have been offered MS positions in top universities/institutes abroad.
3. PhD. students have secured academic positions in IITs, IITDMs, BITS, IITRAM, NITs and various other universities and research institutes in India.
4. In the past three years the Discipline has published nearly 361 journal papers in peer reviewed international journals and close to 264 conference papers. The overall journal publications by the discipline faculty members are well above 500.
5. EE hosts four major sub-specializations viz. Communication and signal processing, VLSI Design and Nanoelectronics, Power electronics and power systems and RF and Microwave.
6. Many faculty have been honored by prestigious awards viz. SVC-Aiya Memorial Award, Bhaskar Advanced Solar Energy (BASE) fellowship, IUSSTF, MRSI medal, Young Faculty Research Fellowship (YFRF) under Visvesraya PhD. scheme etc.
7. Faculty are currently on the editorial boards of various prestigious journals and have often been invited to serve on the project review panel committees of DST/DST-SERB, CPRI etc.
8. The faculty have published 14 book chapters and 3 books.
9. Total number of B. Tech. students graduated: 263
10. Total Number of M. Tech. students graduated: 40
11. Total Number of Ph.D. students graduated: 67

**Awards and Recognitions**

**Prof. Vimal Bhatia** has been awarded IETE-Prof SVC Aiya Memorial Award 2019. IIT Indore hosted 12th

IEEE ANTS 2018 with Prof. Vimal Bhatia as General Chair. IEEE ANTS is the only IEEE ComSoc Portfolio event in India. Through Prof. Vimal Bhatia, IIT Indore is contributing in PAN-IIT 5G test bed development.

**Dr. Prabhat Kumar Upadhyay** is the coordinator of BRICS Multilateral Research and Development Project, 2019.

**Dr. Santosh Kumar Vishvakarma** was awarded DAAD Bilateral Exchange Fellowship in 2018 to visit Ruhr University Bochum, Germany from May 17th to June 16th, 2018 and Brandenburg University of Technology Cottbus (BTU Cottbus), Germany from Dec 1st to Dec 30th 2018.

**Dr. Shaibal Mukherjee** received 2019 DAAD Fellowship to visit Karlsruhe Institute of Technology under Bilateral Exchange of Academics Program, 2019.

**Dr. Trapti Jain** received IETE Technomedia Award 2018 for Young Women in Engineering.

## Mechanical Engineering

The Discipline of Mechanical Engineering offers programmes in the Bachelor's, Master's and Doctoral levels. Its strong and interactive curriculum and hands-on learning make students capable of taking their career to the next level, whether it be in the professional engineering practice or in advanced study. The department, right from its inception in 2009 has been focusing on high-quality teaching along with integrated laboratory experience. The B.Tech programme in Mechanical Engineering started from the year 2009-10 whereas the PhD. programme started from 2010-11. The department started first M.Tech programme in Production and Industrial Engineering (PIE) from year 2013-14 and second M.Tech programme in specialization Mechanical Systems Design from year 2018-19. This discipline also conducts regular Continuing Education Programme (CEP) courses as an outreach activity to the engineering community.

**Achievements/Accomplishments**

- Received the first FIST project in IIT-Indore.
- Successfully conducted 1 international conference along with many workshops.
- 34 research scholars have completed a PhD.
- Research projects completed and ongoing: more than 20.
- International journal publications: 317.
- Conference papers: 132.
- Patents: 12 (Approved/published/ pending).
- Published 8 books and 33 book chapters.
- GIAN courses: more than 5.
- VAJRA project: 1.
- SPARC project: 1.

**Awards and Achievements**

**Dr. Bhupesh K Lad** developed the first prototype of eRespirocare, a unit which detects symptoms of lung related diseases.

**Dr. I. A. Palani** developed and presented working models of Bio-inspired underwater robots at the National Physical Oceanographic Laboratory, Kochi. Recognizing its potential for seabed research, the Indian Navy has agreed to further funding.

**Prof Neelesh Kumar Jain** has received the Cenderkia-Bitara Award by Universiti Malaysia, Pahang in April 2018.

**Dr. Shailesh I. Kundalwal** has received the SERB Early Career Research Award, DST-SERB, Govt. of India, 2018.

## Metallurgy Engineering & Materials Sciences (MEMS)

MEMS began as the Center for Materials Science Engineering comprising of faculty from the Schools of Basic Sciences and Engineering and transitioned into a full-fledged discipline in 2016. Amongst its notable practices include TEQIP sponsored short term courses International workshops and Consultancy Projects to provide advanced knowledge in various areas of MEMS to students and faculty from other institutions.

**Achievements/ Accomplishments**

1. Short term courses: 8.
2. Workshops: 2.
3. Projects: 3.
4. Awards: 10.
5. Journal articles: 2.
6. Book (edited): 1

**Awards and Recognitions**

**Dr. Parasharam Shirage** has been awarded the MRSI (Materials Research Society of India) medal.

**Dr. Eswara Prasad Korimilli** received an Belt and Road Overseas Expert and Visiting faculty fellowship, School of Materials Science Engineering, Xi'an Jiaotong University (XJTU), China (December 2017, May - July, 2018).

## Chemistry

The Discipline of Chemistry at Indian Institute of Technology Indore was started in 2009 with a vision of establishing a Centre of Excellence and a state-of-the-art facilities in chemical sciences research, education and scientific leadership in technology transfer to industry. Masters' students and PhD. students are trained and encouraged to engage in quality research. Regular group meetings, presentations and discussions are carried out to keep them up-to-date and involved in their academic work.

**Achievements/ Accomplishments**

1. Journal papers: 232.
2. Books: 1.
3. Book chapters: 2.
4. Patents: 5.
5. Awards: 29.
6. Fellowships: 6.
7. Grants: 3.
8. Awards/Recognition to students: 14

**Awards and Recognitions**

**Dr Rajneesh Mishra** has been awarded the AvH Fellowship for Experienced Researchers.

**Dr. Apurba Das** has been selected as a Fellow of the Royal Society of Chemistry, London; and is a recipient of UKEIRI-DST research award for the year 2018.

**Dr. Shaikh Mobin** has received an Outstanding Researcher Award by Careers 360 for being among the top 10 in Chemistry researchers in India. A scientific image produced by his research group has also secured first place in the International NanoArtography-2018 competition.

## Mathematics

The Mathematics discipline came into existence in 2009. At present, it offers MSc. and PhD. programmes in Mathematics. It promotes Mathematics among Under Graduate students in India through *Madhava Mathematics Competition*, organizes lectures by eminent mathematicians from reputed institutes around the world such as Ohio University (USA), Tohoku University (Japan), Shantou University (Republic of China), Sapienza University of Rome, etc., actively collaborates with various institutes across the globe (Finland, China, France, Germany, Singapore, Canada, USA etc.) and has conducted various academic events including two International Symposia, five GIAN programs, two MTTS programs, three international conferences, two TEQIP Short Term Courses, one CEP program and one joint seminar by IIT Indore-Russia-ISI Chennai Centre on Complex Analysis.

**Achievements/ Accomplishments**

1. Our PhD. graduates have secured Postdoc positions in India (HRI, IMSC, ISI) and abroad.
2. MSc. Graduates have qualified in national examinations including CSIR-NET, NBHM and GATE, and are pursuing PhD's.
3. Publications: 76
4. Research Projects: 12 research projects valued at approximately INR 22 crore from various Government funding agencies and some research proposals have been submitted to funding agencies.
5. Seminars/Conferences/Symposia organized: 13
6. VAJRA Faculty award of SERB jointly with Prof Michel Broniatowski of UPMC, Paris, France.
7. Faculty have been actively collaborating with various institutes across the globe (Finland, China, France, Germany, Singapore, Canada and USA).

**Awards and Recognitions**

**Dr. M. Tanveer** was awarded a Visiting Professorship to NTUST, Taiwan, and his paper on Sparse pinball twin SVM with Rahul Choudhary and Sanchit Jalan has been chosen for IIT Indore's Best UG Researcher Award.

## Physics

The Physics discipline came into existence in 2009. In addition to the courses for B.Tech and PhD. programmes, the discipline started an MSc. course in July 2013. Holding experimental facilities; a good

mix of theoretical and experimental research; and a significant number of research scholars; the discipline is now a vibrant platform for both higher education and research. Most faculty have multiple research projects, have established collaborations within India and many faculty have collaborations abroad through bilateral projects. The discipline also conducts events, seminars and out-reach activities regularly.

**Achievements/Accomplishments**

1. No. of PhD. students graduated since inception in 2009: 25
2. No. of MSc. students graduated (program started in 2013): 56
3. No. of international conferences held : 02
4. Journal papers: 462
5. Conference papers: 36
6. Book chapters: 04
7. Projects completed: 18
8. Ongoing projects: 14

**Awards and Recognitions**

**Dr. Sarika Jalan** has been invited to be the Plenary speaker at the International conference on Complex Systems 2019 at NTU, Singapore. She has also been the Keynote speaker at the International Conference on Computational Science in Wuxi, China. She is an editorial advisory board member for *Chaos: An interdisciplinary Journal of Nonlinear Sciences* and is an elected member of the complex system society council.

**Dr. Krushna R Mavani** has been appointed as an editorial board member of *Heliyon* - an international science journal by Elsevier.

**Dr. Preeti A. Bhobe** has been awarded the DST Indo-U.S. Fellowship for Women in STEMM.

**Dr. Pankaj R. Sagdeo** has been recognized with an outstanding referee award from the *Journal of Physics and Chemistry of Solids*.

**Dr. Sudeshna Chattopadhyay** has been awarded the German Academic Exchange Service (DAAD) Project as part of the LUH-IIT Indore New Passage to India program.

**Dr. Sudip Chakraborty** has been invited to be the Guest Editor of *Frontiers in Chemistry and Catalysts*. He has been nominated for the following fellowships/awards: Fellow of Royal Society of Chemistry (FRSC), London; Young associate in Indian Academy of Sciences (IASc); Tan Chin Tuan Young Visiting Scientist Fellowship and Young Associateship in International Center for Theoretical Physics (ICTP), Italy.

**Dr. Srimanta Pakhira** has been awarded the Early Career Research Award from SERB-DST.

## School of Humanities & Social Sciences

The School of Humanities and Social Sciences began in 2009 and consists of six disciplines: English, Economics, Philosophy, Psychology, Sociology and History. It is a multi-disciplinary establishment fostering a diversity of knowledge systems. In addition to courses for the B.Tech programme, the School also offers a PhD. programme. It organizes various talks including distinguished talks on various topics

relevant to our social and political situations and provides for student internships. Its objective is to strongly promote cross-disciplinary research projects. It also encourages B.Tech students of the Institute to execute their BTPs with support from faculty members from the school in order to provide strong emphasis on executing socially relevant projects. Students are provided with the much-needed experiences that enable them to face the opportunities and challenges of today's changing world.

**Achievements/Accomplishments**

1. Organized multidisciplinary conference 'Beyond Borders' with the perspective of thinking in dialogic, transactional and transgressive ways across disparate borders: geographic, sociological, anthropological, cultural, economic, political, philosophical, psychoanalytic and linguistic.
2. The school has received funding from international and national agencies to undertake research work, conducted GIAN courses and organized courses under CEP.

**Awards and Recognitions**

**Dr. Akshaya Kumar** has been awarded the ICSSR-IMPRESS Project 'The Musical Mediation: Competitive and Collaborative Lives of Popular Music in North India' worth 15 Lakhs for project work to be done over two years, in collaboration with Dr. Brahma Prakash, Jawaharlal Nehru University, New Delhi.

**Dr. Ananya Ghoshal** has been shortlisted by the European Union (EU) for the 2018 Best Climate Solutions Award with the Centre Euro-Mediterraneo sui Cambiamenti Climatici (CMCC) in the Education and Media category for *An Anthropocene Primer*.

**Dr. Nirmala Menon** has been an Invited Keynote speaker at Academia Europaea, Australian Academy for the Humanities and Lancaster University, UK and Austrian Academy of Sciences, Vienna, Austria and given Invited Public Talks and Conference Keynotes at EFLU, Hyderabad, IIT Gandhinagar and IIT Jodhpur.

**Dr. Ruchi Sharma's** research featured in *Research Matters*.

**Dr. Pritee Sharma** was the Keynote Speaker on Economic Policy at International Workshop on Nutrition Sensitive Agriculture held at Bhopal.

## Counseling Cell

The Counseling Cell has been an integral part of IIT Indore since its inception in December 2011. It offers a supportive and conducive environment for students to discuss personal issues, academic challenges and seek help from a professional counselor. It provides for easy accessibility and approachability of Counselling Cell services, proactive informal interaction with students and a close co-ordination with health center of IIT Indore.

## Finance Section

IITI has implemented 100% digital transactions.

## Health Centre

The Health Centre provides dedicated health services to the Institute community comprising of students, employees, their dependents and Institute Guests. The Health Centre offers Outpatient, Day care, Trauma and Emergency care and follows Access, Assessment and Continuity of care (AAC).

## Library

The Central Library came into existence in 2009 with a small collection of books and subscriptions to a few e-journals and databases. The Library has focused on the Collection Development activity and on user services since 2010. At present, the library collection boasts of more than 35,000 books covering all disciplines and also catering to extra-curricular reading needs of its users. Books authored by faculty members are procured by the library and also highlighted on the library website. Special collections such as a Hindi collection, a Gandhian Studies Collection and Children's book collections are developed keeping the varied requirements of users in view.

**Achievements/Accomplishments**

1. The Library successfully migrated from a proprietary Library Management System to Koha, an open source and free Library Management System with advanced features.
2. The library created the Institutional Digital Repository in order to showcase, organize, share and preserve the scholarly output of IIT Indore. The repository is created using DSpace, which is an open source and free software for creation of repositories. The library is proud to host and maintain the repository.
3. Indian Research Information Network System (IRINS) is a web-based Research Information Management (RIM) service developed by the Information and Library Network (INFLIBNET) Centre, in collaboration with the Central University of Punjab. IRINS helps to showcase and facilitate discovery of research of various departments and individual faculty members.

## Research & Development Section

Research at IIT Indore has been recognized internationally and nationally. IITI has been successful in securing 273 externally sponsored research projects with a sanctioned amount of INR 100.63 crore.

The R & D section has initiated the implementation of ERP software for research purposes which will help PIs get real time instant availability and accuracy of data related to their projects and research. The objective of the practice is achieve fast, accurate and smooth working of the tasks in the section.

Open Day provides an opportunity to the prospective PhD. candidates to take a tour of the research and teaching facilities at IIT Indore. Open Day is mainly for students in the final year of their degree courses and wishing to pursue PhD. or MSc./M.Tech at IIT Indore.

**Achievements/Accomplishments**

1. Promotion of Research and Innovation for Undergraduate Students (PRIUS): To promote and support research and innovation-based projects amongst undergraduate students, IIT Indore has started a new scheme, PRIUS. PRIUS undergraduate projects typically run for a period of at least six months and it is

to be understood that these projects will not in any way come in the way of the student's regular academic obligations and requirements for fulfilling the requirements for the award of degree. 37 projects have been completed under this scheme.

2. Continuing Education Programme (CEP): IIT Indore has organized several Continuing Education Programmes (CEPs) and Short Courses for working professionals in industry, institutions and universities across India to enable them to update their knowledge and skills, and also to train them in state-of-the-art facilities. 29 courses have been conducted under this programme.
3. Patents: IIT Indore has a set of empanelled patent attorneys to help the innovator in the successful filling of a patent application. In the short span of nine years, the institute has filed 36 Indian patent applications and many more are at the filing stage.

## Security Department

IIT Indore's security department personnel conduct patrols of the campus and residence areas 24 hours a day. The security department enforces all regulations and laws. They also work cooperatively with the Indore Police Department to record incidents that may occur off campus. It has a digitized security system and provides for a quick response to the emergencies: a QRT/Patrolling vehicle is available for effective patrolling and immediate response to any situation involving IITI community members.

## Disciplines & Faculty Members: Profiles

# Discipline of Computer Science and Engineering

### From the HoD's Desk

**Dr. Surya Prakash**
Assistant Professor & HOD
surya@iiti.ac.in

## Introducing members of CSE

- Dr. Kapil Ahuja
- Dr. Gourinath Banda
- Dr. Narendra S. Chaudhari
- Dr. Somnath Dey
- Dr. Neminath Hubballi
- Dr. Bodhisatwa Mazumdar
- Dr. Surya Prakash
- Dr. Anirban Sengupta
- Dr. Abhishek Srivastava
- Dr. Aruna Tiwari

CSE@IIT Indore has a strong Ph.D. student group comprising of around 35 students.
We have close to 200 undergraduates.

### Discipline research areas:

Current CSE faculty and students focus on a wide range of emerging research areas. These include -

- Computational Science & Engineering, Numerical Linear Algebra, Numerical Analysis, Optimization, Computational Intelligence, Big Data Analytics, and Cloud Computing.
- Embedded Systems (Cyber-physical Systems, Internet-of-Things, Wireless Sensor Networks, etc.), their Formal Verification (Model Checking, Abstract Interpretation, Program Transformation & Generation, Program Analysis) and Semantics-based Emulation of Languages & Systems.
- Algorithms and Theoretical Computer Science.
- Pattern Recognition, Computer Vision, Image Processing, Biometrics, and Human-Computer Interaction.
- Network Security, System Security, Cloud Security, Dependable Systems & Data Mining, Network Management, Network Security, and Enterprise Management.
- Hardware Security, Side Channel Analysis Attacks on Cryptographic Implementations, Security Aspects in Emerging VLSI Technologies.
- CAD-VLSI, EDA, High-Level Synthesis, IP core Security, Hardware Trojan, Fault Security, Digital Watermark in Digital Chip, Optimization of Hardware Accelerators, and Design Automation.
- Service-Oriented Systems, Dynamic Systems, Geographically Distributed Development Environments, Agile Techniques, and Software-as-a-Service.
- Soft Computing, Artificial Intelligence, Learning Algorithms, Neural Networks, Genetic Algorithms, and Evolutionary Approaches.
- Algorithms, Theoretical Computer Science, Soft Computing, Game Artificial Intelligence (AI).

### Notable Achievements:

General achievements

- The advance JEE rank of current CSE undergraduate students consistently starts below 1000, which is one of the best among the new IITs.
- Many CSE faculty members have been awarded GIAN (Global Initiative of Academic Networks) projects.
- Many CSE faculty members have received external funding for executing research projects.
- CSE faculty members have active collaborations with centrally funded institutes in India, including Indore (Indian Institute of Management Indore and Indian Institute of Soybean Research).
- CSE faculty members have active collaboration with established institutes across the globe (France, Germany, Singapore, Canada, USA, etc.).

### Facilities in CSE

We have two undergraduate labs and one MS Research Lab. Its facilities are:

- Three high-end servers supporting a full-fledged Network File System (NFS), LDAP functionalities, and a Moodle Server.
- Around 140 computing terminals catering to the academic requirements of undergraduate students, graduate students, and placement cell. All terminals offer Windows and Linux working environments. However, the thrust is towards the use of Open-Source Software for various applications.

  Faculty members have also built high-performance clusters for the development of scalable soft computing learning algorithms for big data handling as well as running large computational science and engineering, image processing, and cloud computing application codes.

# Faculty Profiles in
# Computer Science & Engineering

**Dr. Gourinath Banda**
Associate Professor
gourinath@iiti.ac.in

**Dr. Gourinath Banda** is an Associate Professor with a PhD. in Computer Science from Roskilde University, Denmark. His thesis was on formal verification of embedded systems. Before joining IIT Indore, he was with Samsung India at Noida in their Advanced Technology Group as Chief Engineer. He holds a USPTO granted patent in the area of enhanced mobile user experience that employs the concepts of realtime process scheduling. Currently, his group is working on Intelligent Transport Systems algorithms and their formal verification. Intelligent transport systems are autonomous Cyber Physical Systems deployed in transport applications. Another direction of research being pursued is autonomous CPS architectures.

### Patents

1. Application No.: 201821010650 Title: "Intelligent Wheelchair System with Brain Computer Interface and Gesture Recognition"

### Selected Publications

1. Aaditya Prakash Chouhan, Gourinath Banda, "Autonomous intersection management: A heuristic approach", Publication date: 2018/9/26, Journal IEEE Access, Volume 6 Pages 53287-53295, Publisher IEEE

### Research Projects

Development of a portable acoustic sensor based canine pregnancydetection system and the biomarker-based canine pregnancy test kit. (Co-PI, Funded by DBT, GOI)

**Dr. Narendra S. Chaudhari**
Professor (HAG)
nsc@iiti.ac.in

**Dr. Narendra S. Chaudhari** is currently with Indian Institute of Technology, Indore since Aug 2009 as Professor. He was the Director of Visvesvaraya National Institute of Technology (VNIT) Nagpur (M.S.) from June 2013 till June 2018 (five-year term). At the same time, he was also the Director of Maulana Azad National Institute of Technology (MANIT), Bhopal from March 2016 to May 2017. Previous to these appointments, he was Dean - Research and Development (Dean - R&D), IIT Indore. From 2001 to July 2009, he was with the School of Computer Engineering, Nanyang Technological University (NTU), Singapore.

### Research Highlights

Narendra's significant research work contributions are in the areas of machine learning, network security and mobile computing, game AI, novel neural network models like binary neural nets and bidirectional nets, context free grammar parsing, optimization, parallel algorithms, and graph isomorphism problem. Some of his important contributions are: (i) Authentication Protocols and Security Mechanisms for Cellular Networks, (ii) generalization of notion of alignment in bioinformatics sequences to fuzzy similarity and its usage for identification of Context Free structure in languages, (iii) rerouting strategies in Multi-Protocol Label Switching (MPLS) networks, (iv) applications of soft-computing techniques like genetic algorithms for cutting stock problems, and for credit risk estimation.

### Selected Publications

1. Neetesh Saxena, King Hwang Raymond Choo, and Narendra S. Chaudhari, "A Novel Secure Protocol

for Value Added Service Delivery to Mobile Devices," IEEE Transactions on Information Forensics & Security, https://ieeexplore.ieee.org/document/8274977/metrics.
2. Shruti Bhilare, Vivek Kanhangad, & Narendra S. Chaudhari, "A study on vulnerability and presentation attack detection in palmprint verification system", Pattern Anal Applic (Springer) (2018) 21: 769-782. https://doi.org/10.1007/s10044-017-0606-y.
3. Neetesh Saxena and Narendra S. Chaudhari, "EasySMS: A Protocol for End-to-End Secure Transmission of SMS," IEEE Transactions on Information Forensics and Security, Vol. 9, No. 7, pp. 1157-1168.

### Research Projects

TEQIP III, funded by World Bank

**Dr. Somnath Dey**
Assistant Professor
somnathd@iiti.ac.in

**Dr. Somnath Dey** is currently working as an Associate Professor in the Discipline of Computer Science & Engineering at IIT Indore. He is also holding the position of Associate Dean Administration at IIT Indore. His research interest includes biometric security, biometric template protection, biometric crypto system. Dr. Dey's research group is currently looking for a robust cancelable biometric system with substantial template protection mechanism. He has published over 30 research articles (including papers in international journals, conferences and book chapters). He is a recipient of the Young IT Professional Award (Eastern Region Level) of Computer Society of India.

### Research Highlights

In our research, a fingerprint quality assessment (FQA) algorithm is proposed to assign the appropriate quality class of dry, wet, normal dry, normal wet, and good quality using Fuzzy C-means clustering technique to each fingerprint image. It considers seven features namely, mean, moisture, variance, uniformity, contrast, ridge valley area uniformity (RVAU), and ridge valley uniformity (RVU) to cluster the fingerprint images into suitable quality class. Fingerprint images of each quality class undergo through a two-stage fingerprint quality enhancement (FQE) process. In the first stage, a quality adaptive preprocessing (QAP) method is used to preprocess the fingerprint images. Next, fingerprint images are enhanced with Gabor, short-term Fourier transform (STFT), and oriented diffusion filtering (ODF) based enhancement techniques in the second stage. Experimental evaluations are performed on a quality driven database of FVC 2004. Results show that the performance improvement of 1.54% to 50.62% for NBIS matcher and 1.66% to 8.95% for VeriFinger matcher are achieved while the QAP based approaches are used in comparison to the current state-of-the-art enhancement techniques. In addition, the experimentation is also performed on FVC 2002 database to validate the robustness and efficacy of the proposed method.

### Selected Publications

1. R. P. Sharma and S. Dey, Two-stage Quality Adaptive Fingerprint Image enhancement using Fuzzy C-means Clustering Based Fingerprint Quality Analysis, Image and Vision Computing, Elsevier, vol. 83–84, pp. 1-16, 2019.
2. R. Dwivedi and S. Dey, A Novel Hybrid Score Level and Decision Level Fusion Scheme for Cancelable Multi-biometric Verification, Applied Intelligence, Springer, vol. 49, Issue 3, pp. 1016-1035, 2019.
3. R. Dwivedi and S. Dey, Score-level Fusion for Cancelable Multi-biometric Verification, Pattern Recognition Letters, Elsevier (First Online: 16 April 2018).

**Dr. Surya Prakash**
Assistant Professor
HoD
surya@iiti.ac.in

**Dr. Surya Prakash** (PhD.: IIT Kanpur) is an Associate Professor. His field of research includes Biometrics, Pattern Recognition, Computer Vision and Image Processing. He is currently working on the development of efficient and secure biometric techniques for human recognition using face, ear and fingerprint data.

### Research Highlights

1. Developing techniques for following tasks:
2. Image quality assessment and enhancement
3. Human recognition using face, ear and fingerprint biometrics
4. Biometric Template Security

### Selected Publications

1. Syed Sadaf Ali, Iyyakuti Iyappan Ganapathi, Sajid Mahyo and Surya Prakash, Polynomial Vault: A secure and robust fingerprint based authentication, IEEE Transactions on Emerging Topics in Computing, pp. 1-14, 2019 (Accepted).
2. Iyyakutti Iyappan G and Surya Prakash, Ishan R. Dave, and Sambit Bakshi, Unconstrained ear detection using ensemble based convolutional neural network model, Concurrency and Computation: Practice and Experience, Wiley, 2019 (Accepted).
3. Piyush Joshi and Surya Prakash, No-reference Image Quality Assessment for Noise Affected Images using Singular Value Decomposition, IET Signal Processing, 13(2), pp. 183-191, IET, April 2019.

### Events/Seminars Organized

1. Organized a special session: Biometric based Security in 2016 International Conference on Signal Processing & Integrated Networks (SPIN 2016), February 11-12, 2016, Noida.
2. Organized a special session: Biometric based Security in 2015 International Conference on Signal Processing & Integrated Networks (SPIN 2015), February 19-20, 2015, Noida.
3. Organized a special session: Biometric based Security 2014 International Conference on signal Processing & Integrated Networks (SPIN 2014), February 20-21, 2014, Noida.

### Research Projects

Development of an Efficient Ear Biometric System and Investigation of Age Invariant Nature of Human Ear (Funded by DST, GOI).

**Dr. Anirban Sengupta**
Assistant Professor
asengupt@iiti.ac.in

**Dr. Anirban Sengupta** is an Associate Professor. His research interests include Hardware Security, IP Core Protection, Privacy and Digital Rights Management for Electronics Devices, Forensic Engineering for Security. He has been awarded the prestigious IEEE Distinguished Lecturer (Renowned DL of IEEE CE Society) by IEEE Consumer Electronics Society. Prior to joining at IIT Indore, he has been a researcher in Ryerson University, Toronto (Canada). He has also been a honorary visiting scientist at VividSparks IT Solutions between 2016 and 2018.

### Research Highlights

1. Security of DSP cores for consumer electronics systems
2. Optimization of DSP cores for consumer electronics systems
3. High level Synthesis/ESL

### Patents

1. Anirban Sengupta "Embedding Watermark based on Multi-Variable Signature Encoding at Behaviour Level for Reusable IP Core Protection", Patent 4466/MUM/2015, July 11, 2017.
2. Anirban Sengupta, "Design Space Exploration of An Optimized Hardware Trojan Detectable/Secured Datapath During High Level Synthesis", Patent#1666/MUM/2015, Â 2015.
3. Anirban Sengupta, "Design Space Exploration of Optimal Kc-Cycle Transient Fault Secured Datapath System with Intelligent Cut Insertion", Patent No. 63/MUM/2015, 2015.

### Selected Publications

1. Anirban Sengupta, Saraju P. Mohanty "IP Core Protection and Hardware-Assisted Security for Consumer Electronics", The Institute of Engineering and Technology (IET), 2019, Book ISBN: 978-1-78561-799-7, e-ISBN: 978-1-78561-800-0.
2. Anirban Sengupta, E. Ranjith Kumar, N. Prajwal Chandra "Embedding Digital Signature using Encrypted-Hashing for Protection of DSP cores in CE", IEEE Transactions on Consumer Electronics, Volume: 65, Issue:3, Aug 2019, pp. 398 - 407.
3. Anirban Sengupta, MahendraRathor "Protecting DSP Kernels using Robust Hologram based Obfuscation", IEEE Transactions on Consumer Electronics, Volume: 65, Issue: 1, Feb 2019, pp. 99-108.

### Research Projects

1. Development of Novel Methodologies for Trusted and Secured IP chip design for Consumer Electronics (Funded by CSIR).
2. Development of Novel Methodologies for Reliability Aware and Trojan Secured Architectural Synthesis (Funded by MEitY).

**Dr. Aruna Tiwari**
Associate Professor
artiwari@iiti.ac.in

**Dr. Aruna Tiwari** (PhD.: RGPV Bhopal) is an Associate Professor. She works in the areas of soft computing and machine learning frameworks which are able to perform learning by handling real-life ambiguous situations. Dr. Tiwari's work concentrates on the following specific areas: artificial neural networks, fuzzy clustering, genetic programming and their applications to bioinformatics, medical diagnosis, etc. She actively collaborates with other research and academic institutions such as C-DAC, Pune, CSIR-CEERI, Pilani, Indian Institute of Soyabean Research and University of Technology, Sydney, Australia.

### Research Highlights

1. Handling Genome Big Data with Fuzzy Based Classification Approach
2. Breast cancer diagnosis using Genetically Optimized Neural Network model
3. Quantum inspired binary neural network algorithm
4. Construction of Multi-class Classifiers by Extreme Learning Machine Based One Class Classifiers
5. System Evolution Analytics: Pattern mining and Deep learning of an Evolving system
6. Multi-label classification classifies the input samples into multiple possible outputs. We are working on Neural Network and deep learning-based multi-label classifier which classifies the Image and Genome data.

### Patents

1. Aruna Tiwari, Ashok Pencily Poothiyat, Kunal Chaudhary, System and Method for Sign Language Gesture Recognition, India, 1988/MUM/2015 (Awaited)

### Selected Publications

1. Om Prakash Patel, Neha Bharill, Aruna Tiwari, Mukesh Prasad, " A Novel Quantum-inspired Fuzzy Based Neural Network for Data Classification", IEEE Transactions on emerging topics in Computing, vol. 2019, pp. 1-13, 2019.
2. Chandan Gautam, Aruna Tiwari, Sundaram Suresh and Kapil Ahuja , "Adaptive Online Learning With Regularized Kernel for One-Class Classification", IEEE Transactions on Systems, Man, and Cybernetics: Systems, pp. 1-16, 2019.

### Events/Seminars Organized

1. 2019: For research collaboration assignment with Dr. Stephen. L. Smith (Graduate Admissions Tutor, Department of Electronics, University of York, UK), on "Cancer Disease Diagnosis using Soft Computing Algorithm".

2. 2019: Organized TEQIP sponsored Active Learning Course jointly being conducted by disciplines of CSE and Maths.
3. 2018: Organized a student interaction with Mr. Amit Saxena, Principal Technical Officer, CDAC Bioinformatics group Pune.

### Research Projects

Development of an Efficient Scalable Clustering Algorithms for Big Data and investigation of Integrated system for Protein Sequence Classification (Funded by CSIR, GOI).

## Dr. Bodhisatwa Mazumdar

Assistant Professor
bodhisatwa@iiti.ac.in

**Dr. Bodhisatwa Mazumdar** (PhD.: IIT Kharagpur) is an Assistant Professor at CSE. His primary research interest is in the area of hardware security with particular emphasis on side-channel vulnerabilities of cryptographic algorithms and implementations and IC logic locking techniques. The Cryptography and Hardware Security research group is presently involved in determining side-channel vulnerabilities of lightweight cryptographic implementation and logic locking techniques for ICs.

### Research Highlights

Our research group has pinpointed approximation based vulnerabilities in the present-day logic locking techniques that has been adopted as standard for protection against IC piracy and counterfeit production. The work has been published in IEEE VLSI Design conference and its extensive analysis has been accepted as a publication in Springer journal of Electronic testing. Prior to this work, we pinpointed side-channel vulnerabilities and removal attacks on conventional logic locking techniques.

### Selected Publications

1. Removal attacks on logic locking and camouflaging techniques, IEEE Transactions on Emerging Topics in Computing.
2. Logic Locking with Provable Security Against Power Analysis Attacks, IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems.
3. Hardware Security and Trust: Logic Locking as a Design-for-Trust Solution: Design and Implementation, Book Chapter in "The IoT Physical Layer".

## Dr. Abhishek Srivastava

Associate Professor
asrivastava@iiti.ac.in

**Dr. Abhishek Srivastava** (PhD.: University of Alberta, Canada) is involved in research on machine to machine interactions in constrained environments. He is also interested in Service-Oriented Systems, Web-Services, Internet-of-Things, Machine Learning.

### Research Highlights

The research endeavours of the group of Dr. Abhishek Srivastava currently focuses around the development of technology agnostic wrappers for Internet-of-Things deployments. This effectively permits seamless functioning of heterogeneous systems to get useful work done. In addition to this, the group has also started looking at the use of Machine Learning algorithms to optimise the workings of IoT and other related resource constrained environments.

### Selected Publications

1. Tanveer Ahmed, Abhishek Srivastava. Combining Humans and Machines for the Future: A Novel Procedure to Predict Human Interest. Future Generation Computer Systems, Elsevier, 2018.

2. Rohit Verma, Abhishek Srivastava. A Dynamic Service Description for Mobile Environments. Computing, Springer, 2018.
3. Tanveer Ahmed, Abhishek Srivastava. A Prototype Model to Predict Human Interest: Data Based Design to Combine Humans and Machines. IEEE Transactions on Emerging Topics in Computing, 2017.

### Events/Seminars Organized

1. Part of the Organizing Committee of International Conference on Web Engineering (ICWE) 2019, Daejeon, Korea
2. Part of the Organizing Committee of IEEE ANTS Conference, 2018, Indore

### Research Projects

Design and Development of an Automated Surveillance System for the Melghat Tiger Reserve (Funded by DeFries-Bajpai Foundation, USA).

**Dr. Neminath Hubballi**
Assistant Professor
neminath@iiti.ac.in

**Dr. Neminath Hubballi** (PhD.: IIT Guwahati) is an Associate Professor. He is part of the Network Security research group at IIT Indore. His research interests are: Network Security, System Security, Cloud Security and Fault Detection in Networks. Previously, he has worked with Hewlett-Packard, Infosys Labs, Samsung R & D on various security and distributed computing research projects. He was also a visiting Professor in Norwegeain University of Science and Technology.

### Research Highlights

His team conducts cutting-edge research in network security. His group currently works in the areas of traffic classification, Network protocol analysis for finding new exploitable vulnerabilities and fault detection in networks. Previously, his group successfully identified exploitable vulnerabilities in Dynamic Host Configuration Protocol, Hypertext Transfer Protocol (HTTP)/2.0 and Network Time Protocol (NTP).

His group has also proposed new methods to accurately classify network traffic in wired and mobile applications in providing quality of service) and in security monitoring.

### Selected Publications

1. Neminath Hubballi and Mayank Swarnkar, "BitCoding : Network Traffic Classification through Encoded Bit Level Signatures", IEEE/ACM Transactions on Networking, Vol 26(3), PP 2334-2346, IEEE, 2018.
2. Diksha Golait and Neminath Hubballi, "Detecting Anomalous Behaviour in VoIP Systems: A Discrete Event System Modeling", IEEE Transactions on Information and Forensic Security, Vol 12(3), PP 730-745, IEEE, 2017.
3. Neminath Hubballi and Nikhil Tripathi, "A Closer Look into DHCP Starvation Attack in Wireless Networks", Computers & Security, Vol 65(C), PP 387-404, Elsevier, 2017.

### Research Projects

1. Design and Development of a Trusted and Accountable Cloud Computing Platform (Funded by SERB, GOI).
2. Digital Forensic Knowledge Integration And Intelligence (DIREKT-Intel) (Funded by SPARC).
3. Big Data Aware High Capacity Wireless Network Architecture Using Caching and Machine Learning (Funded by DST-UKIERI).

**Dr. Kapil Ahuja**
Associate Professor
kahuja@iiti.ac.in

**Dr. Kapil Ahuja** (PhD.: Virginia Tech, USA) has a varied background, including degrees in Computer Science, Mathematics, and Mechanical Engineering. Dr. Ahuja works on applying mathematics and computation to solve science and engineering problems. Specifically, his research focuses on efficiently solving linear and nonlinear systems of equations, optimization, computational intelligence, big data, and social cloud.

### Research Highlights

There have been two research breakthroughs in the recent past. First, his research group has proved stability of classes of model reduction algorithms with respect to the error introduced by inexact linear solves. The most novel contribution has been developing new linear solvers that satisfy these stability conditions as almost no extra cost. Second, his lab has modelled social cloud systems as a strategic network formation game and proposed a novel solution concept of Bilateral Stability. This concept is more practically implementable than other existing concepts.

### Selected Publications

1. P. C. Mane, K. Ahuja, and N. Krishnamurthy. Stability, Efficiency, and Contentedness of Social Storage Networks. Annals of Operations Research, Springer, DOI:10.1007/s10479-019-03309-9, 2019.
2. N. P. Singh and K. Ahuja. Preconditioned Linear Solves for Parametric Model Order Reduction. International Journal of Computer Mathematics, Taylor & Francis, DOI:10.1080/00207160.2019.1627525, 2019.
3. R. Choudhary and K. Ahuja. Stability Analysis of Bilinear Iterative Rational Krylov Algorithm. Linear Algebra and its Applications, Elsevier, vol. 538, pp. 56-88, 2018.

### Research projects

1. IIT Indore and LU Hannover Partnership in Physics, Chemistry, Bio Science & Computational Science (Funded by DAAD, GOI).
2. A Digital Narratology of Technology as Literary Actors and Artefacts of Settings in Indian English Novels (Funded by SPARC).
3. Novel Hardware Design for Low Power Neural Networks (Funded by ASA Program of German Ministry for Economic Cooperation and Development).
4. Biorthogonal Krylov Subspace Bases and Short Recurrences (Funded by SERB, DST, GOI).

**Dr. Puneet Gupta**
Associate Professor
puneet@iiti.ac.in

**Dr. Puneet Gupta** is an Assistant Professor in Computer Science Engineering. He completed his PhD. from IIT Kanpur in the year 2016. He has also been associated with TCS Innovation Labs and Tampere University earlier. His broad research areas are Artificial Intelligence, Deep Learning and Image Processing.

### Selected Publications

1. Puneet Gupta, Brojeshwar Bhowmick, A Pal, Serial fusion of Eulerian and Lagrangian approaches for real-time heart rate estimation, US Patent App. 10/130, 271.
2. P. Gupta, Brojeshwar Bhowmick, A Pal, Face video based heart rate monitoring using pulse signal modelling and tracking, US Patent App. 15/900, 788.
3. Puneet Gupta, Brojeshwar Bhowmick, A Pal, Heart rate estimation from face videos using quality based fusion, US Patent App. 15/872, 458.

### Research Highlights

1. Designed hand biometrics based authentication systems.
2. Estimated human vital parameters from non-contact face videos.
3. Recognizing and detecting human micro-expression.
4. Adversarial learning for real-world applications.

# Discipline of Electrical Engineering

## From the HoD's Desk

**Dr. Trapti Jain**
Associate Professor
Electrical Engineering
traptij@iiti.ac.in

The vision of this discipline is to impart quality education and promote inter-disciplinary, industry-oriented advanced scientific research to address the challenges of future technologies and societal requirements. The discipline has been a major centre for both academic and research programs in various branches of electrical engineering (which includes micro/ nanoelectronics, communication & bio-medical signal processing, power electronics, and power systems). In order to cater the needs of the discipline for research as well as academic programs, the discipline has grown significantly in terms of faculty strength with diversified specializations, some state-of-the-art research facilities and undergraduate and postgraduate students' strength.

The academic programs offered by the discipline include B.Tech, M.Tech, and PhD. Two M.Tech programs are currently being offered: (i) Communication and Signal Processing; and, (ii) VLSI Design and Nanoelectronics. The discipline also hosts many Post-Doctoral candidates from time to time.

The discipline presently has 15 faculty members with expertise in diverse areas including Power Electronics and Power Systems, Micro and Nano-electronics, Communications, Signal Processing, Image Processing, Bio-photonics, Control Systems and RF Microwave.

**It has the following research laboratories:**

- Biomedical Signal Processing Laboratory
- Bio-Photonics Laboratory
- Devices, Circuits and System Design Laboratory
- Hybrid Nanodevice Research Laboratory
- Low Power Nano-Electronics Laboratory
- Optoelectronic Nanodevice Research Laboratory
- Organic Electronics Laboratory
- Power Electronics and Power Systems Laboratory
- Wireless Communication Research Laboratory

The discipline currently runs 19 research projects funded by various external agencies including Department of Science & Technology, Council of Scientific and Industrial Research, Department of Biotechnology, Department of Atomic Energy and Department of Electronics and Information Technology. The discipline is consistently moving forward in research activities as evinced by publications in various high-quality International journals and conferences and filed patents.

The faculty strive to promote and develop analytical and practical learning skills in students. This is achieved by incorporating various sub-components as a part of the regular course learning and evaluation, industry-relevant mini projects, field trips and real-time assignments to substantially improve the understanding and utilization of concepts. Additionally, students have been supported to attend numerous conferences, competitions; and have won laurels. Consequently, our students have been awarded prestigious foreign internships (DAAD, Fulbright fellowships, etc.); received scholarship opportunities from top Universities for higher-education; and gained appreciation of their work in industries.

A fruitful work environment has been created in IIT Indore where the researchers frequently collaborate to discover out-of-the-box solutions to solve problems. We have invited many industries to visit, discuss and share insights. Our approach has been to take up some of their problems as engineering projects. Some have been successfully solved by our students. This has resulted in collaborations with industry for sponsored research.

**Abhinav Kranti**
Professor
akranti@iiti.ac.in

**Prof. Abhinav Kranti** worked at Université catholique de Louvain (Belgium), Queen's University Belfast (UK) and Tyndall National Institute (Ireland) before joining the Indian Institute of Technology Indore in 2010. Prof. Kranti's Low Power Nanoelectronics Research Group is engaged in pioneering research on capacitorless Dynamic Random-Access Memory (1T-DRAM) and steep switching transistors for the development of next-generation logic and memory technology. The research from the group has been recognized through publications in leading international journals and conferences. Prof. Kranti's research goals and future plans are to engage in cutting-edge research in the area of Nanoelectronics, 1T-DRAM, Steep Switching Transistors, Emerging Solid-State Devices for the development of next- generation logic and memory technology.

### Selected Publications

1. N. Jaiswal and A. Kranti, Modeling short channel effects in core-shell junctionless MOSFET, IEEE Trans. Electron Devices, IEEE Trans. Electron Devices, vol. 66, pp. 292-299, 2019.
2. M. Gupta, and A. Kranti, Regaining Switching by Overcoming Single Transistor Latch in Ge Junctionless MOSFETs, IEEE Trans. Electron Devices, vol. 65, pp. 3600-3607, 2018.
3. P. Dwivedi and A. Kranti, Overcoming biomolecule location dependent sensitivity degradation through point and line tunneling in dielectric modulated biosensors, IEEE Sensors Journal, vol. 18, pp. 9604-9611, 2018.

### Research Highlights

The research work has shown the feasibility of achieving retention (at higher temperatures) in heavily doped semiconductor films through appropriate device engineering and optimization. The work will be useful for the design of next-generation Capacitorless dynamic memory.

A methodology to overcome the single transistor latch phenomenon occurring due to excessive impact ionization has been proposed. Latch impedes the switching characteristics of the transistor and is detrimental for logic applications.

### Research Projects

1. Germanium junctionless transistors for low power logic technology applications
   (Funding by: CSIR)
2. Innovative low power transistor architectures for capacitorless DRAM
   (Funding by: DST, GITA)

## Dr. Amod C. Umarikar

Associate Professor
umarikar@iiti.ac.in

**Dr. Amod C. Umarikar** is an Associate Professor. His areas of research interest are: Application of Power Electronics in Renewable Energy Systems and Power Quality Monitoring.

His research goals and future plans are: 1) Standalone PV systems, High Step Up DC-DC Converters and Microgrid Control; 2) Power Quality Monitoring. His current research focus is on the application of different Signal Processing Techniques for power quality monitoring.

### Selected Publications

1. Vinay K. Tiwari, Amod C. Umarikar and Trapti Jain, "Field programmable gate array-based measurement system for real-time estimation of single phase electric power quantities," IEEE Sensors Journal, March.2019.
2. Karthik Thirumala, Sushmita Pal, Trapti Jain and Amod C. Umarikar, "A classification method for multiple power quality disturbances using EWT based adaptive filtering and multiclass SVM," Neurocomputing, Vol. 334, pp. 265 - 274, March 2019.
3. Karthik Thirumala, Amod C. Umarikar and Trapti Jain, "An Improved Adaptive Filtering Approach for Power Quality Analysis of Time-Varying Waveforms," Measurement, Vol. 131, pp. 677-685, Jan. 2019.

### Research Highlights

1. Development of Standalone PV Power Systems based on Quasi Z-source converter topology.
2. Study of different control algorithms for grid connected solar PV system (for e.g. Synchronverter).
3. Development of power quality monitoring techniques using various signal processing algorithms.
4. Research on various step-up dc converter topologies for renewable energy applications.

### Research Projects

Smart Grid Research Facility
(Funding by: DST)

**Dr. Mukesh Kumar**
Associate Professor
mukesh.kr@iiti.ac.in

**Dr. Mukesh Kumar** received his PhD. (2009) in Integrated Optoelectronics from Tokyo Institute of Technology, Japan. He had been an Exchange Researcher at the University of California Berkeley, USA. He was a JSPS Postdoctoral research Fellow in Tokyo Institute of Technology, Japan. Currently, he is an Associate Professor. His research interests include: (i) Integrated Optoelectronics, (ii) Nanophotonics; and, (iii) Semiconductor optoelectronics.

He has published over 30 articles in journals and conferences of international repute. He has been working on some sponsored research projects funded by the Government of India. He is a senior member of IEEE, a regular member of Optical Society of America and Life Fellow of Optical Society of India.

His research group at Optoelectronic Nanodevice Research Laboratory (Opto Nano Group) focuses on Device Innovations through novel designs and cost-effective fabrication of on- chip devices based on smart and engineered materials for future communication, computing and sensing. His thrust areas for research are:

1. Silicon Photonics: Micro Nano Devices based on Silicon/SOI
2. Nanophotonics: Nano Devices for Multidisciplinary Applications
3. Nanoelectronic Fabrication
4. Devices based on engineered and hybrid materials
5. Engineered on-chip Biosensors

### Selected Publications

1. L. Singh, S. Jain and M. Kumar, "Electrically Writable Silicon Nanophotonic Resistive Memory with Inherent Stochasticity," Optics Letters, Vol. 44, No. 16,2019.
2. S. Rajput, V. Kaushik, S. Jain and M. Kumar, "Slow Light Enhanced Phase Shifter Based on Low-Loss Silicon-ITO Hollow Waveguide", IEEE Photonics Journal, Vol.11, No.1, pp.1-8, February 2019.
3. L. Singh, T. Sharma and M. Kumar, "Controlled Hybridization of Plasmonic and Optical Modes for Low-Loss Nano-Scale Optical Confinement with Ultralow Dispersion," IEEE Journal of Quantum Electronics, vol. 54, no. 2, pp. 1-5, April 2018.

### Research Highlights

We are working on the design, fabrication and characterization of silicon photonic devices for broadband communication, computing and information storage. Recently a silicon nanophotonic memory based on resistive switching is developed with an on-off extinction ratio of 10 dB. The proposed device is an excellent example of the combination of novel device physics and semiconductor technology. Also, a CMOS compatible optical modulator based on Si-ITO is realized with Si-ITO heterojunction enabling intensity modulation with high extinction ratio of 7dB via electrical tuning of optical absorption.

### Events/Seminars Organized

1. Continuing Education Programme (CEP) in Information Communication Technologies (ICT): Concepts, Implementation and Prospects.
2. We have also formed a student chapter "IIT Indore Opto-Nano" of optical society of America to impart and spread the knowledge and to raise the awareness of Optics, Photonics and Optoelectronics in Universities and Schools of Central India.

### Research Projects

1. Photonic Crystal based Hollow Waveguide for Optical Communication
   (Funding by: DRDO)
2. Nano Optoelectronics Sensing platform for fast and efficient Lab-On-Chip applications
   (Funding by: DST-SERB)

**Dr. Prabhat Kumar Upadhyay**
Associate Professor
pkupadhyay@iiti.ac.in

**Dr. Prabhat Kumar Upadhyay** received his PhD. in electrical engineering from the Indian Institute of Technology (IIT) Delhi in 2011. He joined IIT Indore as an Assistant Professor in 2012 and has been an Associate Professor since 2017. He leads national and international research projects in the Wireless Communications Research Group. He is currently an Associate Editor for IEEE ACCESS and a Guest Editor of the Special Issue on Energy-Harvesting Cognitive Radio Networks in the IEEE Transactions on Cognitive Communications and Networking. He is a member of the IEEE Communications Society, IEEE Vehicular Technology Society and a Life Member of the Institution of Electronics and Telecommunication Engineers.

His main research interests are: (i) wireless relaying techniques, (ii) cooperative communications, (iii) MIMO signal processing, (iv) hybrid satellite-terrestrial systems, (v) cognitive radio; and, (vi) molecular communications.

## Selected Publications

1. V. Bankey and P. K. Upadhyay, "Physical Layer Security of Multiuser Multirelay Hybrid Satellite-Terrestrial Relay Networks," IEEE Transactions on Vehicular Technology, vol. 68, no. 3, pp. 2488-2501, Mar. 2019.
2. D. S. Gurjar and P. K. Upadhyay, "Overlay Device-to-Device Communications in Asymmetric Two-Way Cellular Systems with Hybrid Relaying," IEEE Systems Journal, vol. 12, no. 4, pp. 3713-3724, Dec. 2018.
3. S. Solanki, P. K. Upadhyay, D. B. da Costa, P. S. Bithas, A. G. Kanatas, and U. S. Dias, "Joint Impact of RF Hardware Impairments and Channel Estimation Errors in Spectrum Sharing Multiple-Relay Networks," IEEE Transactions on Communications, vol. 66, no. 9, pp. 3809-3824, Sept. 2018.

## Research Highlights

Wireless Communications (WiCom) Research Group, led by Dr. Prabhat K. Upadhyay, is actively involved in cutting-edge research and development to cater to the emerging needs of the next generation wireless communication systems. It has developed and analyzed various spectral-efficient algorithms and spatial diversity schemes that will help the design of future wireless networks to accommodate the increasing data traffic demands over a limited spectrum. He has been supervising many research projects and dissertations toward PhD. (5 completed & 5 ongoing), M.Tech (7 completed & 1 ongoing), and B.Tech (15 completed & 2 ongoing) degrees. The research work has contributed a significant number of publications in IEEE journals and conferences.

## Events/Seminars Organized

1. Publicity Co-Chair, International Conference on Advanced Communication Technologies and Networking (CommNet), Rabat, Morocco, 2019.
2. TPC Co-chair, IEEE International Conference on Advanced Networks and Telecommunication Systems (ANTS), Indore, India, Dec. 2018.
3. Co-organizer, Workshop on "Energy Harvesting Communication Networks", IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC), Bologna, Italy, Sep. 2018

## Research Projects

1. Performance Analysis of Diffusion-Based Molecular Communication Systems with Active Receivers (Funding by: CSIR)
2. Design and Development of Large-Scale Ambient Energy Harvesting Wireless Networks (LargEWiN) (Funding by: BRICS: CNPq-Brazil, DST-India, MOST & NSFC-China, and DST & NRF-South Africa)
3. Development of Green and Secure Communication Techniques for Future Wireless Networks

**Dr. Ram Bilas Pachori**
Professor
pachori@iiti.ac.in

**Dr. Ram Bilas Pachori** received his PhD. (2008) in Electrical Engineering from the IIT Kanpur.

He worked as a Postdoctoral Fellow at Charles Delaunay Institute, the University of Technology of Troyes, France in 2007-08. He served as an Assistant Professor at Communication Research Center, International Institute of Information Technology, Hyderabad in 2008-09. At IIT Indore, he has served as an Assistant Professor (2009-13); Associate Professor (2013-17) and is presently a Professor. He has been a Visiting Scholar at Intelligent Systems Research Center, Ulster University, Northern Ireland, UK in December 2014.

He is the Associate Editor of Biomedical Signal Processing and Control journal and an Editor of IETE Technical Review journal and senior member of IEEE and a Fellow of IETE.

His research interests are in the following areas: (i) biomedical signal processing, (ii) non-stationary signal processing, (iii) speech signal processing, (iv) signal processing for communications, (v) computer-aided medical diagnosis; and, (vi) signal processing for mechanical systems.

### Selected Publications

1. A. Bhattacharyya, L. Singh, and R.B. Pachori, Fourier-Bessel series expansion based empirical wavelet transform for analysis of non-stationary signals, Digital Signal Processing, vol. 78, pp. 185-196, July 2018.
2. V. Gupta, M.D. Chopda, and R.B. Pachori, Cross-subject emotion recognition using flexible analytic wavelet transform from EEG signals, IEEE Sensors Journal, vol. 19, no. 06, pp. 2266-2274, March 2019.
3. R.R. Sharma and R.B. Pachori, Eigenvalue decomposition of Hankel matrix-based time-frequency representation of complex signals, Circuits, Systems, and Signal Processing, vol. 37, issue 08, pp. 3313-3329, August 2018.

### Research Highlights

The automated identification systems based on signal processing and machine learning techniques for diagnosis of various diseases like epilepsy, glaucoma, coronary artery disease, diabetes, congestive heart failure, septal defects, myocardial infarction, atrial fibrillation, amyotrophic lateral sclerosis, sleep disorders, alcoholism, human emotions, etc. have been developed. The new methods for analysis of non-stationary signals have been proposed.

### Events/Seminars Organized

Short term course on artificial intelligence and advanced signal processing techniques for engineering applications, 05-07 October, 2018, Indian Institute of Technology Indore (with Prof. A. Parey).

### Research Projects

1. Detection of human brain disorders using novel machine learning approaches
   (Funding by: CSIR)
2. Development of a portable acoustic sensor based canine pregnancy detection system and biomarker-based canine pregnancy test kit
   (Funding by: DBT)

**Dr. Santosh Kumar Vishvakarma**

Associate Professor

skvishvakarma@iiti.ac.in

**Dr. Santosh Kumar Vishvakarma** obtained his PhD. from IIT Roorkee in 2010. He worked in the Microelectronics and VLSI Group at the department of Electronics and Computer Engineering under the supervision of Dr. S. Dasgupta, & Dr. A. K. Saxena. His research area was MOS device modeling and SRAM circuit design. He has also worked as a Post-Doctoral Fellow at Unik-University Graduate Center, Kjeller, Norway with Prof. Tor. A. Fjeldly under the Project COMON (Compact Modeling Network) on Compact Modeling development and parameter extraction of Nonconventional MOS Devices.

Currently, he is an Associate Professor in the discipline of Electrical Engineering where he is engaged in teaching, research in the area of Modeling and Simulation of conventional and nonconventional MOS device Structures and Circuit & System Design. He is also the reviewer of the following journals: IEEE, Elsevier, IET, IOP Sciences, etc.

Dr. Vishvakarma is a Member of IEEE, Professional Member of VLSI Society of India, Associate Member of the Institute of Nanotechnology, Life member of Indian Microelectronics Society (IMS), India. His research is in the following areas:

1. Microcontroller Design
2. Secure IC Design
3. PLL Design for
4. Custom SoC Design

### Selected Publications

1. Pooja Bohara and Santosh Kumar Vishvakarma, "Self-Amplified Tunneling Based SONOS Flash Memory Device with Improved Performance", IEEE Transactions on Electron Devices, vol. 65, issues 19, pp. 4297 - 4303, Aug 2018.
2. Ambika Prasad Shah, Nandakishor Yadav, Ankur Beohar and Santosh Kumar Vishvakarma, "Process Variation and NBTI Resilient Schmitt Trigger for Stable and Reliable Circuits," IEEE Transactions on Device and Materials Reliability, vol. 16, issue 4, pp. 546-554, Dec 2018.
3. Abhishek Upadhyay, Ajay Kushwaha, Priyank Rastogi, Yogesh Chauhan, and Santosh Kumar Vishvakarma, "Explicit Model of Channel Charge, Backscattering and Mobility for Graphene FET in Quasi-Ballistic Regime," IEEE Transactions on Electron Devices, Vol. 65, issues 12, pp. 5468 - 5474, December 2018.

### Research Highlights

1. SRAM Memory Design
2. Reliable, Secure and Energy Efficient Circuits
3. Reconfigurable SoC including Memory, Processor, Adaptive GPU
4. Machine Learning Accelerators
5. SerDes and PLL Design
6. Advanced MoS Devices

### Research Projects

Evaluation of Stability and Performance analysis of reliable 3D Cyl GAA-TFET based 6T SRAM cell (Funding by: CSIR)

**Dr. Shaibal Mukherjee**
Associate Professor
shaibal@iiti.ac.in

The Hybrid Nanodevice Research Group (HNRG) led by **Dr. Shaibal Mukherjee** explores the new physics of micro and nanostructured materials. The goal is to apply this knowledge in creating and designing advanced tools and devices for chemical, biological, optical, electronic and energy applications.

Till date, Dr. Mukherjee has successfully completed 6 externally funded research projects from DST and CSIR and is currently associated with 8 projects from DST, CSIR, DST Indo-Russia, DST Indo-USA, DST Indo-Taiwan, DAE-BRNS, and CEERI Pilani-IIT Indore. The total research grant from external funding agencies is more than INR 5 crores.

HNRG has been actively involved in diverse research domains including design, fabrication, testing, and packaging of high-performance applications.

### Selected Publications

1. Mangal Das, Amitesh Kumar, Sanjay Kumar, Biswajit Mandal, Md Arif Khan, and Shaibal Mukherjee, Effect of surface variations on the performance of yttria based memristivesystem, IEEE Electron Device Letters, vol. 39, no. 12, pp. 1852-1855, December 2018.
2. Vivek Garg, Brajendra S. Sengar, Pankaj Sharma, Amitesh Kumar, Aaryashree, Shailendra Kumar, Shaibal Mukherjee, Sputter-instigated plasmon-enhanced optical backscattering layer in ultrathin solar cells: Application of GZO in CIGSe material system, Solar Energy, vol. 174, pp. 35-44, September 4, 2018.
3. Md Arif Khan, Rohit Singh, Ritesh Bhardwaj, Amitesh Kumar, Amit Kumar Das, Pankaj Misra, Abhinav Kranti, and Shaibal Mukherjee, Enhanced sheet charge density in DIBS grown CdO alloyed ZnO buffer based heterostructure, IEEE Electron Device Letters, vol. 39, issue 6, pp. 1-4, June 2018.

### Events/Seminars Organized

1. Technical Committee Member of the 9th International Conference on Key Engineering Materials (ICKEM 2019), Oxford, United Kingdom, March 29-April 1, 2019.
2. Symposia Co-Chair of the 30th Annual General Meeting of MRSI and the First Indian Materials Conclave, Indian Institute of Science, Bangalore, February 12-15, 2019.
3. Technical Sub-Committee Member of the 4th IEEE International Conference on Emerging Electronics (IEEE ICEE), Bangalore, December 16-19, 2018.
4. Organizing Chair of the International Conference on Computational Mathematics in Nanoelectronics and Astrophysics (CMNA 2018), IIT Indore, November 1-3, 2018.
5. Technical Program Evaluation Committee Member of the International Conference on Mathematical Modeling and Scientific Computing (ICMMSC – 2018), IIT Indore, July19-21, 2018.

### Research Projects

1. Development of ZnO-based heterostructures for HEMT applications
   (Funding by: DST-SERB)
2. Fabrication of ZnO/MgZnO based ultraviolet photodetector
   (Funding by: CSIR)
3. Complex Cu-containing semiconductors and layered structures for economically-viable, environmentally-benign, and high-performance ultrathin solar cells
   (Funding by: DST-RSF Bilateral Project for Joint Research Cooperation between India and Russia)

**Dr. Srivathsan Vasudevan**
Associate Professor
svasudevan@iiti.ac.in

**Dr. Srivathsan Vasudevan** an Associate Professor, works on the development of different biomedical instruments for diagnosis of diseases such as cancer, pneumonia etc. Over the last few years, his lab has been working on the development of Photoacoustic sensing and imaging for cancer diagnosis. The technique, after applying to samples for characterisation, has reached to perform a pre-clinical study at the surgical theatre of Christian Medical College, Vellore, India through collaboration. Apart from this project, his lab is also working to find hardware-specific solutions to high performance computing applications with the use of embedded systems and System on chip applications.

He has graduated one doctoral student in the last year. His research has widespread collaborations ranging from research Institutions like RRCAT Indore, IIT Kanpur as well as hospitals like Choithram Hospital and Research Centre, Indore and Christian Medical College, Vellore.

### Selected Publications

1. Deblina Biswas, Anshu Kumari, George C K Chen, Srivathsan Vasudevan, Sharad Gupta, Supriya Shukla, Umesh K Garg, Quantitative Differentiation of Pneumonia from Normal Lungs: Diagnostic Assessment Using Photoacoustic Spectral Response, Applied Spectroscopy, vol. 71, pp. 2532, 2017.
2. Srivathsan Vasudevan, George C. K. Chen, Zhiping Lin, Beng Koon Ng, Quantitative photothermal phase imaging of red blood cells using digital holographic photothermal microscope, Applied Optics, vol. 54(14), pp. 4478, 2015.
3. Deblina Biswas, Srivathsan Vasudevan, George C K Chen, and Norman Sharma, Quantitative photoacoustic characterization of blood clot in blood: A mechanobiological assessment through spectral information, Review of Scientific Instruments, vol. 88, pp. 024301, 2017.

### Research Projects

1. Reducing computational complexity using FPGA to study structure and dynamical properties of nanoparticles
   (Funding by: DST-SERB)
2. Development of multi-spectral photoacoustic imaging and sensing system for non-invasive imaging and characterization of tumor vasculature during angiogenesis using zebrafish xenograft and chicken chorioallantoic membrane (CAM) model
   (Funding by: DST-SERB)

**Dr. Trapti Jain**
Associate Professor
trapti@iiti.ac.in

**Dr. Trapti Jain** received her PhD. from IIT Kanpur in 2008. She is currently an Associate Professor. Prior to joining IIT Indore in 2012, she worked as an Assistant Professor in IIT Mandi from December 2010 to June 2012. She is a Senior member of IEEE. Her research goals and thrust areas include:(I) synchrophas or applications in power systems, (ii) grid integration of renewable energy systems, (iii) powerquality monitoring; and,(iv) artificial intelligence applications to power systems.

### Selected Publications

1. Vinay K Tiwari, Amod C Umarikar and Trapti Jain, "Field Programmable Gate Array-Based Measurement System for Real-Time Estimation of Single-Phase Electric Power Quantities", IEEE Sensors Journal, Vol. 19, pp. 5086-5097, 2019.
2. Joice G Philip and Trapti Jain, "An Improved Stochastic Subspace Identification based Estimation of Low Frequency Modes in Power System Using Synchrophasor", International Journal of Electrical Power and Energy Systems, Vol. 109, pp. 495-503, 2019.

3. Vinay K Tiwari, Amod C Umarikar and Trapti Jain, "Fast Amplitude Estimation of Harmonics Using Undecimated Wavelet Packet Transform and Its Hardware Implementation", IEEE Transactions on Instrumentation and Measurement, Vol. 67, pp. 65-77, 2019.

### Research Highlights

Since the operational philosophy of tomorrow's power grid is expected to change significantly with the technological advancements, the focus of our research group is towards analyzing the impact of these technologies on the operation of power systems and determining the measures needed to mitigate possible negative impact. Stable operation of microgrids, use of synchrophasor technology for security assessment of power system and power quality monitoring are the few thrust areas of our research.

### Research Projects

Development of Smart Grid Research Facility
(Funding by: DST-FIST)

## Dr. Vivek Kanhangad

Associate Professor
kvivek@iiti.ac.in


**Dr. Vivek Kanhangad** received his PhD. from the Hong Kong Polytechnic University in 2010; and M.Tech. in Electrical Engineering, from the Indian Institute of Technology Delhi in 2006. He is currently an Associate Professor.

His research focuses on the following areas: (i) Signal and Image Analysis, (ii) Biometrics; and, (iii) Pattern Classification. He partnered with the Nanyang Technological University on a collaborative research project in forensic biometrics. He was invited to review research projects funded by the Italian Ministry of Education, Universities and Research (MIUR). He regularly serves as a Technical Program Committee Member for reputed international conferences on biometrics. He is currently an Editorial Board Member of the IEEE Biometrics Compendium Journal. He is also a member of Committee of Experts for recommending articles to SPIE Defence and Security Newsroom and IEEE SMC Technical Committee on Biometrics and Applications. He is a Senior Member of the IEEE.

### Selected Publications

1. Ankita Jain and Vivek Kanhangad, "Gender Recognition in Smartphones using Touchscreen Gestures," Pattern Recognition Letters, vol. 125, pp. 604-611, 2019.
2. Ankita Jain and Vivek Kanhangad, "Human Activity Classification in Smartphones using Accelerometer and Gyroscope Sensors," IEEE Sensors Journal, vol. 18, no. 3, pp. 1169-1177, 2018.
3. T. Sunil Kumar and Vivek Kanhangad, "Gabor Filter-based 1D-Local Phase Descriptors for Obstructive Sleep Apnea Detection using Single-lead ECG," IEEE Sensors Letters, vol. 2, no. 1, 2018.

### Research Highlights

Pattern Recognition and Image Analysis (PRIA) research group at IIT Indore is primarily engaged in addressing research problems related to biometric recognition. The areas of our current research include high-resolution fingerprint matching, biometric solutions for smartphones, and attack detection in biometric systems. With the development of high-resolution fingerprint scanners, high-resolution fingerprint-based biometric recognition has received increasing attention. Level-3 fingerprint features, which include very fine details such as pores, are generally observable in fingerprint images having a resolution greater than 800 dpi. Pore features have been found to be effective for fingerprint recognition. Accurate detection of pores is crucial for biometric recognition using high-resolution fingerprints. Recently, we have developed a deep convolutional neural network-based method for detecting pore coordinates in high-resolution fingerprint images.

### Events/Seminars Organized

Organized a Distinguished Lecture titled Two Paradoxes in Electromagnetics by Professor S. C. Dutta Roy

### Research Projects

Development of Counter Measures For Presentation Attacks on Biometric Systems with Focus on Hand Geometry and Palm Print Based Systems

(Funding by: CSIR)

**Dr. Vipul Singh**

Associate Professor

vipul@iiti.ac.in

**Dr. Vipul Singh** is an Associate Professor. He is a PhD. and M.E from the Department of Biological Functions and Engineering, Kyushu Institute of Technology, Japan. His B.E. is in Electronics and Communication Engineering from the Delhi College of Engineering.

His research goals and future plan is to research and develop cheap, flexible, disposable electronic devices and systems by employing techniques that do not require high-temperature processing, are cost-effective and particularly suitable for large area fabrication with applications ranging from bio/chemical sensors, LEDs, Photovoltaic and Transistors.

His research group works with a wide range of materials. These include organic semiconductors, oxide semiconductors, and other front-end materials in the area of nanoscience and technology.

His focus is towards the growth of nanostructures tuning the size and shape of nanoparticles to utilize the unique optical and electrical properties presented by these materials at the nanoscale dimensions

### Selected Publications

1. "Solution Processed Transparent CuO Thin Films for Solar Blind Applications": Tejendra Dixit, Akash Tripathi, K L Ganapathi, I A Palani, M S R Rao and Vipul Singh, IEEE Electron Device Letters, Vol. 40 (2019) 255.
2. "Fabrication of High Responsivity Deep UV Photodetector Based on Na Doped ZnO Nanocolumns": Jitesh Agrawal, Tejendra Dixit, I A Palani, M S Ramachandra Rao and Vipul Singh, J Phys D Appl Phys, Vol. 51 (2018) 185106.
3. "Insights into Non-noble Metal Based Nanophotonics: Exploration of Cr-coated ZnO Nanorods for Optoelectronic Applications": Tejendra Dixit, I A Palani and Vipul Singh, RSC Advances, Vol. 8 (2018) 6820.

### Research Highlights

Molecular and Nanoelectronics Research Group (MNRG), led by Dr. Vipul Singh was established in 2011. We are into solution processed material synthesis for inorganic and organic semiconductors. We utilize the unique opto-electronic properties exhibited by these nanostructured materials towards demonstration of functional devices viz. photodetectors, photo transistors and other type of sensors. We are interested in studying the photo-generated charge carrier dynamics in semiconductors. We are also focussed towards development of organic photosensitive transistors using novel techniques. Of particular interest to us is the LSPR effect in nanostructured materials.

### Events/Seminars Organized

Short Term Course on Mechatronics, MEMS and Microfabrication, from 27th to 29th March'2019, jointly organized by Dr. Vipul Singh and Dr. I A Palani.

### Research Projects

1. Development of Low Voltage, High Sensitivity Organic Photosensitive Transistors for Near Infrared Light Sensing.
   (Funding by: DST SERB)
2. Design and Development of Laser Decal Transfer Based Micro 3D Printer for Printing Microdevices
   (Funding by: DST)

**Dr. Vimal Bhatia**
Professor
vbhatia@iiti.ac.in

**Dr. Vimal Bhatia** is currently a Professor. He completed his PhD. from the University of Edinburgh (UK) in 2005 and has over 11 years of industry experience both in India and the UK. He has also been associated with IIT Delhi as an adjunct faculty. His research is primarily on proposing new architecture and solutions for communications and signal processing problems. His research focus is broadly in Future Communication, Signal Processing systems, Software Product Development, and Entrepreneurship Development.

### Selected Publications

1. S. Sharma, A. Gupta and V. Bhatia, "Compressed Sensing based UWB Receiver using Signal-Matched Sparse Measurement Matrix", IEEE Transactions on Vehicular Technology, Jan. 2019.
2. R. Mitra and V. Bhatia, "Minimum Error Entropy Criterion Based Channel Estimation for Massive-MIMO in VLC", IEEE Transactions on Vehicular Technology, Jan. 2019.
3. P. Swami, V. Bhatia, S. Vuppala and T. Ratnarajah, "A Cooperation Scheme for User Fairness and Performance Enhancement in NOMA-HCN", IEEE Transactions on Vehicular Technology, Dec. 2018.

### Research Highlights

Proposing new architectures and solutions for communications and signal processing problems is the focus of his research group. In particular, solutions for visible light communications for efficient high speed data transfer are of interest. The research on algorithm design for large/massive-MIMO, and NOMA schemes are currently being explored in my research group. We have also been able to demonstrate world's first standard (IEEE 802.22) compliant TV-White Space platform on open source software and hardware with improved channel estimation, spectrum sensing and data rates. We have also explored compressed sensing based techniques for ultra-wide band communications. Validation of achievable data rates and outage by the future cooperative networks is found by our work on theoretical bounds under various channel conditions, modulation techniques and practical system considerations. The quality and innovative research has been well accepted and recognized by the IEEE, Elsevier, Springer, OSA, IET and IETE publications. Published articles have featured in the most downloaded/popular article list.

**Dr. Abhinoy Singh**
Inspire Faculty
abhinoy.singh@iiti.ac.in

**Dr. Abhinoy Kumar Singh** did his PhD. in Electrical Engineering from IIT Patna in 2016. He worked at McGill University, Canada as a post doctoral researcher between 2017-18. He has been working at IIT Indore as an Inspire faculty since Oct-2018. His major research interest on estimation and filtering. He is also working to develop a continuous glucose monitoring system with application of estimation and filtering algorithms.

### Selected Publications

Abhinoy Kumar Singh, "A model independent fractionally delayed Kalman filter", IEEE Automatica Sinica, Accepted, 2019.

### Events/Seminars Organized

1. Short term course on "Industrial Applications of Control Systems and Signal Processing", IIT Indore, 19-24 Aug. 2019.
2. Short term course on "Control Systems and Signal Processing: Solutions to Biomedical Problems", IIT Indore, 3-4 June 2019.
3. Student travel grant co-chair, IEEE ANTS 2018, 16-19 Dec. 2018, Indore
4. Exhibition co-chair, V-DAT 2019, to be held in July 2019, Indore.

### Research Projects

New estimation and filtering algorithms, and their possible application in continuous glucose monitoring (Funding by: DST- INSPIRE)

**Dr. Saptarshi Ghosh**

Assistant Professor
sghosh@iiti.ac.in

**Dr. Saptrashi Ghosh** has joined IIT Indore as an assistant professor in Jan-2019. He received his M. Tech and PhD. from IIT Kanpur in 2013 and 2017, respectively. He was a post doctoral researcher at Chung-ang University, Seoul, South Korea from Dec. 2017- Dec. 2018. His research interests include electromagnetics, frequency selective surface, metamaterials, microwave absorbers and microwave antennas.

### Selected Publications

1. Saptarshi Ghosh, and Sungjoon Lim, "A Multifunctional Reconfigurable Frequency Selective Surface Using Liquid Metal Alloy," IEEE Transactions on Antennas and Propagation, vol. 66, no. 9, pp. 4953-4957, 2018.
2. Saptarshi Ghosh, and Sungjoon Lim, "Fluidically-Reconfigurable Multifunctional Frequency Selective Surface with Miniaturization Characteristic," IEEE Transactions on Microwave Theory and Techniques, vol. 66, no. 8, pp. 3857-3865, 2018.
3. Saptarshi Ghosh, and Kumar Vaibhav Srivastava, "Broadband Polarization-Insensitive Tunable Frequency Selective Surface for Wideband Shielding," IEEE Transactions on Electromagnetic Compatibility, vol. 60, no. 1, pp. 166-172, 2018.

### Research Highlights

1. Experimental demonstration of different types of passive and active microwave absorbers
2. Use of frequency selective surfaces to realize different types of microwave devices, e.g. filters, polarizers, absorbers, rasorbers, antennas
3. Exploitation of metamaterial properties to construct ultra-thin and flexible structures
4. Use of cutting-edge technologies, such as 3D printing, inkjet printing, liquid metal technology to realize electromagnetic devices
5. Familiarization of computational software to model different devices

**Dr. Swaminathan R.**

Assistant Professor
swamiramabadran
@iiti.ac.in

**Dr. Swaminathna R.** has joined IIT Indore as an Assistant Professor in Feb 2019 after working as a research fellow at Nanyang Technological University (NTU) Singapore. Earlier, he has completed his PhD. from IIT Kharagpur. His current research focus is on efficient design of space-air-ground integrated networks with hybrid optical-RF wireless communications, developments of novel algorithms for blind parameters estimation of forward error correcting codes and interleavers.

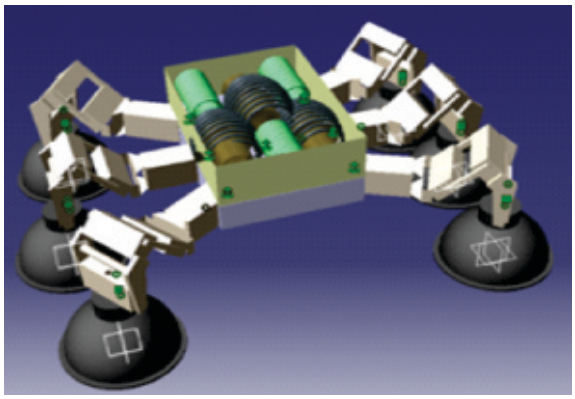
### Selected Publications

1. S. Sharma, A. S. Madhukumar, and Swaminathan R, ``Switching-based cooperative decode-and-forward relaying for hybrid FSO/RF networks'', IEEE/OSA Journal of Optical Communications and Networking (JOCN), vol. 11, no. 6, pp. 267-281, June 2019.
2. Swaminathan R, A. S. Madhukumar, and W. Guohua, ``Blind estimation of code parameters for product codes over noisy channel conditions'', IEEE Transactions on Aerospace and Electronic Systems, DOI: 10.1109/TAES.2019.2934308, Early Access, Aug. 2019.
3. Swaminathan R and A. S. Madhukumar, ``Blind parameter estimation of turbo convolutional codes: noisy and non-synchronized scenario'', Elsevier Digital Signal Processing, vol. 95, 102577, Dec. 2019.

### Research Highlights

1. Performance Analysis of Hybrid FSO/RF Terrestrial and Satellite Communications
2. Automatic Channel Code and Interleaver Classification for a Non-Cooperative Scenario
3. Efficient Wireless Sensor Network for Landslide Monitoring

# Discipline of Mechanical Engineering



**Research Thrust/Facility**

- Micro-Channel Heat Transfer, Nuclear Thermal Hydraulics, Combustion & Computational Fluid Dynamics (CFD)
- Condition Monitoring & Prognosis
- Micro-Mechanics & Nano-Mechanics
- Laser & Additive Manufacturing
- Mechatronics & Control

**Application Areas**

- Biomechanics & Composite Structures
- Gear Manufacturing & Noise Vibration Harness (NVH)
- Smart Manufacturing
- Green Energy & Bio-Fuels
- Robotics & Control
- Automotive & Aerospace

## From the HoD's Desk

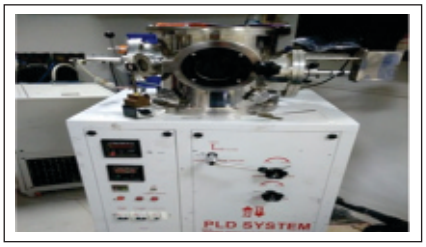
**Dr. I A Palani**
Associate Professor
palaniia@iiti.ac.in

The Mechanical Engineering Discipline is committed to providing quality education by carrying out robust research programs and working closely with industry. One of our major objectives is to provide quality engineering education with basic as well as specialized engineering training required for the present and emerging requirements of the society. The discipline also has a responsibility to conduct relevant social research with cutting-edge technology; to provide continuing education to practicing industrial engineers; and, to develop industry/academia collaborations. The discipline also organizes continuing educational programs. It comprises of 15 regular faculty.

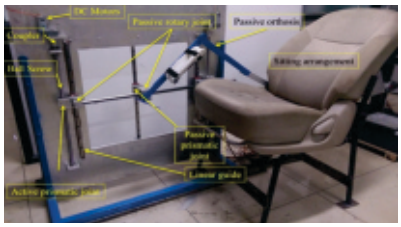
## Achievement of Discipline in the current reporting year

- Developed world class infrastructures and cutting edge technologies in Industry 4.0, Autotronics, Additive manufacturing, smart materials etc for Man power training and cutting edge research.
- Secure funding from different External funding agencies including SERB, DST, CSIR, ISRO, DRDO, Royal Academy of Engineering, RSF, OVDF etc work more than 5 crore.
- The Discipline has published around 100 Research publications in reputed International journals.
- The Discipline has built strong linkage in terms of consultancies and manpower training with industries such as Vovlo Eischer, WABCO India Ltd, John Deere etc.
- Alumnus from the discipline are placed in reputed industries and R&D centres including ISRO, DRDO etc. In addition the students have also received scholarships to pursue their higher studies including post doctoral fellowships etc, in highly ranked universities abroad.

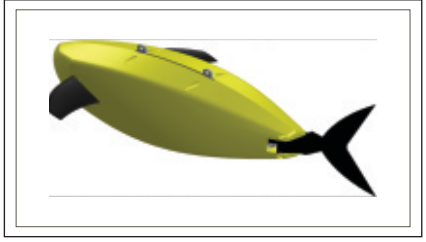
## Research at glance – Discipline of Mechanical Engineering




Pulsed Laser Deposition System

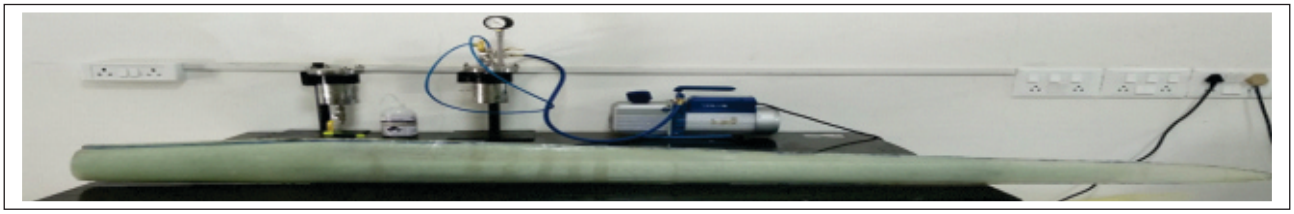


Real-time scaled down prototype of ANKUR-LL 2

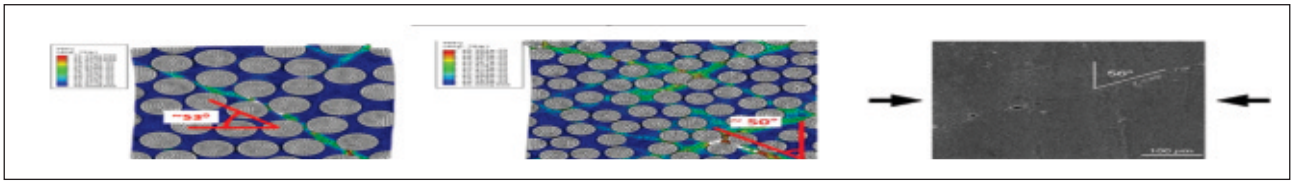


Design of Hybrid Underwater Vehicle with fin propulsion

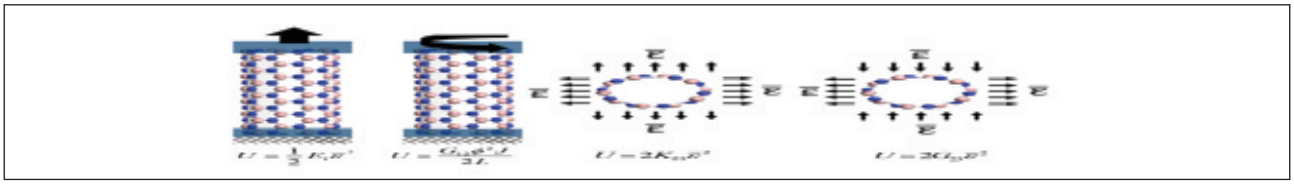
Design, manufacturing and computational research @ composite materials lab



Continuum simulations @ composite meterials lab



Molecular dynamic studies at ATOM lab



**Dr. Devendra Deshmukh**

Associate Professor
dldeshmukh@iiti.ac.in

PhD.: Indian Institute of Science, Bangalore.

**Dr. Devendra Deshmukh** received his PhD. degree in Mechanical Engineering from IISc Bangalore in 2012. He carried out his doctoral research in the area of biofuel spray characterization at high pressures. He has previously worked as a research engineer in GM-TCI Bangalore and at the TVS Motor Company. His current research interests are in the areas of Combustion Engines, Laser diagnostics in Spray and Combustion and Modelling.

### Research Highlights

1. Multi component spray modelling for biodiesel under LTC condition.
2. Low Temperature Combustion engine using biofuels.
3. Dense spray characterization with liquid volume fraction and SMD distribution in dense sprays.
4. Combustion diagnostics in flames using structured illumination.
5. Optical engine diagnostics in diesel engine.

### Selected Publications

1. V.D. Chaudhari, D. Deshmukh, "Challenges in charge preparation and combustion in homogeneous charge compression ignition engines with biodiesel: A review," Energy Reports, Volume 5, 2019, Pages 960-968, ISSN 2352-4847.
2. Aniket P. Kulkarni, D. Deshmukh, "Improvements in laser sheet dropsizing using numerical and experimental techniques," International Journal of Multiphase Flow, Volume 110, 2019, Pages 273-281, ISSN 0301-9322.
3. Lanjekar, R. D., & Deshmukh, D. "A review of the effect of the composition of biodiesel on NOx emission, oxidative stability and cold flow properties" Renewable and Sustainable Energy Reviews. 2016.

### Events/Seminars Organized

1. SERB School on "Combustion Diagnostics and Modelling" 2013.
2. A public Lecture by Prof. Peter Lindstedt in collaboration with UKIRE 2014.
3. Workshop on "Sprays And Combustion Diagnostics" 2019.

### Research Projects

1. Investigation of Biodiesel Spray in an Optical Diesel Engine (Funded by SERB).

**Dr. I.A. Palani**

Associate Professor
palaniia@iiti.ac.in

PhD.: Indian Institute of Technology Madras

**Dr. I. A. Palani** is currently an Associate Professor in the Mechatronics and Instrumentation lab. Before joining IIT Indore, he was a post-doctoral research scientist in the Graduate school of Information Science and Electrical Engineering, Kyushu University, Japan. His area of research includes: Laser assisted micro-manufacturing, Smart materials and structures, Additive Manufacturing, Micro-Nano Fabrication, and Shape Memory alloys.

### Selected Publications

1. S Jayachandran, K Akash, SS Mani Prabu, M Manikandan, M Muralidharan, A Brolin, IA Palani, Investigations on performance viability of NiTi, NiTiCu, CuAlNi and CuAlNiMn shape memory alloy/Kapton composite thin film for actuator application, Composites Part B: Engineering, 176, 107182, 2019.

2. K Akash, Akash K Jain, Gaurav Karmarkar, Aniket Jadhav, Dhiraj C Narayane, Nandini Patra, IA Palani, Investigations on actuation characteristics and life cycle behaviour of CuAlNiMn shape memory alloy bimorph towards flappers for aerial robots, 2018, Materials and Design144, 64-71.
3. P Rajagopalan, Gaurav Khandelwal, IA Palani, Vipul Singh, Sang-Jae Kim, La-doped ZnO ultra-flexible flutter-Piezoelectric Nanogenerator for Energy Harvesting and Sensing Applications: A Novel Renewable Source of Energy, Nanoscale, 2019.

### Events/Seminar Organized

1. GIAN course on Laser assisted surface micro and Nano fabrication, 8th -14th July 2019.
2. TEQUIP course on Mechatronics, MEMS and micro-fabrication, 27th to 29th March 2019.

### Patents

Strained SMA Bimorph & Spring Based Condition Monitoring System for Fluid Leak Detection in Hydraulic Hoses Filing date: 12/10/2018.

### Research Projects

1. Development of thick and thin NiTi shape memory alloy porous structures using laser and wire arc additive manufacturing (Funded by DST-RSF).
2. Design and development of Laser Decal Transfer based Micro 3D Printer for printing micro devices (Funded by DST).
3. Laser assisted peening and Nitriding of worm shafts (Funded by WABCO India Ltd).
4. Laser assisted forming of thin sheets for engine cabinets (John Deere India Ltd).

## Dr. Santosh K. Sahu

Associate Professor
sksahu@iiti.ac.in


PhD.: Indian Institute of Technology Kharagpur

**Santosh Kumar Sahu** is serving as an Associate Professor in the Discipline of Mechanical Engineering at the Indian Institute of Technology Indore. He received his Ph.D. (2009) degree from Indian Institute of Technology KharagpurIndia.HisresearchinterestsThermal Engineering and Fluid Flow.

### Selected Publications

1. A.K. Sharma, S.K. Sahu, An experimental study on heat transfer and rewetting behavior of hot horizontal downward facing hot surface by mist jet impingement, Applied Thermal Engineering, 151 (2019) 459-474. https://doi.org/10.1016/j.applthermaleng.2019.02.038.
2. S Yadav, S K Sahu, Heat transfer augmentation in double pipe water to air counter flow heat exchanger with helical surface disc turbulators, Chemical Engineering and Processing - Process Intensification, 135 (2019) 120 - 132. https://doi.org/10.1016/j.cep.2018.11.018.
3. R. Kothari, S. Das, S.K. Sahu, S.I. Kundalwal, Analysis of solidification in a finite PCM storage with internal fins by employing heat balance integral method, International Journal of Energy Research, 43 (2019) 1-23. https://doi.org/10.1002/er.4363.

### Research Projects

1. Development of light weight heat sink integrated with phase change material (PCM) for cooling applications (Funded by DST).
2. Numerical investigation of flow and heat transfer characteristics of three dimensional impinging jets/jets on an isothermal hot surface (Funded by DST).
3. Thermal management of electronic components using phase change material (Funded by DST).
4. Heat transfer analysis of melting and solidification of phase change materials for concentrated solar power plants (Funded by DST).

**Dr. Neelesh Kumar Jain**
Professor
nkjain@iiti.ac.in

PhD.: Indian Institute of Technology Kanpur(2003)

**Professor Neelesh Kumar Jain** joined IIT Indore as Associate Professor in Jan 2010 and became Professor in Dec. 2013. He completed his PhD. (2003) from IIT Kanpur, specializing in Manufacturing Science. Before joining IIT Indore, he served the Mechanical and Industrial Engineering Department at IIT Roorkee from June 2004 to Jan 2010; South Asia International Institute, Hyderabad from June 2003 to May 2004 and Netaji Subhash Institute of Technology, New Delhi from July 2002 to June 2003. Prof. Jain works on Additive Manufacturing of Metallic Materials and biomedical implants, Development of FGM and SMM by µ-Plasma Transferred Arc Process, Micro-joining of Thin Sheets, High Quality Gear Finishing by Advanced Finishing Processes, Sustainable Hobbing of Gears, Near Net-shape Manufacturing of Meso-sized Gears, Manufacturing of Non-Circular Gears by WSEM, Advanced and Hybrid Machining Processes, Micromachining and Nano-finishing Processes, and Modeling and Optimization of the Manufacturing Processes.

## Selected Publications

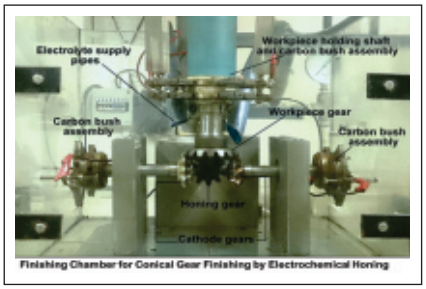
1. "Finishing of Conical Gears by Pulsed Electrochemical Honing" Sunil Pathak, Neelesh Kumar Jain and I.A. Palani, Cambridge Scholars Publishing, UK, 2019, ISBN (13): 978-1-5275-3366-0; ISBN (10): 1-5275-3366-2.
2. N.K. Jain, Sunil Pathak, Muneer Alam (2019), "Synthesis of copper nano-particles by pulsed electrochemical dissolution (PECD) process" Industrial & Engineering Chemistry Research, 58(2), 602-608, DOI: 10.1021/acs.iecr.8b03146 (Jan 2019).
3. Mayur S Sawant, N.K. Jain (2018), "Investigations on Additive Manufacturing of Ti-6Al-4V by µ-Plasma Transferred Arc Powder Deposition Process" Transactions of ASME: Journal of Manufacturing Science and Engineering, 140(8), 081014-1 to 081014-11, DOI: 10.1115/1.4040324 (Aug 2018).

## Research Highlights

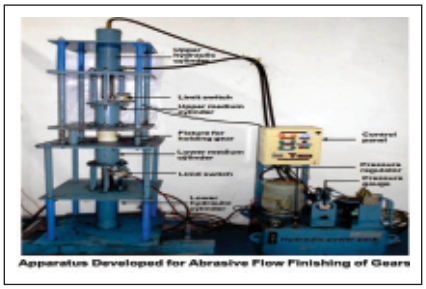
1. Development of micro-plasma transferred arc (µ-PTA) wire and powder deposition processes for various meso-sized additive manufacturing (AM) of different metallic materials, knee implants from biocompatible materials, developing functionally graded materials (FGM) and shape memory materials (SMM).
2. Development of electrochemical honing (ECH) and pulse-ECH process as an economical and sustainable alternative process for high quality finishing of different types of cylindrical and conical gears.
3. Development of abrasive flow finishing (AFF) process for high quality finishing of spur and bevel gears.
4. Establishing WEDM as near-net shape manufacturing process for high quality meso-sized cylindrical, conical, and non-circular gears through extensive experimental research, modeling and optimization.

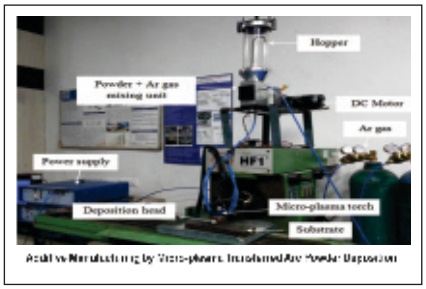
## Research Projects

1. DST-FIST Project on Gear Engineering (Funded by DST).



Finishing Chamber for Conical Gear Finishing by Electrochemical Honing


Apparatus Developed for Abrasive Flow Finishing of Gears



**Dr. Satyajit Chatterjee**
Assistant Professor
satyajit@iiti.ac.in

PhD.: Indian Institute of Technology Kharagpur

**Dr. Satyajit Chatterjee** joined the Mechanical Engineering Discipline as an Assistant Professor. Having a background in Production Engineering with Tool Engineering specialization, he is involved in teaching Production and Manufacturing Technologies.

His research endeavors include Surface Technologies, Coatings' Tribology and Solid Lubrication. Primarily, his focus remains on the development of protective coatings with a suitable combination of hardness, thermal stability, wear and corrosion resistance and low friction characteristics following different methods and procedures.

### Selected Publications

1. Debjit Misra, Balmukund Dhakar, E. Anusha, S. M. Shariff, Suman Mukhopadhyay, Satyajit Chatterjee, Evaluation of Nanomechanical and Tribological Properties of Laser Surface Alloyed Boride-Nitride-Carbide Ceramic Matrix Composite Coatings, Ceramics International, 2018, Volume 44, pp 17050–17061.
2. Debjit Misra, S.M. Shariff, Suman Mukhopadhyay, Satyajit Chatterjee, Analysis of instrumented scratch hardness and fracture toughness properties of laser surface alloyed tribological coatings, Ceramics international, 2018, Volume 44, pp 4248–4255.
3. Debjit Misra, Sumit Barange, Hillol Joardar, Jityendra Kumar, Alok Kumar Das, Suman Mukhopadhyay, Satyajit Chatterjee, Comparative study on the tribological properties of laser post-treated and untreated AISI304 stainless steel matrix composite reinforced with hard ceramic particles (TiB2–TiN–SiC) and prepared by ex-situ P/M route, Ceramics international, 2019, Volume 45, Issue 15, pp 18852–18864.

### Research Highlights

Coatings Tribology group's research Hard coatings can be manufactured in-situ or ex-situ through laser surface alloying (LSA) or powder metallurgical routes. Manufacturing such hard metal matrix or ceramic matrix composite coatings can increase the potential of a metal surface in tribological applications. Presently, we are trying to find a way to incorporate lubricious phases into the electroless coating matrix with a view to improve its frictional properties, development of electroless Ni plating, which is also one effective route to manufacture metal alloy or composite coatings with considerable superiority in terms of hardness and tribological properties and has relevance to aero space, automotive, chemical and electrical industries.

**Dr. Kazi Sabiruddin**
Associate Professor
skazi@iiti.ac.in

PhD.: Indian Institute of Technology Kharagpur

**Dr. Kazi's** work on surface engineering, focusing on Thermally sprayed ceramic coatings, Plasma sprayed alumina coating for tribological applications, Synthesis of hydoxyapatite powder from natural resources, D-Gun coated alumina as TBC, Plasma sprayed HA for biomedical application, and Explosively coated Ni-Al.

### Selected Publications

1. Vishal Sharma, Kazi Sabiruddin, An investigation on D-gun sprayed Al2O3-SiC coatings, Surface & Coatings Technology, Volume 375, 2019, pp 303-314.
2. Balmukund Dhakar, Kazi Sabiruddin, "Effect of Particle size of Al2O3 feedstock on the phases of Plasma Sprayed Al2O3-Cr2O3 coatings". 9th Asian Thermal Spray Conference (ATSC 2018), Nanyang Executive Centre, NTU, Singapore.

**Dr. Shanmugam Dhinakaran**
Associate Professor
sdhina@iiti.ac.in

PhD.: Indian Institute of Technology Kharagpur

**Dr. Shanmugam Dhinakaran** is an Associate Professor in the Discipline of Mechanical Engineering. He is also the coordinator of The Centre for Fluid Dynamics. Besides, Dr. Dhinakaran has an adjunct appointment in the Discipline of Biosciences and Biomedical Engineering, IIT Indore. He received his PhD in the area of Computational Fluid Dynamics and Heat Transfer from IIT Kharagpur in 2008 and then gained additional post-doctoral experience between 2006 and 2012 at the Université de Pau et des Pays de L'Adour, France; Universidade do Minho, Portugal; Faculdade de Engenharia da Universidade do Porto, Portugal and Universitéde Valenciennesetdu Hainaut-Cambrésis,France.

Dr. Dhinakaran's research interests are in Computational Fluid Dynamics and Heat Transfer, Heat Transfer in Porous Media, Biofluid mechanics and Bioheat transfer.

### Selected Publications

1. K. Anirudh, and S. Dhinakaran (2020). Numerical study on performance improvement of a flat plate solar collector filled with porous foam. Renewable Energy - In Press.
2. K. Anirudh, and S. Dhinakaran (2020).Performance improvement of a flat-plate solar collector by inserting intermittent porous blocks. Renewable Energy, 145, 428-441.
3. K. Anirudh, and S. Dhinakaran (2018). On the vortex shedding and unsteady flow past a two-dimensional porous square cylinder. Journal of Wind Engineering and Industrial Aerodynamics , 179, 200-214.

### Research Highlights

We have developed comprehensive models for thermal conductivity and effective viscosity of nanofluids. Moreover, we have also demonstrated the various modelling techniques for nanofluid flow like Multiphase Modeling (MPM) and Discrete Particle Modeling (DPM) in studying the enhancement in heat transfer due to insertion of different kinds of nanofluids. Magnetohydrodynamics and its coupling with a nanofluid flow have also been explored in a porous region for discerning on the rich flow physics involved in buoyant flows. Numerical studies of transport phenomena in porous media is another topic which stays relevant since the inception of CFD. We have used the underlying theory of porous media modelling in studying both fundamental and real-time problems. Flow and heat transfer from basic bluff body shapes, made of porous material, has been studied extensively, under different physical conditions. For instance, the onset of vortex shedding was studied from a porous square cylinder, along with the influence of Prandtl number and mixed convection (aiding buoyancy) when it is heated. Hydrodynamics of porous triangular- and diamond-shaped cylinders have also been traversed. When it comes to real-time problems, we have prescribed on the usage of porous media in performance enhancement of the basic design of a direct absorption type flat plate solar collector. Several methods of numerical modelling and methods of inserting the porous material have been disclosed through our research.

**Dr. Anand Parey**
Professor
anandp@iiti.ac.in

PhD.: Indian Institute of Technology Delhi

**Prof. Anand Parey** works on Condition monitoring, noise and vibration isolation and signal processing of mechanical systems. At present his group is working on gear fault diagnosis.

### Selected Publications

1. Parey, A., Singh, A., Gearbox fault diagnosis using acoustic signals, continuous wavelet transform and adaptive neuro-fuzzy inference system, Applied Acoustics, vol. 147, pp. 133-140, 2019.

2. Raghuwanshi, N.K., Parey, A., A New Technique of Gear Mesh Stiffness Measurement Using Experimental Modal Analysis, Journal of Vibration and Acoustics, Transactions of the ASME, vol. 141(2),021018, 2019.
3. Sharma, V., Parey, A., Performance evaluation of decomposition methods to diagnose leakage in a reciprocating compressor under limited speed variation, Mechanical Systems and Signal Processing, vol. 125, pp. 275-287, 2019.

### Events/Seminars Organized

1. Artificial Intelligence and Advanced Signal Processing Techniques for Engineering Applications; 05-07 October 2018.
2. Research and Development in Condition Monitoring of Rotating Machines; 10-12 December 2018.
3. Vibration Monitoring Techniques for Machinery Fault Diagnosis; 18-19 March 2019.

### Research Highlights

Developed algorithm for fault detection of wind turbine gearbox.

### Research Projects

1. Internal noise measurement, analysis, source identification and design counter measures for trucks and buses (Funded by DST UAY).
2. Design, Modeling and diagnostic of wind turbines for sustainable energy efficiency (Funded by DST, India-Tunisia Joint Research).

## Dr. Bhupesh Kumar Lad

Associate Professor
bklad@iiti.ac.in


PhD.: Indian Institute of Technology Delhi

Before joining IIT Indore, where he currently serves as an Associate Professor, **Dr. B. K. Lad** worked with GE Global Research Center, Bangalore, India as a Research Engineer from 2010 to 2011. He is also the author of the book, Machine Tool Reliability (Scrivener- Wiley Publishing, USA), 2016. His major research interests include: smart manufacturing, reliability engineering, and prognostics.

### Research Highlights

Conventional Enterprise Resource Planning (ERP) and Manufacturing Execution Planning (MES) tools are typically centralized in their operations and thus have limited capabilities for dynamic adaptation of the production plan required for any intelligent or smart manufacturing. First time in the literature, a novel agent-based operations planning approach considering production, maintenance, quality, and inventory is developed for next generation manufacturing systems. The approach provides quick response to dynamics conditions. The results of comprehensive investigation reveal colossal reduction in computation time (47 to 86 percent) over centralized approach for approximate same solution for various manufacturing scenarios. Also, the approach delivers 0.05 to 38.5 percent economic improvements over centralized approach under dynamics conditions. Moreover, the approach offers flexibility to choose degree of integration based on the performance and computational time of the overall approach. The results of extensive performance investigation show that the proposed approach has capability to realize the ultimate benefits of Industry 4.0. The results are a breakthrough in the field of smart manufacturing, especially from operations planning perspective.

### Selected Publications

1. Kumar, S., Purohit, B. S., Manjrekar, V., Singh, V., and Lad, B. K., Investigating the value of integrated operations planning: A case based approach from automotive industry, " International Journal of Production Research", Vol. 56, no. 22, pp. 6971-6992, 2018.

2. Rawat, M. and Lad, B. K., Novel approach for machine tool maintenance modelling and optimization using fleet system architecture, "Computers & Industrial Engineering" vol. 126, pp. 47-62, 2018.
3. Tameshwar Nath, Akash K, Priya Chouhan, B. K. Lad, IA Palani, Investigation on thermo-mechanical behavior of SMA spring under the influence of different actuation medium, "Microsystem Technologies", pp.1-9, 2018.

### Patents

1. Method And System For Providing Smart Communications For Distributed Operations Planning In An Industrial Network, B. K. Lad, M. S. Kulkarni, V. S. Pandhare, N. Agrawal, K. Upasani, M. Bakshi, Indian Patent Office, Application No. 201621007003.
2. Thermo-Mechanical Test Bench for Reliability Estimation of Shape Memory Alloy (SMA) Springs. I A. Palani, B. K. Lad, Tameshwar Nath, Pradeep Kundu, Application No.: 201621007005.
3. A Metal Inert Gas (MIG) based additive manufacturing technique for fabricating shape memory allow ring, Priya Chouhan, Shiva Sekar, I.A. Palani, and B. K. Lad, Indian Patent Office, No.: 201721007136 (Filled on February 28, 2017).

### Events/Seminar Organized

Hosted grand finale of MHRD, Smart India Hackathon, 2019.

### Research Projects

1. Investigation and modelling of the relationships among cutting tool wear, product quality and operating conditions based on online condition monitoring (Funded by DST-SERB).
2. Building capacity in collaborative research for advanced manufacturing (Funded by Royal Academy of Engineering, London).

**Dr. Ritunesh Kumar**

Associate Professor
ritunesh@iiti.ac.in

PhD.: Indian Institute of Technology Delhi

**Dr. Ritunesh Kumar's** group is currently working on absorption cooling systems, heat transfer at microscale, biofuels, and energy. In heat transfer in the microscale area, the group explores bubble dynamics, heat transfer augmentation methods and maldistribution problems. In absorption cooling systems, high performance falling film towers for desiccant cooling applications has been developed. In the sphere of biofuels and energy, microalgal biofuels are currently being explored.

### Selected Publications

1. Effect of microchannel heat sink configuration on the thermal performance and pumping power, MP Vasilev, RS Abiev, R Kumar, International Journal of Heat and Mass Transfer, 2019 141, 845-854.
2. Numerical Study on Mitigation of Flow Maldistribution in Parallel Microchannel Heat Sink: Channels Variable Width Versus Variable Height Approach. R Kumar, G Singh, D Mikielewicz. Journal of Electronic Packaging, 2019 141 (2), 021009.
3. Performance intensification of regeneration process for non-corrosive plastic plate vertical falling film tower, R. Kumar, D. Patil, F. Xiao, T. Lu, Applied Thermal Engineering, 2019, 162, 114301.

### Research Projects

1. Design and development of a new innovative parallel microchannel heat sink with mitigated flow maldistribution (Funded by DST).
2. Heat transfer intensification in novel design micro-pin-fin heat sink for microprocessor cooling with improved temperature uniformity (Funded by DST).

**Dr. Shailesh I. Kundalwal**

Assistant Professor
kundalwal@iiti.ac.in

PhD.: Indian Institute of Technology Kharagpur

Before joining IIT Indore in 2017, **Dr. Shailesh Kundalwal** was Banting Fellow at the University of Toronto. He was awarded his PhD. degree in Solid Mechanics from IIT Kharagpur. He proposed a novel multi functional Fuzzy Fiber Reinforced Composite in his doctoral studies which led to a critical break through in the field of hybrid nanocomposites. During three-separate international postdoctoral stints, he worked in the field of multiscale modeling of composites and nanotechnology in engineering. He also founded the Applied and Theoretical Mechanics (ATOM) Laboratory at IIT Indore.

The ATOM Lab undertakes research primarily in the following areas: Mechanics of Carbon- and Boron-Based Nanostructures, Nanomechanics and Micromechanics of Composites, Nanotechnology in Engineering, and Finite Element Analysis of Composites. The lab's mission is to lead the advancement and application of multifunctional nano- and micro-structures addressing the challenges associated with their multifaceted aspects via numerous nanomechanical and micromechanical techniques.

### Selected Publications

1. Shingare KB, Kundalwal SI. Static and dynamic response of graphene nanocomposite plates with flexoelectricity effect, Mechanics of Materials 134, 69-84, 2019.
2. Kundalwal SI, Shingare KB, Ankit Rathi. Effect of flexo electricity on the electromechanical response of graphene nanocomposite beam, International Journal of Mechanics and Materials in Design 2018, in press, doi:0.1007/s10999-018-9417-6.
3. Vijay Choyal, Choyal VK, Kundalwal SI. Effect of atom vacancies on elastic and electronic properties of transversely isotropic boron nitride nanotubes: A comprehensive computational study, Computational Materials Science 156, 332-345,2018.

### Research Projects

1. Characterizing the flexoelectric phenomena in monolayer/layered hexagonal boron nitride nanosheets and development of their nano electro mechanical systems (Funded by DST-SERB).
2. Modeling of multifunctional carbon-based composite flexoelectric and piezoelectric energy harvesters: beam, cylinder, plate and shell (Funded by CSIR).

**Dr. Indrasen Singh**

Assistant Professor
indrasen@iiti.ac.in

PhD.: Indian Institute of Science Bangalore

**Dr. Indrasen Singh** received his PhD. in Mechanical Engineering at IISc, Bangalore in Aug 2010. His PhD. research focused on understanding fracture and de formation response of metallic glasses and nanoglasses. In Oct 2016, he joined as post-doctoral researcher at NUS, Singapore. Since April 2017, he has been working as an Assistant Professor at IIT Indore. The broad areas of his research are Mechanical behaviour of materials, Computational solid Mechanics, Fracture mechanics, finite element methods, Amorphous metals, Crystal Plasticity, and Piezoelectric materials. More specifically, his research focuses on Deformation and fracture behavior of nanoglasses and nanoglass-metallic glass nano-composites, understanding the mechanics of deformation in piezo-electric materials through experiments and complementary finite element simulations, understanding the effect of Surface Mechanical Attrition Treatment (SMAT) process in FCC metals, deformation and fracture response of BCC single crystals, mechanical response of metallic glass composites, deformation behaviour of metallic glass honey-comb structures, understanding the indentation mechanics in Nanoglasses, and Finite element modelling of additive manufacturing process .

### Selected Publications


1. SS Hirmukhe, KE Prasad, I Singh (2019) Finite element analysis of tensile deformation of nanoglass-metallic glass laminate composites. Computational Material Science 161, 83-92.
2. Tulika Dixit, I. Singh, K. Eswar Prasad (2019). Room and high temperature wear behavior of Boron modified as-cast Ti-6Al-4V alloys against hardened steel. Wear. 420-421, 207-214.
3. T. Dutta, A. Chauniyal, I. Singh, R. Narasimhan, P. Thamburaja and U. Ramamurty (2018). Plastic deformation and failure mechanisms in nano-scale notched metallic glass specimens under tensile loading. J. Mech. Phys. Solids. 111, 393–413.

**Dr. Yuvraj K Madhukar**

Assistant Professor
yuvrajmadhukar@iiti.ac.in


PhD.: Indian Institute of Technology, Kharagpur

**Dr. Yuvraj Kumar Madhukar** is an Assistant Professor. Since January 2018, he has also been 'in-charge' of Central Workshop. His area of research is the additive manufacturing of metals and laser material processing, and additive manufacturing. His current research focuses on design, development and control of wire and arc additive manufacturing process, and the development of supersonic nozzle for manufacturing applications.

**Dr. Subbareddy Daggumati**

Assistant Professor
daggumati@iiti.ac.in


Ph.D.: Ghent University, Belgium

After recieving his PhD. and before joining IIT Indore, **Dr. Subbareddy** worked in GE global research as well as SIEMENSR & D solving various research problems related to fiber reinforced composites, applied to aviation gas turbine and wind turbines. The mission of the composite materials lab at IIT Indore is: I) to produce high-quality fundamental research work in the field of multiscale modeling of composite materials/structures; and ii) to establish state-of-the-art advanced fiber reinforced composite manufacturing and experimental testing center. His research areas are Mechanics of Fiber Reinforced Composites, Design of Composite Structures, Experimental Characterization of Composite Materials (Static, Fatigue, Low velocity Impact), Computational Solid Mechanics, and Finite Element Methods.

### Selected Publications


1. Daggumati, S., De Baere,I., Van Paepegem, W. and Degrieck, J., Xu, J., Lomov, S.V.,Verpoest, I. Fatigue and post-fatigue stress–strain analysis of a 5-harness satinweave carbon fibre reinforced composite. Composites Science and Technology,2013. 74(0): p. 20-27.
2. Daggumati, S., Van Paepegem, W. and Degrieck, J., Xu, J., Lomov, S.V., Verpoest, I.Local strain in a 5-harness satin weave composite under static tension: Part I –Experimental analysis. Composites Science and Technology, 2011. 71(8): p. 1171-1179.
3. Daggumati, S., Van Paepegem, W. and Degrieck, J., Xu, J., Lomov, S.V., Verpoest, I.Local strain in a 5-harness satin weave composite under static tension: Part II –Meso-FE analysis. Composites Science and Technology, 2011. 71(9): p. 1217-1224.

### Research Highlights

1. Micromechanics of polymer and ceramic matrix composites: for various advanced structural applications, both polymer and ceramic matrix composites are used. Our group research work is aimed to understand the damage initiation mechanism, thereby improving the robustness of the design process.
2. Damage analysis of composite laminate/structure under variable amplitude fatigue loads: glass fibre reinforced composite are heavily utilized in the construction of wind turbine rotor blades, which are designed to undergo 100 million variable amplitude fatigue load cycles. Our group is working towards developing a numerical methodology to estimate the fatigue life under variable amplitude loads.

### Patents

1. Fang, Biao, Steven Haines Olson, Wendy Wen-Ling Lin, Sriram Krishnamurthy, Balaji Haridasu, Prakash Kashiram Jadhav, Subbareddy Daggumati. "Wind turbine rotorblade with fabric skin and associated method for assembly." U.S. Patent Application13/664,603, granted on October 31, 2012.
2. Krishnamurthy, Sriram, Wendy Wen-Ling Lin, Suresh Subramanian, Subbareddy Daggumati, Udit Kulmi, Prakash Kashiram Jadhav, and Vasan Churchill Srinivasan Chandrasekaran. "Wind turbine blades with tension fabricskin structure." U.S. Patent Application 13/665,148, granted on October 31, 2012.

**Dr. Pavan Kumar Kankar**

Assistant Professor
pkankar@iiti.ac.in

PhD.: Indian Institute of Technology, Roorkee

Before joining IIT Indore. **Dr. Pavan Kumar Kankar** served as an Assistant Professor at PDPM Indian Institute of Information Technology, Design and Manufacturing. The broad areas of his research are Condition Monitoring of Mechanical Components, and Machine Design, Vibration, Soft computing, Nonlinear Dynamics.

### Events/Seminars Organized

Short Term Course on Vibration Monitoring Techniques for Machinery Fault Diagnosis (March 18-19, 2019, Coordinators: Dr. Pavan Kumar Kankar and Dr. Anand Parey).

### Research Highlights

During root canal shaping, pain could result from the high level of force or vibration generated. This could be related to file kinematics or geometry. In this study, a comparison is made between forces and vibrations generated by endodontic files having three different kinematics. In other study, localized surface defects are modelled in inner race and outer race, and nonlinear dynamic behaviour of the system has been observed and quantified using Higuchi's fractal dimensions.

## Adjunct Faculty

**Prof. Igor Sevostianov**

Adjunct Professor
igor@nmsu.edu

**Prof. Igor Sevostianov** completed his PhD. from St. Petersburg State University, Russia. He is a Dwight L. and Aubrey Chapman Distinguished Professor at New Mexico State University and an Adjunct Professor at IIT Indore. His research interests are Micromechanics, Biomechanics, Advanced manufacturing, Contact mechanics, Multi-physics phenomena in solids, Inverse problems, and Mechanics of viscoelastic solids.

### Selected Publications

1. Barthelemy, J.F., Giraud, A., Sanahuja, J., Sevostianov,I. Effective properties of ageing linear viscoelastic media with spheroidal inclusions. International Journal of Engineering Science, 144 (2019) 103104. DOI: 10.1016/j.ijengsci. 2019.103104.
2. Seyedkavoosi, S. and Sevostianov,I. Multiscale micromechanical modeling of the elastic properties of dentin. Journal of the Mechanical Behavior of Biomedical Materials, 100 (2019) 103397. DOI: 10.1016/j.jmbbm.2019.103397.
3. Smirnov, A., Vilchevskaya, E. and Sevostianov,I. Evaluation of the effective viscoelastic properties of a material containing multiple oblate inhomogeneities using fraction-exponential operators. International Journal of Engineering Science, 144 (2019) 103124. DOI: 10.1016/j.ijengsci.2019.103124.

### Research Projects

- Mechanisms of amplification and damage in three- and four-phase aluminum matrix composites (Funded by NIH, Germany).

# Discipline of Civil Engineering

**Research Thrust/Facility**

- Concrete Technology
- Earthquake Engineering
- Environment Engineering
- Geotechnical Engineering
- Hydrology & Water Resource Engineering
- Structural Engineering

**Application Areas**

- Disaster Management
- Smartcities, Urban planning
- Municipal Solid Waste Management
- Structural Health Monitoring
- Sustainable Construction
- Water-Energy-Foodnexus
- Himalayan Glaciology

## From the HoD's Desk

**Dr. Neelima Satyam**
Associate Professor
neelima.satyam@iiti.ac.in

The Discipline of Civil Engineering has been functioning since 2016 with a focus on basic and applied research to solve real world problems. The Discipline offers a four-year course leading to the Bachelor's Degree in Civil Engineering and PhD. in Civil Engineering. The CE faculty and students are actively involved in sponsored research projects funded by the Government of India as well as in industry/ consultancy projects throughout the country and abroad. The Discipline has an active and dynamic faculty with international exposure having expertise in diverse fields of civil engineering.

The CE faculty has been recognized at different platforms across the world as committee chairs/members, outstanding reviewers, editorial board members. Our Discipline looks forward to establishing itself, nationally and globally, as a premier academic centre with active industry interaction and national/ international collaborations.

**Dr. Munir Ahmad Nayak**

Assistant Professor
munir_nayak@iiti.ac.in

**Dr. Munir Ahmad Nayak** is an Assistant Professor of Civil Engineering at Indian Institute of Technology Indore. Prior to this appointment, he was a Postdoctoral Associate at Cornell University, USA. Dr. Nayak earned his PhD. degree in Civil and Environmental Engineering at the University of Iowa, USA. He has three master's degrees in the fields of Water Resources Engineering, Environmental Water Resources Systems, and Statistics. Dr. Nayak's research is focused on understanding interactions between large-scale climatic modes, hydrology, and water resources, particularly extreme precipitation, floods, and droughts. He is particularly interested in finding innovative ways for water resources management and optimization of water resources systems under uncertain future climates. The thrust areas for his research group are dynamic adaptive water management for a changing climate, and hydrologicex tremesina changing climate to under stand background physical atmospheric process and developing statistical modeling for extremes.

### Selected Publications

1. Munir A. Nayak Jonathan D. Herman and Scott Steinschneider,. 2018: Balancing flood risk and water supply in California: Policy search integrating short-term forecast ensembles with conjunctive use. Water Resources Research, 54 (7557–7576), doi: https://doi.org/10.1029/2018WR023177.
2. Munir A. Nayak and Gabriele Villarini, 2017: A long-term perspective of the hydroclimatological impacts of atmospheric rivers over the central United States. Water Resources Research,53 (1144–1166), doi:10.1002/2016WR019033Featured in Water Resources Research.
3. Munir A. Nayak and Mark A. Turnquist, 2016: Optimal Recovery from Disruptions in Water Distribution Networks. Computer-Aided Civil and Infrastructure Engineering, 31( 566–579). doi: 10.1111/mice.12200.

### Research Projects

Atmospheric Rivers and extreme precipitation over India (Funded by SERB DST).

**Dr. Neelima Satyam**

Associate Professor
neelima.satyam@iiti.ac.in

**Dr. Neelima Satyam** completed her Ph.D. in Civil Engineering from the Indian Institute of Technology, Delhi. Her broad areas of research are Geo-technical Earthquake Engineering, Dynamic Soil Structure Interaction Analysis, Foundation Engineering, Liquefaction Modelling, Landslide Hazard Assessment and Monitoring, and Rock Mechanics and Underground Structures

### Selected Publications

1. Putti Swathi Priyadarsini and Neelima Satyam (2019), Estimation of ground response analysis and local site effects for Vishakhapatnam, India, Natural Hazards, Springer.(https://doi.org/10.1007/s11069-019-03658-5).
2. Abhirup Dikshit, Neelima Satyam, Ikuo Towhata (2018), " Early warning system using tilt sensors in Chibo Kalimpong, Darjeeling Himalayas, India" Natural Hazards, 94(2), 727-741 Springer. (https://doi.org/ 10.1007/s11069-018-3417-6).
3. Ahirup Dikshit and Neelima Satyam (2019) Probabilistic rainfall thresholds in Chibo, India: estimation and validation using monitoring systems, Journal of Mountain Science, Springer (https://doi.org/ 10.1007/s11629-018-5189-6).

### Events/Seminar Organized

1. Course Coordinator for Two Day National Seminar on Advances in Geo-technical Engineering 29th - 30th March 2019.

### Research Projects

1. Geo-spatial numerical modelling of debris flow for quantitative landslide risk assessment considering the entrainment (Funded by ISRO).
2. Landslide hazard assessment and monitoring at Chibo Pashyar, Kalimpong, NRDMS (Funded by DST).

**Dr. Lalit Borana**

Assistant Professor
lalitborana@iiti.ac.in

**Dr. Lalit Borana** has received his PhD. in Geotechnical Engineering from the Hong Kong Polytechnic University (PolyU) in 2014. Dr. Borana has more than eleven years' experience which includes more than three years' of varied corporate, consulting experience and eight years' of dedicated academic research. His current research interests involve Unsaturated soil mechanics, Structural Health monitoring, Soil-Structure Interaction, Geo environmental Engineering, and Ground Improvement techniques. The key focus areas of his research are slope stability analysis based on real-time displacement measurements, development of a preliminary slope stability calculation method based on internal horizontal displacements, and investigations on accumulated permanent axial strain of a subgrade fill under cyclic high-speed railway loading.

### Selected Publications

1. Chen, W-B.,Feng, W.Q., Yin J.-H., Borana, L. and Chen, R.P. (2019). Characterization of permanent axial strain of granular materials subjected to cyclic loading based on shakedown theory. Construction and Building Material, Elsevier: 198:751–761.
2. Chengyu Hong , Yifan Zhang, Lalit Borana. (2019). Design, Fabrication and Testing of a 3D Printed FBG Pressure Sensor, IEEE Access, vol. 99, In press.
3. Pei, H-F., Zhang, S-Q., Bai, L., D, Hou, Yang , Q., and Borana, L. .(2019.) Early–age Shrinkage Strain Measurements of the Graphene Oxide Modified Magnesium Potassium Phosphate Cement. Measurement, Elsevier. https://doi.org/10.1016/j.measurement.2019.03.002.

### Events/Seminar Organized

1. A lecture of Prof. Jian Hua Yin
2. Bridge Designing competition
3. Industrial site visits

### Research Projects

Development of Infrastructure of New campus of IIM Udaipur (Funded by Oriental Str. Engg. Pvt Ltd, New Delhi)

**Dr. Manish Kumar Goyal**

Associate Professor
mkgoyal@iiti.ac.in

**Dr. Manish Kumar Goyal** is an Associate Professor in the Discipline of Civil Engineering at IIT Indore. Prior to this, he has worked at IIT Guwahati, McGill University, Montreal and Nanyang Technological University, Singapore. The broad thrust of his work is in water management, climate change, flood modelling, water audit, drought, water use efficiency and crop yield modeling. The key areas of his research focus are Resilience of River Basins and Hydrological Modeling, Hydro-climatology and Statistical Downscaling, Irrigation Management, Crop Modeling Applications, Multivariate Statistical Analysis, Machine Learning Models and Data Mining.

### Selected Publications

1. Probabilistic evaluation of vegetation drought likelihood and its implications to resilience across India. S Jha, J Das, A Sharma, B Hazra, MK Goyal. Global and Planetary Change, 176, 23-35.
2. Assessment of the impacts of climatic variability and anthropogenic stress on hydrologic resilience to warming shifts in Peninsular India. J Sinha, A Sharma, M Khan, MK Goyal Scientific reports 8 (1), 13833.
3. Influences of watershed characteristics on long-term annual and intra-annual water balances over India. J Sinha, S Jha, MK Goyal. Journal of Hydrology 577, 123970.

### Events/Seminar Organized

1. 6 Days Active Learning Course on Recent Advancements in Water Resources and Environmental Engineering. April 22-27, 2019, Sponsored by TEQIP, Discipline of Civil Engineering & Discipline of Biosciences and Biomedical Engineering.
2. Short Term Course on Sustainable Water Resources Management under Changing Climate. 28 May 2018 - 02 June 2018, Sponsored by TEQIP, Discipline of Civil Engineering.

### Research Projects

Identification hydropower sites and critical glacial lakes for sustainable water resources management in Himachal Pradesh (Funded by National Mission on Himalayan Studies)

Development of Infrastructure of New campus of IIM Udaipur (Funded by Oriental Str. Engg. Pvt Ltd, New Delhi)

**Dr. Mohd. Farooq Azam**

Assistant Professor
farooqazam@iiti.ac.in

**Dr. Mohd Farooq Azam** is an Assistant Professor in the Discipline of Civil Engineering at IIT Indore. He has ten years of research experience in the field of Himalayan glaciology and hydrology. Dr. Farooq has developed glacier mass balance, energy balance, and hydrological models, and has contributed to understanding the fundamental aspects of the Himalayan glaciers. He obtained his Doctorate in Earth, Universe & Environmental Sciences from Grenoble-Alps University, France. In order to strengthen his research, Dr. Farooq has also done advance level mountaineering courses with the Indian army. The broad area of his research is Himalayan Cryosphere and Climate Change.

### Selected Publications

1. Azam M F, Wagnon P, Ramanathan AL, Vincent C, Sharma P, Arnaud Y, Linda A, Pottakkal P G, Chevallier P, Singh V B and Berthier E (2012). From balance to imbalance: a shift in the dynamic behaviour of Chhota Shigri Glacier (Western Himalaya, India). Journal of Glaciology, Vol. 58(208), 315-324, doi: 10.3189/2012JoG11J123.
2. Azam M F, Wagnon, P., Berthier, E., Vincent, C., Fujita, K., & Kargel, J. (2018). Review of the status and mass changes of Himalayan-Karakoram glaciers. Journal of Glaciology, 64(243), 61-74. doi:10.1017/jog.2017.86.

3. T. Bolch, J. M. Shea, S. Liu, M. F. Azam, Y. Gao, S. Gruber et al. Status and change of the HKH Cryosphere. In Wester P, Mishra A, Mukherji A, Shrestha AB, editors, The Hindu Kush Himalaya Assessment – Mountains, Climate Change, Sustainability and People. Springer. 2018.

### Events/Seminar Organized

1. Organized an international course "Use of remote sensing and GIS techniques for geoscience applications" as Indian co-PI at Royal Thimphu College, Bhutan (June 3-4th, 2018,) under UNESCO project.
2. TEQIP III-Sponsored course "Himalayan Glaciers under Changing Climate" is to be held at IIT Indore during 13-16 November 2019.

### Research Projects

1. Glacio-hydrological studies in two contrasting watersheds in the Indian Himalaya (Funded by DST).
2. Mass and energy balance of Phuche and Khardung glaciers, Ladakh range (Funded by DST).
3. Integrated studies of Himalayan Cryosphere using space-based inputs (Funded by Space Application Center).
4. Dust or Soot? Tracing the Primary Drivers of Increased Glacial Melt of the Himalayan Glaciers (Funded by DST).
5. Himalayan glaciers and risks to local communities (Funded by UNESCO).

**Dr. Sandeep Chaudhary**

Professor & Head
schaudhary@iiti.ac.in

**Prof. Sandeep Chaudhary** received his PhD in civil engineering from Indian Institute of Technology Delhi in 2006. He was a postdoctoral fellow at Kunsan National University (South Korea), before joining Indian Institute of Technology Indore in 2017, where he has been a Professor since 2018. Additionally, he also serves as the Chair of "Technical Committee 1: Design" of the Asian Concrete Federation. He was recently selected as a core member of NDMA, Government of India for development of a detailed outline for Resource Material on Earthquake Engineering.

The broad areas of his research are Structural Engineering and Building Materials. His key research focus is in (i) Steel Concrete composite structures (ii) Microstructure and durability of concrete (iii) Advanced characterisation techniques for building materials (iv) Service load behaviour of structures and (v) Finite element analysis. The primary aim of his research is to develop efficient models to study composite structures, provide economical and sustainable solutions to promote greener building materials and to develop a deeper understanding of various alternative building materials.

### Selected Publications

1. Siddique, S., Chaudhary, S., Shrivastava, S., and Gupta, T. (2019). "Evaluating resistance of fine bone china ceramic aggregate concrete to sulphate attack." Journal of Cleaner Production, 210, 246-255.
2. Kumar, P., and Chaudhary, S., (2019). "Evaluating resistance of fine bone china ceramic aggregate concrete to sulphate attack." Engineering Structures, 179, 476-492.
3. Siddique, S., Shrivastava, S., and Chaudhary, S. (2019). "Durability properties of bone china ceramic fine aggregate concrete" Construction and Building Materials, 173, 323-331.

### Research Highlights

1. Microstructural Characterization and other tests were done on Ashes from different industrial sources, for identifying their potential as SCMs and promote use of other industrial waste ash in construction.
2. Fly Ash Bricks were developed by modifying mixing techniques and water composition on an industry like compressed brick manufacturing unit. This will optimize mixing technique for improved properties of fly ash bricks in industry.

### Events/Seminar Organized

Training Program for Senior Faculty on Active Learning from June 11-July 06, 2018. Program attended by 172 senior faculty members from different Institutes.

### Research Projects

1. Natural-coloured functionally graded rubberised geo-polymer system: A cement-less solution for optimised concrete paver manufacturing (Funded by DST).
2. Sustainable and economical functionally graded rubberized concrete pavements (Funded by DST).
3. Safe-guarding heritage structures using seismic metamaterials (Funded by DST).

**Dr. Abhishek Rajput**

Assistant Professor
abhishekrajput
@iiti.ac.in

**Dr. Abhishek Rajput** received his PhD from Indian Institute of Technology Roorkee in 2017. He was a postdoctoral fellow at the Korean Ships and Offshore Research Institute, Busan (South Korea), before joining Indian Institute of Technology Indore, as an Assistant Professor. The broad areas of his research are Structural and Impact Mechanics Corrosion. He works on the influence of corrosion on the mechanical properties of structural steel, and the behaviour of carbon fiber reinforced polymer under projectile impact.

### Selected Publications

Effects of the surface preparation on the life of epoxy coating in steel ship plates: an experimental study. Ships and offshore structures, doi: https://doi.org/10.1080/17445302.2019.1565072.

### Research Projects

Third Party Quality Assurance for the project "Development of infrastructure of new campus of IIM Udaipur" (Funded by IIM Udaipur).

**Dr. Guru Prakash**

Assistant Professor
guruprakash@iiti.ac.in

**Dr. Guru Prakash** received his PhD from the University of Waterloo in 2017. He was also a postdoctoral fellow at the same university before joining Indian Institute of Technology Indore, as an Assistant Professor. The broad areas of his research are Structural Health Monitoring and Reliability Assessment. He works on a probabilistic approach to structural health monitoring of reinforced concrete beams, damage detection and localization in bridge components using static and dynamic responses, reliability assessment of bridges under fatigue loading, and a Bayesian approach to dam health monitoring using dam responses.

### Selected Publications

1. Prakash, G., Sadhu, A., Narasimhan, S., & Brehe, J.-M. (2018). Initial service life data towards structural health monitoring of a concrete arch dam. Structural Control and Health Monitoring, 25(1). http://doi.org/10.1002/ stc.2036.
2. Prakash, G., & Narasimhan, S. (2017). Bayesian two-phase Gamma process model for damage detection and prognosis. Journal of Engineering Mechanics, 144(2). http://doi.org/10.1061/ (ASCE)EM.1943-7889.0001386.
3. Prakash, G., Narasimhan, S., & Pandey, M. D. (2018), A probabilistic approach to remaining useful life prediction of rolling element bearings. Journal of Structural Health Monitoring http://doi:10.1177/1475921718758517

**Dr. Kaustav Bakshi**

Assistant Professor
kaustav.bakshi
@iiti.ac.in

**Dr. Kaustav Bakshi** received his PhD from Jadavpur University in 2017, before joining Indian Institute of Technology Indore, as an Assistant Professor. The broad areas of his research are Failure and instability studies for laminated composite shell roofs. He works on Static bending and dynamic response studies of laminated shell panels, First Ply failure prediction of laminated composite shell panels, comparison of geometrically linear and nonlinear approaches in failure prediction, Progressive damage detection and instability behaviour study for laminated composite shell panels, and Low energy impact induced failure prediction.

### Selected Publications

1. K. Bakshi and D. Chakravorty (2015). First ply failure loads of composite conoidal shell roofs with varying lamination. Mechanics of Advanced Materials and Structures, 22, pp. 978 - 987.
2. K. Bakshi and D. Chakravorty. (2014). Geometrically linear and nonlinear first ply failure loads of composite cylindrical shells. Journal of Engineering Mechanics, 140 (12), 04014094.
3. K. Bakshi and D. Chakravorty. (2014), First ply failure study of thin composite conoidal shells subjected to uniformly distributed load. Thin Walled Structures, 76, pp. 1 – 7.

**Dr. Saikat Sarkar**

Assistant Professor
saikat@iiti.ac.in

**Dr. Saikat Sarkar** received his PhD from Indian Institute of Science, Bangalore. He was also a postdoctoral fellow at Texas A&M University before joining Indian Institute of Technology Indore as an Assistant Professor. The broad areas of his research are Computational Mechanics, Metamaterials, Crack propagation, and Inverse problems. Structural Health Monitoring and Reliability Assessment. The highlights of his research are:

1. Metamaterials for large scale civil engineering applications, e.g. metamaterials-based earthquake resistant design; saving structures against shock.
2. Quantitative prediction of structural failure via deriving upscaled continuum theory for multiple crack propagation in structural element.
3. Designing light weight civil engineering structures via development and application of evolutionary optimization schemes considering displacement, stress and buckling constraints.
4. Dynamics of localized region in an inhomogeneous solid under high frequency forcing.

### Selected Publications

1. A derivative-free upscaled theory for analysis of defects, M Nowruzpour, S Sarkar, JN Reddy, D Roy, Journal of the Mechanics and Physics of Solids,2019, 122, 489-501.
2. A discrete Lagrangian based direct approach to macroscopic modelling, S Sarkar, M Nowruzpour, JN Reddy, AR Srinivasa, Journal of the Mechanics and Physics of Solids, 2017, 98, 172-180.
3. Exploring the source of non-locality in the Euler–Bernoulli and Timoshenko beam models, S Sarkar, JN Reddy, International Journal of Engineering Science, 2016, 104, 110-115.

### Events/Seminar Organized

1. Organized a workshop for modifying B.Tech. syllabus for Civil Engineering at IIT Indore, by inviting eminent faculty members from IISc and other IITs.
2. Invited Prof. Debasish Roy from the Department of Civil Engineering at IISc Bangalore for giving a talk at IIT Indore.
3. Invited Prof. Ram Mohan Vasu from the Department of Instrumentation and Applied Physics at IISc Bangalore for giving a talk at IIT Indore.

### Research Projects

1. A peridynamics-like framework to predict failure of concrete structures (Funded by DST SERB, ECR).
2. Safeguarding heritage structures using seismic metamaterials (SPARC).

## Adjunct Faculty

**Prof. Tarun Kant**

Adjunct Professor
tkant@civil.iitb.ac.in

**Prof. Tarun Kant** completed his PhD from IIT Bombay in 1977. His research interests lie in the areas of solid mechanics, plates, shells, fibre reinforced polymer composites, refined higher-order theories, thermal stresses, transient dynamics, finite element and other numerical methods, use of polymer composites in construction, mechanics of composite materials and structures & computational mechanics. He has published numerous research papers in refereed journals, chapters in edited books, and papers in conference proceedings, and edited books.

### Selected Publications

1. A critical review of stress and vibration analyses of functionally graded shell structures, D Punera, T Kant, Composite Structures.
2. Comparison of three dimensional elasticity solutions for functionally graded plates, YT LomtePatil, T Kant, YM Desai, Composite Structures 202, 424-435.
3. Thermoelastic analysis of laminated and functionally graded sandwich cylindrical shells with two refined higher order models, D Punera, T Kant, YM Desai, Journal of Thermal Stresses 41 (1), 54-79.

### Research Highlights

1. Development of both continuum and discrete (finite element) higher order deformation models for improved response characteristics of the laminates in the form of beams, plates and shells.
2. Finite element computational models for the thermo-mechanical behaviour of fibre reinforced composite laminates used in the form of beams, plates and shells for the three types of analyses, i.e., equilibrium, eigenvalue and transient, encountered in practice.

**Dr. Biswajeet Pradhan**

Adjunct Professor
biswajeet.pradhan
@uts.edu.au

**Professor Biswajeet Pradhan** completed his PhD from University Putra Malaysia, Serdang, Malaysia. His research interests are Remote Sensing & Image Processing, • GIS and Complex Modelling, and Soft Computing Techniques in Natural Hazards, Environmental & Natural Resources Applications.

### Selected Publications

1. Novel GIS-Based Model for Automatic Identification of Road Geometry in Vector Data, B Pradhan, MI Sameen, Laser Scanning Systems in Highway and Safety Assessment, 87-94.
2. Laser Scanning Technologies in Road Geometry Modeling, B Pradhan, MI Sameen, Laser Scanning Systems in Highway and Safety Assessment, 3-13.
3. Road Geometric Modeling Using Laser Scanning Data: A Critical Review, B Pradhan, MI Sameen, Laser Scanning Systems in Highway and Safety Assessment, 15-31.

### Research Highlights

1. Development of an optimized spatial model for orthorectification of high-resolution satellite images for urban applications.
2. Catchment study for rainfall-induced debris flow using high-resolution satellite images and statistical based spatial models.
3. The implementation of model builder development for natural hazard and risk ranking.

### Research Projects

Automating Transfer Learning in Credit Risk (Funded by Rich Data Corporation Pvt Ltd., Australia).

**Prof. Ing. Balthasar Novak**

Adjunct Professor
balthasar.novak
@ilek.uni-stuttgart.de

**Prof. Ing Balthasar Novak** completed his PhD from Technical University Darmstadt in 1995. His research interests are Design of bridges, Development of bridge management systems, Reinforcing structural elements using carbon fiber, Earthquake earthquake design of concrete structures, Safety and security of bridges and tunnels under natural and manmade disasters, and Effect of predicted climate change on pre-stressed concrete structures.

# Discipline of Chemistry

| Research Thrust/Facility | Application Areas |
|---|---|
| • Single Crystal X-ray Diffraction (XRD)<br>• Powder XRD<br>• Atomic Force Microscope (AFM)<br>• Gas Chromatography- Massspectrometry (GC- MS)<br>• Nuclear Magnetic Resonance (NMR, 400MHz) | • Catalysts for Alternate Energy<br>• Drug Delivery & Design<br>• Medicinal Chemistry<br>• Environmental Sensors<br>• Water Purification |

The discipline of Chemistry began in 2009 with a vision of establishing a Centre of Excellence and state-of-the-art facilities in chemical sciences research, education and scientific leadership in technology transfer to industry. Today, the discipline is home to 14 faculty members, 18 postdoctoral fellows and 61 PhD. students.

**Research areas and funding:** Faculty and students focus on various frontier areas of the discipline. These include: nanotechnology, organic light harvesting materials, organometallic pharmaceuticals and catalysts, asymmetric synthesis, biosensor metal clusters, molecular fluorescence spectroscopy, computational aspects of materials and molecular inhibitors for disease targets.

Research in these areas has been recognised by the scientific community in international research publications and lectures in national and international conferences.

Our research is supported by generous funding from private, and public agencies, particularly DST and CSIR. The total amount of funding is nearly INR 7.86 crores.

**Teaching:** The Chemistry discipline at IIT Indore was one of the first amongst other new IITs in India to introduce a two-year masters program in Chemistry. Since 2013, this unique programme devotes a full year to real research problems in the laboratory than a traditional two year theoretical programme with hardly any time allotted for research exercise.

**Facilities:** Single Crystal XRD, Nuclear Magnetic Resonance (NMR), Atomic Force Microscope (AFM), Scanning Electron Microscope (FE-SEM), Fluorescence Microscope, Cyclic Voltammeter, Elemental Analyzer, Polarimeter, Rheometer, Langmuir-Blodgett Film Deposition System, UV-Vis, c, TSCPC, FT-IR, HPLC, Dynamic light scattering. Toxic and hazardous substances generated in the Chemistry laboratories during day-to-day research activities are being disposed of in an environmental friendly manner by following world-class research practices.

The discipline is also engaged in interdisciplinary collaborations with institutes of national (Banaras Hindu University, RRCAT, IACS, IIT Kharagpur, SNU) and international (Uppsala University, Sweden, Kalshrue Institute of Technology, University of Mainz, Germany, National Institute of Advanced Industrial Science and Technology, Osaka University, Japan, Purdue University, University of Nebraska,

York University, Virginia University, USA, IST, Lisbon, Portugal, Nanyang Technological University, Singapore) repute to expedite scientific discoveries in various disciplines of research ranging from the sciences to engineering.

*Faculty members in Chemistry*

## Faculty Profiles in **Chemistry**

**Dr. Amrendra K. Singh**

Assistant Professor
HoD
aks@iiti.ac.in

**Dr. Amrendra K. Singh** (PhD. IIT Bombay, India; Recipient of the Shyama Prasad Mukherjee (SPM) Fellowship – 2003, CSIR, India; Carl Trygger Foundation's Postdoctoral Fellow – Lund University, Sweden; Research Associate, Michigan State University, USA) focuses on the development of renewable energy and energy efficient processes.

**Broad research area:** Inorganic, Organometallic Chemistry and Catalysis

**Research Highlights:**

- Bifunctional ligands with disparate metal binding sites for the preparation of homo- and hetero-bimetallic complexes.
- Cooperative metal-metal interactions for the multi-electron reduction of small molecules.
- Transition metal complexes with a focus on metal-ligand multiple bonds (MLMB).
- Multidentate N-heterocyclic carbene (NHC) ligands.

**Selected Publications:**

1. Aldrich, K. E.; Fales, B. S.; Singh, A. K.; Staples, R. J.; Levine, B. G.; McCracken, J.; Smith, M. R.; Odom, A. L. Electronic and Structural Comparisons between Iron(II/III) and Ruthenium(II/III) Imide Analogs. Inorg. Chem. 2019, 58(17), 11699-11715.
2. Singh, S.; Raghuvanshi, A.; Mathur, P.; Singh, A. K. Coordination Behaviour of 2-(Methylthio)Pyrazine with Ag(I) in the Presence of Different Counter Anions and Emission Properties. Polyhedron 2019, 169, 8-13.
3. Tauqeer, M.; Ji, R. S.; Singh, A. K.; Mobin, S. M.; Lahiri, G. K.; Mathur, P. Synthetic and Structural Study on Orthometallated Ferrocene Complexes: Non-Planar Metallabenzene and Five-Membered Metallacycle Complexes with Closed Os3 Triangles. Eur. J. Inorg. Chem. 2018, 2018 (26), 3126–3130.

### Research Projects

1. Designing Bimetallic Complexes with Cooperative Metal-Metal Interactions for the Multi- electron Reduction of Small Molecules
   (Funding by: SEBI)
2. FIST program of DST- CHEMISTRY
   (Funding by: SERB)

**Dr. Pradeep Mathur**
Professor
Director, IIT Indore
director@iiti.ac.in

**Prof. Pradeep Mathur** (PhD.: Keele University, UK; Research Associate: Yale University, USA; J.C. Bose Fellow; Recipient of the Shanti Swarup Bhatnagar Prize in Chemical Sciences; Professor: IIT Bombay; Visiting Professor: University of Cambridge, University of Freiburg; DAAD Distinguished Guest Professor: University of Karlsruhe; Fellow of the Indian Academy of Sciences, Bangalore; Editorial Board Member - Organometallics, Journal of Organometallic Chemistry and Journal of Cluster Science; and Chair of Inorganic Ring Systems, 2009).

**Broad research area:** Inorganic, organometallic & cluster chemistry.

**Research Highlights:**

- Metal mediated transformations of acetylenes
- Metal-acetylide and metal-oxo chemistry
- Alkynyl Fischer carbene complexes in metal cluster chemistry
- Synthesis of mixed-metal clusters
- Ferrocenyl-incorporated metal carbonyl complexes

### Selected Publications

1. S. N. Ansari, P. Kumar, A. K Gupta, P. Mathur, S. M. Mobin, Catalytic CO2 Fixation over a Robust Lactam-Functionalized Cu(II) Metal Organic Framework, Inorg. Chem. 2019, doi.org/10.1021/acs.inorgchem.9b00684.
2. S. Singh, A. Raghuvanshi, P. Mathur, A. K. Singh, Coordination behaviour of 2-(Methylthio)Pyrazine with Ag(I) in the presence of different counter anions and emission properties, Polyhedron, 2019, 169,8.
3. D. K. Rai, M. Tauqeer, S. Chatterjee, K. Sarathkumar, S. M. Mobin, P. Mathur, Modulation of Electronic Communication between Two Equivalent Ferrocenyl Groups Mediated Through Tricarbonyl Cyclobutadiene Iron, Eur. J. Inorg. Chem. 2019, 668.

**Dr. Rajneesh Misra**
Professor
rajneeshmisra@iiti.ac.in

**Prof. Rajneesh Misra** (PhD.: IIT Kanpur; Postdoctoral Fellow: GATECH, Atlanta, USA, University of Kyoto, Japan).

Superior electronic communication was achieved by introducing the ethynyl spacer at the meso-position of the BODIPY. Previous reports show that the substituents on the meso-phenyl ring of the BODIPY hampers the conjugation with BODIPY core due to the orthogonal orientation of the meso-phenyl ring. This problem was eradicated by introducing the 'ethynyl' spacer at the meso-position.

The meso-ethynyl spacer facilitates the superior electronic communication, and induces stronger interaction between the substituent and the BODIPY core. The ethynyl ferrocene substituent at the meso-position shows 15 nm red shifted absorption as compared to the same substituent at -pyrrolic position, indicating higher degree of conjugation.

**Broad research area:** Development of new organic/inorganic materials for Photonic and electronic applications.

### Research Highlights

Our research interest focuses on design, and synthesis of conjugated organic molecules for organic electronics, and photonics such as solar cells, field-effect transistors, light-emitting diodes, and multi-photon absorption.

### Selected Publications


1. Tetracyanobutadiene (TCBD) functionalized benzothiadiazole derivatives: effect of donor strength on the [2+2] cycloaddition–retroelectrocyclization reaction, New J. Chem., 2019,43, 12299-12307.
2. Reversible mechanochromism and aggregation induced enhanced emission in phenothiazine substituted tetraphenylethylene. New J. Chem., DOI:10.1039/ C9NJ03290H.
3. Near-infrared absorbing tetracyanobutadiene-bridged diketopyrrolopyrroles. New J. Chem., 2018,42, 3892-3899.


### Research Projects

1. Diketopyrrolopyrrole based Low Cost Accepor for Bulk Heterojuncion Organic Solar Cells
   (Funding by: Indian National Science Academy)
2. Tuning the Homo-Lumo gap of donor-acceptor Benzothiadiazoles
   (Funding by: CSIR)
3. Development of new small molecules and device architectures for highly efficient and reliable organic solar cells
   (Funding by: SERB)
4. Doner-Acceptor NIR absorbing tetracyanobutadiene and expanded tetracyanobutadiene derivatives of ferrocenyl functionalized BODIPYs
   (Funding by: SERB)

## Dr. Suman Mukhopadhyay

Professor
suman@iiti.ac.in


**Prof. Suman Mukhopadhyay** (PhD.: Indian Association for the Cultivation of Science; Postdoctoral Fellow: National University of Singapore; FCT Postdoctoral Fellow: Instituto Superior Técnico in Portugal; Marie-Curie International Incoming Fellow: EPFL in Lausanne (Switzerland)) works on the application of metal mediated cycloaddition to develop metal complexes with potential applications in the field of catalysis and bioactivity. He is also currently working on ruthenium based organometallic complexes with anti-metastatic property by inhibition of enzymes and proteins and application of smart organogelators in sensing.

**Broad research area:** Transition Metal Chemistry.

### Research Highlights:

- Metal based soft materials in sensing, catalysis and self-healing materials.
- Ruthenium(II) based anti-cancer compounds and their mode of action.

- Heterodonor ligands and their complexes in sensing of heavy metal ion and explosives.
- Bioinspired transition metal catalysis.
- Biomimetic model complexes.

**Selected Publications:**

1. Mechanistic and thermodynamical aspects of pyrene based fluorescent probe to detect picric acid, Bidyut Kumar Kundu, Pragti Porwal, Reena Kyarikwal, Shaikh M Mobin, Suman Mukhopadhyay, New J Chem, 2019, 43, 11483.
2. Comparative study on the tribological properties of laser post-treated and untreated AISI304 stainless steel matrix composite reinforced with hard ceramic particles (TiB2–TiN–SiC) and prepared by ex-situ P/M route, Debjit Mishra, Sumit Barange, Hilol Joardar, Jitendra Kumar, Alok Kumar Das, Suman Mukhopadhyay, Satyajit Chatterjee, Ceramics International, 2019, 45, 18852.
3. Cobalt metallogel interface to selectively sense L-Tryptophan among essential amino acids, Novina Malviya, Chanchal Sonkar, Rakesh Ganguly, Suman Mukhopadhyay, Inorg. Chem. 2019, 11, 7324.

**Research Projects**

- Exploring tetrazole based transition metal complexes in the field of catalysis, luminescent materials and bioactivity
  (Funding by: CSIR)

**Dr. Apurba K. Das**

Associate Professor
apurba.das@iiti.ac.in

**Dr. Apurba K. Das** (PhD.: Indian Association for the Cultivation of Science; Postdoctoral Research Associate: Manchester Interdisciplinary Biocentre and School of Materials, University of Manchester, Manchester, UK; Department of Pure and Applied Chemistry, University of Strathclyde, Glasgow, UK) is working on directed self-assembly of peptides and DNA- based molecules for potential applications in Biology and Nanosciences.

**Broad research area:** Organic Synthesis, Peptide and DNA based nanostructured materials, Supramolecular Chemistry.

**Research Highlights**

- Biomaterials
- Peptide and nucleobase-based nanostructured materials
- Systems Chemistry
- Supramolecular electronics
- Organic-Inorganic hybrid materials
- Electrochemical Catalytic Reactions

**Patents**

1. pi-Conjugated Compound for Resistive Switching, Device and Method of Fabrication Thereof.
   Inventors: A. K Das, S. Mukherjee, R. G. Jadhav, A. Kumar Patent application number 201921027542, July 10, 2019.
2. Hybrid Mesoporous Composites Gas Sensors Inventors: S. Mukherjee, A. K Das, A. Agarwal, Aaryashree, B. Mandal, A. Biswas Patent application number 201921026576, July 3, 2019.
3. Organo-acidified Zinc Oxide Carbon Monoxide Sensor Inventors: S. Mukherjee, A. K Das, A. Agarwal, B. Mandal, Aaryashree, S. Maiti Patent application number 201921026594, July 3, 2019.

### Selected Publications

1. Investigations of Anti-Inflammatory Activity of a Peptide-Based Hydrogel using Rat Air Pouch Model, P. K. Gavel, H. S. Parmar, V. Tripathi, N. Kumar, A. Biswas, A. K. Das, ACS Applied Materials & Interfaces, 2019, 11, 2849-2859.
2. Tuning the Handedness: Role of Chiral Component in Peptide-appended Bolaamphiphile-based Co-assembled Hydrogels, S. Biswas, A. K. Das, Langmuir, 2019, 35, 2383-2391.
3. Intertwined Gababutin-based Supramolecular Double Helix M. Konda, T. Ghosh, S. M. Mobin, A. K. Das, New Journal of Chemistry, 2019, 43, 4830-4834.

### Research Projects

1. Development of cation-switchable functionalized nucleobase based metallohy-drogels for drug delivery.
   (Funding by: CSIR)
2. UCL – IITI Partnership: Development of 3D Printable Biomimetic Hydrogels (Bio-inks).
   (Funding by: DST)
3. Complex Cu-containing Semiconductors and Layered Structures for Economically-Viable, Environmentally-benign, and High Performance Ultrathin Solar Cells.
   (Funding by: DST)

## Dr. Anjan Chakraborty

Associate Professor
anjan@iiti.ac.in

**Dr. Anjan Chakraborty** (PhD.: IIT Kharagpur; Postdoctoral Fellow: Pennsylvania State University, Florida State University USA, Kobe University, Japan) Physical interaction between liposomes and different functionalized and non-functionalized metal nanoparticles has tremendous application in drug delivery, imaging, bio-sensing and separation. Although there are numerous reports on the lipid bilayer-nanoparticles interaction, the existing literature lacks systematic spectroscopic investigation on the impact of nanoparticles on different liposomes. Keeping this in mind we have undertaken the project to study the interaction between liposomes and different functionalized nanoparticles by spectroscopic tools.

**Broad research area:** Study of different biological systems by fluorescence spectroscopy.

### Research Highlights

- Interaction of liposomes with metal ions and nanoparticles.
- Dynamics of interfacial region of lipid bilayers in presence of nanoparticles and metal ions using spectroscopic techniques.
- Study of nanoparticles-liposomes assemblies for biological application, drug delivery systems.
- Application of spectroscopic techniques for the investigation of liposomes-drug interactions.

### Selected Publications

1. S. K. De, N. Kanwa, and A. Chakraborty, Influence of Trivalent Metal Ions on Lipid Vesicles: Gelation and Fusion Phenomena, Langmuir 2019, 35, 6429.
2. N. Kanwa,A. Patnaik, S. K. De, M. Ahamed and A. Chakraborty, Effect of surface ligand and temperature on lipid vesicle-gold nanoparticle interaction: a spectroscopic investigation, Langmuir 2019, 45, 1008.
3. S. K. De, N. Kanwa, M. Ahamed and A. Chakraborty, Spectroscopic evidence for hydration and dehydration of lipid bilayers upon interaction with metal ions: a new physical insight, Phys. Chem. Chem. Phys. 2018,20, 14796.

**Dr. Sampak Samanta**
Associate Professor
sampak@iiti.ac.in

**Dr. Sampak Samanta** (PhD.: Indian Association for the Cultivation of Science, India; Postdoctoral Fellow: University of Missouri Rolla, USA, University of Texas at San Antonio, USA; JSPS Post-doctoral Fellow: Tokyo University of Science, Japan; Senior Research Scientist, New Drug Discovery Research Centre, Medicinal Chemistry, Ranbaxy Laboratories Limited and Daiichi Sankyo Research Centre in India, Medicinal Chemistry Gurgaon) is interested in organo-catalytic mediated asymmetric synthesis, total synthesis of highly biologically active compounds, metal mediated synthetic transformations and green chemistry.

The research in Samanta's group spans methodology and complex molecule synthesis.

**Broad research area:** Asymmetric synthesis, Metal mediated synthetic transformation Green chemistry, Total synthesis of biologically active compounds.

## Research Highlights:

- Asymmetric synthesis
- Heterocycles
- Metal mediated synthetic transformation
- Green chemistry
- Total synthesis of biologically active compounds
- Medicinal Chemistry
- Agrochemicals

## Selected Publications

- Metal-Free Based Domino Approach to Pyrano-Fused-Pyrido[3,2,1-jk]carbazolones: Antibacterial and Molecular Docking Studies, Monika Ahuja,D. Majee, P. Sharma, A. Kumar, Sampak Samanta Chemistry Select 2019,4, 9096-9101.
- Diastereoselective pot and atom-economical synthesis of densely-substituted polycyclic 1,2-and 1,2,3-fused indole scaffolds, Soumen Biswas, Anubha Yadav, Debashis Majee, Shaikh M. Mobin, Sampak Samanta, Tetrahedron Letters 2019, doi.org/10.1016/j.tetlet.2019.07.012.
- Rationally designed small molecules targeting toxic CAG repeat RNA that causes Huntington's disease (HD) and spinocerebellar ataxia (SCAs), E. Khan, S. Biswas, S.k. Misra, R. Misra, Sampak Samanta, A. Misra, A. Tiwari, A. Kumar, Biochimie, 2019, 163, 21-32.

## Research Projects

1. Metal free based domino technique for the access to functionalized pyridines/related heterocycles and their application in drug-discovery.
   (Funding by: CSIR)
2. Enantioselective Organocatalysis: A Valuable Strategy for the Synthesis of Important Class of Spirooxindoles/3,3-Disubstituted Oxindoles and Related Scaffolds
   (Funding by: SERB)

**Dr. Tushar K. Mukherjee**

Associate Professor
tusharm@iiti.ac.in

**Dr. Tushar K. Mukherjee** (PhD.: Indian Institute of Technology Bombay; Postdoctoral Fellow: Columbia University, New York, USA) works on fluorescence spectroscopy and imaging of nanocomposite systems. The goal of his research group at IIT Indore is to understand complex photophysical processes of various chemical and biological systems using luminescent nanoparticles as fluorescent probes. He is also working on protein-protein and protein-nanoparticle interaction using various spectroscopic techniques. Another area of his active research is to understand the role of surface plasmon of metal nanoparticles on the photophysical properties of nearby fluorescent dyes.

**Broad research area:** Single molecule spectroscopy, Fluorescence imaging.

**Research Highlights**

- Protein-Protein and Protein-NP interaction.
- Self-assembled Luminescent Materials.
- Nanocomposite based Energy Transfer Processes.
- Fluorescence Sensing.

**Selected Publications**

1. Vaishnav, J. K.; Mukherjee, T. K. "Highly Photostable and Two-Photon Active Quantum Dot-Polymer Multicolor Hybrid Coacervate Droplets" Langmuir 2019, 35, 11764-11773.
2. Maiti, S.; Jadhav, R. G.; Mobin, S. M.; Mukherjee, T. K.; Das, A. K. "Insights into the Aggregation Behaviour of Benzoselenadiazole-Based Compound and Generation of White Light Emission" ChemPhysChem 2019, 20, 2221-2229.
3. Vaishnav, J. K.; Mukherjee, T. K. "Surfactant-Induced Self-Assembly of CdTe Quantum Dots into Multicolor Luminescent Hybrid Vesicles" Langmuir 2019, 35, 6409-6420.

**Dr. Biswarup Pathak**

Associate Professor
biswarup@iiti.ac.in

**Dr. Biswarup Pathak** (PhD.: Hyderabad Central University, Hyderabad; Postdoctoral Fellow: Jackson State University, USA & Uppsala University Sweden). His primary area of interest is computational designing of nanomaterial based electrodes for fuel cell and battery related applications. Presently, he is actively collaborating with various international research groups in Australia, Germany and Sweden.

**Broad research area:** Computational Material Science.

**Research Highlights:**

- 130 international journal publications.
- 2400 citations.
- 10 Cover page articles published in Angew Chemie, Nanoscale, Journal of Materials Chemistry A, Applied Physics Letter.

**Publications**

1. Catalytic Upgrading of Ethanol to n-Butanol using Aliphatic Mn-PNP Complex: Theoretical Insights on Reaction Mechanisms and Product Selectivity, Kuber S. Rawat, Shyama C. Mandal, Preeti Bhauriyal, Priyanka Garg, Biswarup Pathak, Catalysis Science and Technology, 9, 2794-2805, 2019.
2. Computational Screening for ORR Activity of 3d Transition Metal Based M@Pt Core-Shell Clusters, Akhil S Nair, Biswarup Pathak, Journal of Physical Chemistry C, 123, 6, 3634-3644, 2019.

3. Broken symmetry driven topological semimetal to gapped phase transitions in SrAgAs, Chiranjit Mondal, C. K. Barman, A. Alam, Biswarup Pathak, Physical Review B, 99, 205112, 2019.

### Research Projects

Designing of core-shell nanocluster based electrodes for fuel cell applications
(Funding by: CSIR)

## Dr. Chelvam Venkatesh

Assistant Professor
cvenkat@iiti.ac.in


**Dr. Chelvam Venkatesh** (PhD.: IIT Kanpur; Alexander von Humboldt fellowship: Freie University Berlin, Germany; Postdoctoral Fellow: Purdue University, USA). His research interests are: synthesis of anti-cancer natural products, diagnostic and therapeutic applications of new targeting ligands for cancers, inflammatory and neurodegenerative diseases, synthesis of inhibitors for drug targets, drug delivery systems, near-infra red fluorescence and nuclear radioisotopes imaging and bio-conjugate chemistry. His long-term goal is to establish a Centre for Excellence in the field of Chemical Biology.

**Broad research area:** Synthesis of natural products, heterocycles, carbocycles and small molecule targeting ligands or inhibitors for therapeutic and diagnostic applications of pathological diseases.

### Research Highlights

- Total synthesis of biologically important natural products.
- Design and synthesis of heterocycles and carbocycles of biological importance.
- Developing new methodologies for construction of C-C and C-X (X =N,O,S,P) bonds.
- Design, synthesis and diagnostic applications of new targeting ligands for cancers and inflammatory diseases.
- Drug delivery systems, near-infra red fluorescence, nuclear Imaging and bio-conjugate chemistry.
- Synthesis of Inhibitors for drug targets.

### Patents

1. New small molecule inhibitors/ligands for early diagnosis and therapy of prostate specific membrane antigen (PSMA+) cancers and neurodegenerative diseases, Venkatesh, C., Sengupta, S., Krishnan, M. A., Pandit, A. Nov. 2018, Indian patent, Application no. 201821044594.
2. Method and system for metal-free solvent-free synthesis of fused-pyrido heterocycles and their biological activities against cancer and multi-drug resistant pathogens, Venkatesh, C., Dudhe, P., Krishnan, M. A., Sonawane, A., July 2019, Indian Patent, Application no. 201921029311.
3. Effect of spacers on the binding affinity of PSMA targeted diagnostic agents in detection of prostate cancer in 3D-spheroid or tissue models, Venkatesh, C., Krishnan, M. A., Pandit, A. Aug. 2019, Indian patent (Provisional filing).
4. CA IX Ligand targeted bio-conjugates with nanoparticles for diagnosis and treatment of cancers over-expressing CA IX receptors, Venkatesh, C., Kirschning, A., Drager, G., Sharma, C., Dudhe, P., Sept. 2019, European Patent (in process).

### Selected Publications

- Synthesis of tubuvaline (Tuv) fragment of tubulysin via asymmetric dihydroxylation of homoallylamine, Reddy, B. R., Venkatesh, C., Synlett (2019).
- Tyrosine-based asymmetric urea ligand for prostate carcinoma: Tuning biological efficacy through in silico studies, Sengupta, S., Krishnan, M. A., Pandit, Amit, Dudhe, P., Sharma, R., Venkatesh C., Bioorganic Chem., 91, 103154-103167, (2019).

- Structure activity relationships (SAR) study to design and synthesis new tubulin inhibitors with enhanced anti-tubulin activity: In silico Approach, Pandit, A., Reddy, R. B., Sengupta, S., Sharma, R., Venkatesh C., J. Mol. Struct (2019).

### Events/ Seminars organized

- Workshop at Leibnitz University of Hannover, Germany; Dec-2018.

### Research Projects

1. Synthesis of Anticancer Natural Product-Tubulysins and Synthetic Derivatives.
   (Funding by: DST-SERB)
2. Synthesis and Biological Evaluation of Ligand Targeted MRI Contrast Agent and Nanoparticles as Theranostic Tool for Hypoxic Solid Tumors.
   (Funding by: DAAD-IIT Masters Exchange Program International Project)
3. A novel prostate specific membrane antigen or glutamate carboxypeptidase II inhibitor as a therapeutic agent for amyotrophic lateral sclerosis and targeting moiety for PSMA+ cancers.
   (Funding by: DST-SERB-Purdue Overseas Research Grant)

**Dr. Sanjay K. Singh**

Associate Professor
sksingh@iiti.ac.in

**Dr. Sanjay K. Singh** (PhD.: A. P. S. University, India; JSPS Postdoctoral Fellow and AIST Postdoctoral Scientist at AIST, Osaka, Japan; Alexander von Humboldt (AvH) Postdoctoral Fellow at Karlsruhe Institute of Technology (KIT), Germany) focuses on the development of catalysts for organic transformations and energy.

### Broad research area:

- Inorganic Chemistry and Organometallics: Catalysis
- Catalysis for Energy and Environment.
- Catalyst synthesis and design (organometallic and coordination chemistry of transition metals and Nanoparticles) for various organic transformation (C-C and C-H bond activation), biomass transformation (biofuel), H2 generation and storage, and CO2 capture and utilization.

### Research Highlights

Dr. Singh's research group has undertaken the task to development of homo- and heterogeneous catalytic systems for various important organic transformations, including coupling reactions, hydrogenation /oxidation reactions, Biomass Transformations, Hydrogen Generation, Carbon Capture and Utilization. His group has developed several metal-arene complexes with readily available nitrogen ligands as catalysts for C-N coupling, C-C coupling and C-H bond activation reactions. These catalysts were also used for facile transformation of biomass derived furans to open-chain diketones and ketoacids for applications in bio-fuel and fine chemicals.

Moreover, several activated bimetallic nanoparticle-based catalysts were also developed, which showed excellent TOF and TON for C-C coupling reactions, HMF to FDCA, and so on.

His work has been appeared in several high impact research papers in Inorg. Chem., Green Chem., Catal. Sci. Technol., ChemCatChem, Chem. Asian J., Inorg. Chem. Front., Eur. J. Inorg. Chem., and so on. He has several research projects from DST-SERB, CSIR and MES. These students are now pursuing their respective Post-doc and PhD positions at renowned institutions in RWTH-Aachan, KAUST, KIT, Oslo University, Hokkaido University.

### Selected publications

- Dharmendra K. Panchariya, E. Anil Kumar, and Sanjay K. Singh, Inducing in-situ hydrothermal carbonization of glucose to synthesize carbon-MIL-101 hybrid composites for improved hydrogen uptake, Energy & Fuels, 2019, doi: 10.1021/acs.energyfuels.9b01809 (IF 3.021).

- Dharmendra K. Panchariya, E. Anil Kumar, and Sanjay K. Singh, Lithium-doped silica rich MIL-101(Cr) for enhanced hydrogen uptake, Chem. Asian J., 2019, doi: 10.1002/asia.201900833 (IF 4.083).
- Chinky Binnani, Shyama Charan Mandal, Biswarup Pathak, and Sanjay K. Singh, Biomass Derived Ligands Accelerated Ruthenium-Catalyzed C-H Bond Activation/ Arylation, Eur. J. Inorg. Chem., 2019, 2844-2852 (IF 2.507).

### Events/Seminars organized

- Organized National Science Day, Feb. 28, 2019
- Organized Chemistry In-house symposium (CHEM2019), Feb. 28, 2019
- Organized International Conference on Emerging Trends in Chemistry, Jul. 12-15, 2019

### Research Projects

1. Development of active molecular based on transition metal complexes for efficient C-H bond activation and functionalization.
   (Funding by: CSR)
2. Development of new catalytic systems for efficient transformation of biomass/biomass derivatives to biofuel components.
   (Funding by: SERB-DST)
3. Reversible Alkali Metal Based Hydrides for High Temperature Thermal Energy Storage.
   (Funding by: DST)

**Dr. Tridib K. Sarma**
Assistant Professor
tridib@iiti.ac.in

**Dr. Tridib K. Sarma** (PhD IIT Guwahati, India; JSPS Post-Doctoral Research Fellow: University of Tokyo, Japan; Alexander-von-Humboldt Post- Doctoral Fellow: University of Heidelberg, Germany). His research aims to exploit emerging and thrust areas of nanosciences, catalysis and coordination polymers. The intention is to develop functionalized materials with potential applications at the interface of Chemistry, Engineering and Biology. The route chosen is mainly through solution phase.

**Broad research area:** Nanostructured Materials, Polymer composites, Biomimetic materials chemistry, self and directed assembly of organic inorganic materials.

### Research Highlights

- Nanoparticles mediated catalysis.
- Inorganic nanoparticle enzyme composites.
- Coordination polymers and hydrogels.
- Functionalized materials based on carbon structures.
- Nanoparticles as in-vitro and in-vivo contrast agents.

### Selected Publications

1. Siddarth Jain, Abhiram Panigrahi, and Tridib K. Sarma; Counter Anion Directed Growth of Iron Oxide Nanorods in a Polyol Medium with Efficient Peroxidase Mimicking Activity for Degradation of Dyes in Contaminated Water. ACS Omega 2019, 4, 8, 13153-13164.
2. Neha Thakur, Bhagwati Sharma, Suman Bishnoi, Siddarth Jain, Debasis Nayak, Tridib K. Sarma. Biocompatible $Fe^{3+}$ and $Ca^{2+}$ Dual Cross-Linked G-Quadruplex Hydrogels as Effective Drug Delivery System for pH-Responsive Sustained Zero-Order Release of Doxorubicin. ACS Applied Bio Materials 2019, 2, 8, 3300-3311.
3. Daisy Sarma, Biju Majumdar and Tridib K. Sarma: Carboxyl-Functionalized Carbon Dots as Competent Visible Light Photocatalysts for Aerobic Oxygenation of Alkyl Benzenes: Role of Surface Functionality, ACS Sustainable Chem. Eng., 2018 (DOI: 10.1021/acssuschemeng.8b03811).

**Dr. Satya S. Bulusu**
Assistant Professor
sbulusu@iiti.ac.in

**Dr. Satya S. Bulusu** (PhD.: University of Nebraska, USA; Assistant Professor: Shobhit University, India; Postdoctoral Fellow: York University, University of New Brunswick, University of Nebraska) After discovering that gold is catalytically active at nanoscale, it is always important to understand such peculiar activity of gold at atomic level. This leads to knowing the nanoparticle's most stable configuration, dynamical and thermodynamic properties. Knowing the structure and properties of such nanoparticles will also allow biomedical engineers to identify appropriate binding sites for drugs used to treat cancer and other diseases. The findings could also optimize the use of gold nanoparticles in catalyzing the oxidation process that transforms dangerous carbon monoxide emissions into the less noxious carbon dioxide.

**Broad research area:** Computational Chemistry, Structural evolution of Nanoclusters and Nanoalloys, Global Optimization Methods, Algorithms for predicting Transition State, DFT Guided Monte Carlo Simulations.

### Research Highlights:

- Developing machine learning methods (Artificial neural networks) for chemical problems.
- Modelling of atomic environments.
- Developing sampling algorithms.
- Using hardware technologies to parallelize our programs that will help to extend the above methods to experimentally relevant sizes.

### Selected Publications

1. Shweta Jindal, Satya S Bulusu,"A transferable artificial neural network model for atomic forces in nanoparticles",J. Chem. Phys. 149 (19), 194101 (2018).
2. Shweta Jindal, Satya S Bulusu,"An algorithm to use higher order invariants for modelling potential energy surface of nanoclusters",Chem. Phys. Lett. 693, 152-158 (2018).
3. Siva Chiriki, Shweta Jindal, Priya Singh, Satya S Bulusu,"Spherical harmonics based descriptor for neural network potentials: Structure and dynamics of Au147 nanocluster", J. Chem. Phys. 149 (7), 074307 (2018).

### Research Projects

Reducing computational complexity using FPGA to study structure and dynamical properties of nanoparticles.

(Funding by: SERB)

**Dr. Shaikh M. Mobin**
Associate Professor
xray@iiti.ac.in

**Dr. Shaikh M. Mobin** (PhD.: University of Bombay, India; Research Scientist: IIT Bombay) is In-Charge of the Sophisticated Instrument Centre at IITI. He studies Single-Crystal to Single-Crystal (SCSC) Transformation and works on Synthesis and Structural Characterization of Some Novel Organo-metallic Clusters and Inorganic MOFs.

**Broad Research Area:** Design and synthesis of facile ligands, inorganic complexes, MOFs, Solid-state structural reactivity by employing SCSC transformations techniques and crystallography represent a significant and principal contribution to discovery and property study of new, unknown compounds – usually with applications to problems of practical interest.

### Research Highlights

Dr. Shaikh's group has evolved very rapidly within a short period of time and worked on several projects of urgent and deep importance to practical development of science and technology including flexible substrates for various applications and facile

synthesis of new metal organic frameworks (MOFs), solid-state structural reactivity as Single-Crystal-to-Single-Crystal (SCSC) transformation and their applications in energy generation and storage.

**Selected Publications:**

1. Mixed-ligand Architected 2D Co(II) MOF Expressing Novel Topology as an Efficient Photoanode for Water Oxidation Using Visible Light Natarajan, K., Gupta, A., Ansari, S. N., Saraf, M. and Shaikh M. Mobin. ACS Appl. Mater. Interfaces, 2019, 11, 13295-13303.
2. A facile two-photon fluorescent probe: Endoplasmic Reticulum tracker, monitoring ER stress and vesicular transport to lysosomes Kumari. P., Verma, S. K. and Shaikh M. Mobin. Chem. Commun., 2019,55,294-297.
3. Visible light driven water splitting through an innovative Cu-treated-d-MnO2 nanostructure: probing enhanced activity and mechanistic insights Natarajan, K., Saraf. M. and Shaikh M. Mobin., Nanoscale, 2018, 10, 13250-13260.

**Research Projects**

1. Development of Intracellular Fluorescent Metal Ion Sensors and Subcellular Targeting.
   (Funding by: SERB)
2. Development of biosensors and antibacterial imaging agents for rapid and effective detection of bacteria by employing certain metal complexes and nanomaterials.
   (Funding by: CSIR)

**Dr. Abhinav Raghuvanshi**
Associate Professor
r.abhinav@iiti.ac.in

**Dr. Abhinav Raghuvanshi** (PhD.: IIT Bombay; Postdoctoral Fellow: IIT Indore, University of Franch-Comte, France) is an Assistant Professor. He works on Luminescent complexes of late transition metals with emphasis on the development of Thermally activated delayed fluorescent (TADF) materials.

**Selected Publications**

Singh, S.; Raghuvanshi, A.; Mathur, P.; Singh, A.K. Polyhedron 2019, 169, 8-13. Coordination behaviour of 2-(Methylthio) Pyrazine with Ag(I) in the presence of different counter anions and emission properties.

**Dr. Dipak Kumar Roy**
Associate Professor
dipak.roy@iiti.ac.in

**Dr. Dipak Kumar Roy** (PhD.: IIT Madras; SERB; Postdoctoral Fellow at Julius-Maximilians-Universität Würzburg) is an Assistant Professor.

**Broad Research Area:** Main group and organometallic chemistry.

**Research Highlights:**

- Low-valent s- and p-block compounds and small molecule activation.
- Multiply bonded main group compounds.
- Organic-Inorganic hybrid polymers.

# Discipline of Mathematics

**Research Thrust/Facility**

- Algebra
- Differential Equations
- Analysis
- Machine Learning & Optimization
- Rough Set Theory & Modal Logics
- Information, Statistics & Probability

**Application Areas**

- Earthquake Statistics
- Machine Learning
- Mathematical Modeling
- Numerical Linear Algebra
- Theoretical Seismology
- X-ray & Radon Transfer

## From the HoD's Desk

**Dr. Md. Aquil Khan**
Associate Professor
aquilk@iiti.ac.in

### Discipline of Mathematics

The Discipline of Mathematics at IIT Indore has been a major center for both academic and research programs in various branches of Mathematics. The discipline has been constantly engaged in frontier areas of research and encourages collaborative research with other Science and Engineering Disciplines. The discipline currently offers PhD. and M.Sc. programs in Mathematics and envisages other Master's programs in allied fields such as Statistics and Applied Computing.

The faculty are well-qualified and motivated with a strong commitment to teaching and research. This is reflected through (i) various academic events of national and international importance conducted in the discipline, (ii) ongoing research projects sponsored by several funding agencies such as NBHM, SERB, DST, CSIR; and, (iii) research publications in reputed journals. Further, the discipline is also engaged in promoting Mathematics among under-graduate students in India through *Madhava Mathematics Competition*. The discipline also conducted lectures by eminent mathematicians from reputed institutes around the world such as Ohio University (USA), Tohoku University (Japan), Shantou University (Republic of China), Sapienza University of Rome, etc.

**Dr. Sk. Safique Ahmad**
Associate Professor
safique@iiti.ac.in

**Dr. Sk. Safique Ahmad** (PhD.: Indian Institute of Technology Guwahati and Postdoctoral : TU Berlin). Dr. Ahmad was born and brought up in Bhadrak, Odisha. He did his B.Sc. from Bhadrak College, M.Sc. in Mathematics from Utkal University, and received his M.Phil from Ravenshaw University. He was awarded the Ph.D. degree in Mathematics from IIT Guwahati in 2008. After his thesis submission, he joined in SERC, IISc. Bangalore as a Research Associate. One year after his research at IISc, he received NBHM Post- Doctoral fellowship funded by DAE and German Post-Doctoral Fellowship BAT IIa. So he accepted the German Fellowship and visited the Institut für Mathematik, Universität Berlin, Germany in 2nd February 2009 as a Post doctoral fellow and in Dec 2009, he returned to IIT Indore as a Faculty of the discipline of Mathematics. He has visited many places and delivered lectures in international institutes abroad. His research interest includes Numerical Linear Algebra, Quaternion Linear Algebra and Operator Theory and its Applications, Inverse Eigenvalue problems, etc .

**Broad research area:** Numerical Linear Algebra, Operator Theory, Quaternion Linear Algebra

**Research Highlights:**

We study the structured backward error analysis of s-specified ($1 \leq s \leq n$) eigenpairs of n-by-n matrix pencil with coefficient matrices having structures like T-symmetric, T-skew- symmetric, Hermitian, skew-Hermitian, T-even, T-odd, H-even, H-odd, T-palindromic, T-anti-palindromic, H-palindromic and H-anti-palindromic. Minimal structured perturbations are constructed with respect to Frobenius norm such that s-specified eigenpairs become exact eigenpairs of an appropriately perturbed matrix pencil which preserves sparsity. Due to the various applications of Port-Hamiltonian systems, a lot of research work is going on at International level. Following are some researchers who are working in this direction.

The generalized Hamiltonian nature of the resulting dynamical models is due to the assumption that the constitutive relations between the variables corresponding to storage at the vertices and/or edges are derivable from an energy (Hamiltonian) function, while the remaining variables are related to by static energy-dissipating relations.

This will imply that the total energy itself satisfies a conservation law that is the increase of the total energy is equal to externally supplied power, minus the power lost in the dissipative elements. The resulting generalized Hamiltonian systems, describing for energy-dissipation and interaction with the environment, fall within the class of port-Hamiltonian systems.

Inverse eigenvalue problems arise in many applications and have a unique attraction because of their coefficient matrices have different structures such as symmetric, T-even and T-odd, sparsity, etc. The objective of an inverse eigenvalue problem is to construct a physical system that maintains a particular structure that gives various spectral properties. Inverse eigenvalue problems arise in a remarkable variety of applications, including system and control theory. We have developed a mathematical method on perturbation analysis of structured matrix pencils, matrix polynomials. Dr. Ahmad also works on quaternion linear algebra and focuses on localization theorems for matrices over quaternion division algebra, which include the Ostrowski, Brauer, and Gerschgorin type of theorems. His research group also works on perturbation analysis of linear, nonlinear, and singular Multi-parameter problems including infinite matrices.

**Selected Publications:**

1 Perturbation analysis for palindromic and anti palindromic eigenvalue problems, ETNA, Volume 51, pp. 151–168, 2019.

2. Sensitivity Analysis of Nonlinear Eigen-problems, R. Alam, SS Ahmad, SIAM J. Matrix Anal. Appl., 40(2), 672–695, 2019.
3. Mathematical Modelling and Scientific Computing, Springer Proceedings in Mathematics & Statistics.

**Events and Seminars Organized:**

International Conference on Mathematical Modelling and Scientific Computing (ICMMSC-2018) July 19-21, 2018.

**Research Projects**

On Inverse Eigenvalue Problems for structured matrix pencils
(Funding by: SERB)

**Dr. Swadesh Kumar Sahoo**

Associate Professor
swadesh.sahoo
@iiti.ac.in

**Dr. Swadesh Kumar Sahoo** was born in Balasore, a city of Odisha in 1978. He has obtained his Master's Degree in Mathematics from Utkal University, Bhubaneswar in 2000 and received his PhD. degree from the Indian Institute of Technology Madras in 2008. He has been a visiting researcher at the University of Turku, Finland supported by the Centre for International Mobility (CIMO). After joining IIT Indore, he has participated and delivered a series of invited talks in several scientific events held in India, Japan, China, the United States, and Ukraine.

**Broad research area:** Complex Analysis and Hyperbolic Geometry.

**Research Highlights:**

We work on problems in the theory of univalent functions, special functions, quasiconformal mappings, and hyperbolic-type geometry. We also use the terminology Geometric Function Theory consisting of these types of problems. Mostly we focus on computing areas of domains that are images of disks centred at the origin with radii at most one. Secondly, we also investigate several characterizations of domains having geometric properties in terms of hyperbolic-type metrics. It also includes comparison of such metrics. Compactness, boundedness, and spectral properties of certain integral operators involving Hornich operations are also part of our research.

**Selected Publications:**

1. M.R. Mohapatra and S.K. Sahoo, Mapping properties of a scale invariant Cassinian metric and a Gromov hyperbolic metric, Bull. Aust. Math. Soc., 97 (1) (2018), 141-152.
2. S. Ponnusamy, S.K. Sahoo and T. Sugawa, Hornich operations on functions of bounded boundary rotations and order alpha, Comput. Methods Funct. Theory, 19 (3) (2019), 455-472.
3. V. Arora, S. Ponnusamy, and S.K. Sahoo, Successive coefficients for spirallike and related functions, Rev. R. Acad. Cienc. Exactas Fis. Nat.Ser. A Mat. RACSAM, 113 (2019), 2969-2979.

**Research Projects:**

Geometry of hyperbolic-type metrics and their applications in analytic function theory.
(Funding by: National Board for Higher Mathematics, DAE)

**Dr. Antony Vijesh**

Associate Professor
vijesh@iiti.ac.in

**Dr. Antony Vijesh** (PhD.: Indian Institute of Technology Madras) Dr. Vijesh is currently involved in the development of an efficient monotone iterative finite difference method for nonlinear partial differential equation arising from mathematical modeling. He is also working on existence and uniqueness theorem using iterative technique for various kinds of differential equations and operator equations in abstract space. His research group also studies wavelet based numerical technique to solve nonlinear partial differential equation as well as integro-partial differential equation.

**Broad research area:** Iterative methods for nonlinear problems

**Research Highlights:**

An accelerated iterative procedure for a nonlinear fourth order elliptic equation with nonlocal boundary conditions has been studied. First, an existence and uniqueness theorem is proved for the fourth order elliptic equation via the accelerated iterative procedure. To solve this problem numerically, a finite difference based numerical scheme is also developed in view of the main theorem. Theoretically, the monotone properties as well as the convergence analysis are proved for both the continuous and discretized cases. The main result also supplements several algorithms for computing the solution of the fourth order elliptic Integro-partial differential equation. The proposed scheme not only accelerates the scheme in the literature but also provides a greater flexibility in choosing the initial guess. The efficacy of the proposed scheme is demonstrated through a comparative numerical study with the recent literature. The numerical simulation confirms the theoretical claims too.

**Selected Publications:**

1. LiniaAnie Sunny and V. Antony Vijesh, A monotone iterative technique for nonlinear fourth order elliptic equations with nonlocal boundary conditions, Journal of Scientific Computing, Vol.76, 275–298, 2018. https://doi.org/10.1007/s10915-017-0615-4.
2. G. Chandhini, K.S. Prashanthi and V. Antony Vijesh Direct and integrated radial functions based quasilinearization schemes for nonlinear fractional differential equations, BIT Numerical Mathematics, to appear. https://doi.org/10.1007/s10543-019-00766-3.
3. K. Harish Kumar and V. Antony Vijesh, Wavelet based iterative methods for a class of 2D-partial integro differential equations, Computers & Mathematics with Applications, Vol. 75, 187–198, 2018. https://doi.org/10.1016/j.camwa.2017.09.008.

**Dr. Anand Parkash**

Assistant Professor
anandparkash
@]iiti.ac.in

**Dr. Anand Parkash** was born in a village in Haryana on October 22nd, 1983. After completing his school education, he took admission in Moti Lal Nehru College, Delhi University and graduated with a Mathematics degree. He completed his Post Graduation from the Indian institute of Technology (IIT) Delhi. Here, he undertook a project in Algebra and developed an interest in the area. During his PhD. research at IIT Kanpur, he worked on Prime Submodules and Multiplication Modules under the supervision of Prof. A.K. Maloo. After submitting his PhD. thesis, he taught at LNMIIT Jaipur as a lecturer for three months, followed by IISER Bhopal as a visiting faculty for one year. He is currently an Assistant Professor in the Discipline of Mathematics, IIT Indore.

**Broad research area:** Commutative Algebra

**Research Highlights:**

I am working on Prime Submodules and Radical Formulae. For commutative rings with unity, intersection of all prime ideals is equal to the set of all nilpotent elements and it is called the radical formula for rings. Prime submodules are generalization of prime ideals and some radical formulae have been defined for modules.

**Dr. Md. Aquil Khan**

Associate Professor
aquilk@iiti.ac.in

**Dr. Md. Aquil Khan** (PhD.: Indian Institute of Technology Kanpur), Visiting Researcher: University of Amsterdam, The Netherlands; Postdoctoral Fellow: The Institute of Mathematical Sciences, Chennai, India; Marie-Curie Fellow: Fraunhofer SIT, Darmstadt, Germany.

Dr. Khan works on modal logics, rough set theory and its applications. Since the inception of rough set theory, it has seen applications in many areas viz. medicine, finance, information science, decision analysis, social science, pharmacy, etc.

To increase the applicability of the rough set theory, it is important to extend the theory to relate it with some important issues in artificial intelligence such as multiple-source (agent) knowledge bases, temporal evolution of knowledge bases, information updates. This line of research comes under Dr. Khan's expertise. Moreover, he also focuses on the logical systems which can be used for reasoning with rough sets.

**Broad research area:** Modal Logic, Rough Set Theory

**Research Highlights:**

Currently, we are working on proposals to bring together the operators of epistemic logic and approximation operators of rough set theory by combining the ideas from epistemic logic and rough set logics. In one of our recent works, the possible world semantics of epistemic logic is extended to capture a situation where we have a set of states, each representing a possible state of affairs and carrying information about a set of objects regarding a set of attributes. We proposed and studied logic that can be used to reason about the knowledge operator as well as the approximation operators generated from the constituent information systems.

**Selected Publications:**

1. Khan, M. A. and Manuel, A. (Eds.): Logic and Its Applications. 8th Indian Conference, ICLA 2019, Delhi, India, March 1-5, 2019, Proceedings. Lecture Notes in Computer Science 11600. Springer-Verlag.
2. Khan, M. A. and Patel, V. S.: A Simple Modal Logic for Reasoning in Multigranulation Rough Set Model. ACM Transactions on Computational Logic 19(4), Article 30.
3. Khan, M. A. and Patel. V. S.: A Formal Study of a Generalized Rough Set Model Based on Relative Approximations. Lecture Notes in Computer Science 11103, 502-510. Springer-Verlag.

**Events/Seminars organized:**

1. Program Co-chair, Eighth Indian Conference on Logic and its Applications 2019 (ICLA 2019), March 1-5, 2019, IIT Delhi.
2. Course Co-ordinator, TEQIP sponsored 3-Days Active Learning Course on "How to do good research? & How to write papers/ thesis using Latex?", March 26-28, 2019, IIT Indore.
3. Course Co-organizer, TEQIP sponsored 6-days course on ``Inverse Problems and Imaging Techniques'', February 21-27, 2019, IIT Indore.
4. Program Committee Member, The International Joint Conference on Rough Sets (IJCRS 2019), Debrecen, Hungary.
5. Program Chairs, International Conference on Mathematical Modelling and Scientific Computing (ICMMSC 2018), IIT Indore.
6. Program Committee Member, The International Joint Conference on Rough Sets (IJCRS 2018), Quy Nhon, Vietnam.

**Dr. Niraj Kumar Shukla**

Assistant Professor
nirajshukla@iiti.ac.in

**Dr. Niraj Kumar Shukla** (PhD.: University of Allahabad) is an Assistant Professor. Dr. Shukla's main research area is Frame and Wavelet Analysis. His current research interests include: Dual frame wavelets, Shift invariant spaces, Parseval Super wavelets and Parseval Semi- orthogonal wavelets and their applications. A wavelet is a function which together with its dilates and their translates determine all functions of our need. Wavelets are well suited for approximating data with sharp discontinuities and automatically adapt to different components of a signal by a procedure known as the multiresolution analysis.

**Broad research area:** Wavelets, frame and Harmonic Analysis

**Research Highlights:**

Having potential applications in multiplexing techniques and in the synthesis of frames, orthogonality (or strongly disjointness) plays a significant role in frame theory (e.g. construction of new frames from existing ones, constructions related with duality, etc.). In the one of the our research works, we studied the theoretical and application aspects of orthogonality of a pair of frames, the dual Gramian analysis tools, and wave-packet systems over locally compact abelian groups.

**Selected Publications:**

1. A. Gumber and Niraj K. Shukla, Orthogonality of a pair of frames over locally compact abelian groups, J. Math. Anal. Appl., 458(2)(2018), 1344-1360.
2. Niraj K. Shukla and S.C. Maury, Super-wavelets on local fields of positive characteristics, Math. Nachr., 291(2018), 704-719.
3. A. Gumber and Niraj K. Shukla, Pairwise orthogonal frames generated by regular representations of LCA groups, Bull. Sci. Math., 152(2019), 40-60.

**Events/ Seminars organized:**

1. International Conference on Mathematical Modelling and Scientific Computing during July 19-21, 2018.

**Research Projects:**

1. A study of Shearlet frames and Shearlet transform
   (Funding by: CSIR)
2. Study of generalized TI system and wave-packet systems over LCA groups
   (Funding by: NBHM-DAE, Mumbai)

**Dr. Ashisha Kumar**

Assistant Professor
akumar@iiti.ac.in

**Dr. Ashisha Kumar** (PhD.: Indian Institute of Technology Kanpur) Dr. Kumar has spent three years as DS Kothari Post-doctoral Fellow in Indian Institute of Science Bangalore. He works on "d-plane transform" which is a generalization of X-ray and Radon transform. His research is focused on the mapping properties of the d-plane transform on certain Euclidean and Non-Euclidean Spaces. His research interest also includes Information Theory.

**Broad research area:** Analysis

**Research Highlights:**

Discovered a Unified Framework for Problems on Guessing, Source Coding and Task Partitioning in the research group of Information Science.

**Events/Seminars organized:**

- Discipline seminars have been organised. One of the coordinators for science day programme and a 6-day TEQIP Course on "Inverse Problems and Imaging Techniques".
- Madhava Mathematics Competition "Coordinator Indore Region", Coordinator of Mathematics Training and Talent Search Programme (O-Level) during 21/05/2018 to 16/06/2018 held at IIT Indore.

**Dr. Vijay Kumar Sohani**

Assistant Professor
vsohani@iiti.ac.in

**Dr. Vijay Kumar Sohani** completed his PhD. from Harish Chandra Research Institute Allahabad. His area of research is Harmonic Analysis and PDE. His recent studies include well posed ness results for nonlinear Schrodinger equation for the twisted Laplacian and Laguerre operator. He further worked on Hardy-Sobolev inequality for the twisted Laplacian. He is currently working on well posed ness results for nonlinear Schrodinger equation for the discrete Hermite operator

**Broad research area:** Harmonic Analysis and PDE

**Research Highlights:**

I am working on Scattering properties of Schrodinger equation associated with the twisted Laplacian.

**Selected Publications:**

- Dispersion Estimates for the Discrete Hermite Operator (Jointly with Devendra Tiwari), communicated.

**Research Projects:**

- Some problems on Nonlinear Schrodinger equation (NLS) and Hardy- Sobolev inequality for the twisted Laplacian.
  (Funding by: SERB)

**Dr. M. Tanveer**

Assistant Professor
mtanveer@iiti.ac.in

**Dr. M. Tanveer** is an Assistant Professor and Ramanujan Fellow. Previously, he was a Postdoctoral Research Fellow at the Rolls-Royce@NTU Corporate Lab of NTU, Singapore for one year. He received his PhD. degree in Computer Science from JNU, New Delhi. He has published in over 20 referred journal papers of international repute. He is the recipient of the 2017 SERB-Early Career Research Award in Engineering Sciences and the only recipient of 2016 DST-Ramanujan Fellowship in Mathematical Sciences. These are prestigious national awards at the early-career level. He is a Senior Member in IEEE, Section Editor of Smart Science, Taylor & Francis and Editorial Review Board member of Applied Intelligence, Springer. He has also co-edited one book in Springer on machine intelligence and signal analysis. He has organized two international conferences and been invited to speak in many international conferences, symposiums and winter schools. He is the Co-Chair of the Special Session proposal in 2018 IEEE symposium series on Computational intelligence (IEEE SSCI 2018). Dr. Tanveer is currently Principal Investigator in four major research projects funded by the Government of India including Department of Science and Technology (DST), Science & Engineering Research Board (SERB) and Council of Scientific & Industrial Research (CSIR).

**Broad research area:** Machine learning, deep learning, optimization

**Research Highlights:** The OPTIMAL research group focusses on the following research areas:

- Optimization
- Machine Learning
- Support Vector Machines
- Biomedical Signal Processing
- Deep Learning
- Neuroimaging
- Applications to Alzheimer's Disease and Dementias

**Selected Publications:**

1. M. Tanveer, A. Sharma, P.N. Suganthan (2019), General twin support vector machine with pinball loss function, Information Sciences, Elsevier.
2. M. Tanveer, C. Gautam, P.N. Suganthan (2019), Comprehensive evaluation of twin SVM based classifiers on UCI datasets, Applied Soft Computing, Elsevier.
3. M. Tanveer, A. Tiwari, R. Choudhary, S. Jalan (2019), Sparse pinball twin support vector machines, Applied Soft Computing, Elsevier.

**Events/Seminars organized:**

1. Special Session on "Non-parallel Support Vector Machine Classifiers" under 2018 IEEE Symposium Series on Computational Intelligence (IEEE SSCI-2018) from November 18-21, 2018, Bengaluru [Organising Chair].
2. Special Session on "Computational Intelligence in Cyber Threat Analytics" under 2018 IEEE Symposium Series on Computational Intelligence (IEEE SSCI-2018) from November 18-21,2018, Bengaluru. [Organising Chair].
3. Special Session on "Computational Intelligence for Biomedical Data and Imaging" under 2018 IEEE Symposium Series on Computational Intelligence (IEEE SSCI-2018) from November 18-21, 2018, Bengaluru. [Organising Chair].
4. TEQIP Active Learning Course on "How to write a good PhD" at IIT Indore during March 18-20, 2019. [Coordinator].

**Research Projects:**

1. Classification and prediction of Alzheimer disease using multimodal imaging data.
   (Funding by: SERB)
2. Optimization models and algorithms for non-parallel support vector machines.
   (Funding by: SERB)
3. Detection of human brain disorders using novel machine learning approaches.
   (Funding by: CSIR)
4. Development of novel machine learning algorithms for automated detection of seizure using EEG signals.
   (Funding by: DST)

**Dr. Sanjeev Singh**

Assistant Professor
snjvsngh@iiti.ac.in

**Dr. Sanjeev Singh** completed his school education from Ballia, Uttar Pradesh; B.Sc. from Ewing Christian College, Allahabadin 2004; and, M.Sc. in Mathematics from the Indian Institute of Technology, Madras in 2010. He worked as a lecturer in Mathematics at the Rajiv Gandhi University of Knowledge Technologies Basar, Andhra Pradesh from July 2010 to December 2011. He came back to IIT Madras in December 2011and completed his PhD in November 2016 under the supervision of Prof. S. Ponnusamy and Prof. A. Baricz. Before joining IIT Indore as an Assistant Professor in September 2017, he was an Institute Pre-Doctoral Fellow at the Department of Mathematics, IIT Madras from June 2016 to December 2016.

**Broad research area:** Special Functions, Differential Equations, Geometric Function Theory.

**Research Highlights:**

Currently, we are working on various properties of some special functions, namely, Bessel function, Hyper-Bessel function, Struve function, Marcum function, etc. We work on geometric as well as classical properties of these special functions.

**Selected Publications :**

1. Technical Program Committee Co-Chairs, International Conference on Computational Mathematics in Nanoelectronics and Astrophysics (CMNA 2018), IIT Indore.
2. Program Chairs, International Conference on Computational Mathematics in Nanoelectronics and Astrophysics (CMNA 2018), IIT Indore.
3. Program Committee Member, International Conference on Mathematical Modelling and Scientific Computing (ICMMSC 2018), IIT Indore.

**Dr. Santanu Manna**

Visiting
Assistant Professor
smanna@iiti.ac.in

**Dr. Santanu Manna** did his B.Sc. in Mathematics (Honours) from the University of Calcutta; Master's in Mathematics & Computing from the Indian School of Mines, Dhanbad in 2011 and PhD. in Applied Mathematics from the Indian Institute of Technology (ISM), Dhanbad in 2015. After his PhD., Dr. Manna joined the Indian Institute of Science Education and Research at Kolkata as Post-Doctoral fellow.

In 2016, Dr. Manna was awarded the "National Post-Doctoral Fellowship" from SERB, DST, Govt. of India; and, "Dr. D.S. Kothari Post-Doctoral Fellowship"from UGC. In 2018, he was awarded the Open Arms Grants Awards.

**Broad research area:** Differential Equations, Wave Propagation aspects, Asymptotic Analysis.

**Research Highlights:**

I am working on Numerical Mathematics (Partial differential equations, Stability analysis, Simulation). My research is concerned with the mathematical modelling, analysis and numerical simulation of PDEs and their application in multi-field problems likes, wave propagation, asymptotic analysis, solid mechanics, and mathematical seismology. Moreover, I am equally interested on the study of earthquake source parameters and statistical analysis of World earthquakes in order to get most efficient earthquake forecasting analysis.

**Selected Publications:**

1. Manna S., Kundu S. and Misra J.C., (2018) Theoretical analysis of torsional wave propagation in a heterogeneous aeolotropic stratum over a viscoelastic half-space of Voigt type. International Journal of Geomechanics (American Society of Civil Engineers) vol. 18, pp. 1-17.
2. Manna S., Misra J.C, Kundu S. and Gupta S., (2018) Surface wave propagation in an initially stressed heterogeneous medium having a sandy layer and a point source, Geomechanics and Engineering, An International Journal, vol. 16 (2), pp. 169-176.

**Dr. Charitha Cherugondi**
Visiting
Assistant Professor
charithac@iiti.ac.in

**Dr. Charitha Cherugondi** (PhD.: Indian Institute of Technology Kanpur) is a Visiting Assistant Professor in the discipline. She completed her B.Sc. from Andhra University and a postgraduate from University of Hyderabad. She received her PhD. degree in Mathematics from the Indian Institute of Technology Kanpur; after which, she worked for few years as an Assistant Professor of Mathematics at the National Institute of Technology in Calicut. Later, she spent nearly 4 years as a Postdoctoral Researcher at Georg-August-Universitaet in Goettingen, Germany before joining IIT Indore as a Visiting Assistant Professor.

**Broad research area:** Optimization theory

**Research Highlights:**

- Variational analysis
- Continuous Optimization
- Optimization to Imaging

**Dr. Anupam Pal Choudhary**
Assistant Professor
anupampcmath@iiti.ac.in

**Dr. Anupam Pal Choudhary** (PhD.: TIFR; Post-doctoral research: University of Basel, Technische Universitat Darmstadt, Johann Radon Institute for Computational and Applied Mathematics, Linz) works on Partial Differential equations.

**Broad research area:** Partial differential equations

**Research Highlights:**

- Evolutionary partial differential equations (Hyperbolic and Parabolic type)
- Inverse problems

**Events/ Seminars organized:**

- TEQIP Short Term Course on Inverse Problems and Imaging Techniques (February 21-27, 2019)

**Dr. Bapan Ghosh**
Assistant Professor
keshab.bapan@iiti.ac.in

**Dr. Bapan Ghosh** (PhD.: IIEST, Shibpur, previously at NIT Meghalaya) is an Assistant Professor.

**Broad research area:** Nonlinear Dynamics and Mathematical Biology

**Research Highlights:**

- Existence of hydra effect in population dynamics models.
- Measuring maximum yield and resilience in ecological systems
- Dynamics of stage-structure predator-prey models.

# Discipline of Physics

The Physics discipline at IIT Indore was established in 2009 and it has matured into an active research and teaching community. The discipline offers two postgraduate academic programs, M.Sc. and PhD. in Physics. In addition, we are also involved in handling two courses and one lab in first year B.Tech program. The discipline currently has 37 Masters and 40 PhD. students. Many faculty members are also involved in interdisciplinary research areas extending to disciplines of Astronomy, Biosciences and Biomedical Engineering, Metallurgy Engineering and Materials Science. The major thrust research areas in the Physics discipline are:

1. Experimental Solid State Physics
2. Statistical Mechanics and Complex Networks
3. Theoretical High Energy Physics
4. Experimental High Energy Physics

## Faculty

**Dr. Krushna R. Mavani**
Professor& Head
krushna@iiti.ac.in

**Prof. Krushna R. Mavani** is working as Professor in the Discipline of Physics. She joined IIT Indore in 2009 after completing her postdoctoral tenure of about 3.5 years at Osaka University, Japan and Kyoto University, Japan. She was awarded by 'Wakastayoshiki' research fund as Principal Investigator for her project at Kyoto University. Before this, she worked as a Research Fellow at Tata Institute of Fundamental Research (TIFR), Mumbai for about 3 years. In 2003, she completed her PhD. from Saurashtra University, which included major collaboration with TIFR, Mumbai. She also worked as Junior Research Fellow in a collaborative project of Saurashtra University and Inter-University Centre for Acceleration (Former Nuclear Science Centre), New Delhi, on High Temperature Superconductor Thin Films.

### Selected Publications:

1. Tuning of exchange bias with interfacial ferromagnetism in NdNiO3/NdMnO3 heterostructures S. Harisankar, Mahesh Chandra, K. R. Mavani, Journal of Magnetism and Magnetic Materials 477, 35 (2019).
2. Controlling porosity and ultraviolet photoresponse of crystallographically oriented ZnO nanostructures grown by pulsed laser deposition Ankit Soni and Krushna R. Mavani, Scripta Materialia 162, 24 (2019).
3. Strain-mediated effects of oxygen deficiency and variation in non-Fermi liquid behavior of epitaxial PrNiO3-δ thin films Harisankar S, Kavita Soni, Ekta Yadav, Krushna R. Mavani, Journal of Physics: Condensed Matter 31 (2019) .

### Research Highlights:

She works in the area of Experimental Condensed Matter Physics. Her research interests include Terahertz Spectroscopy of functional oxides, thin films, multilayered structures and nanostructures by Pulsed Laser Deposition method. She studies phenomena like first order metal- insulator transition, structure-property correlations, charge dynamics in functional oxides, strongly correlated properties and phase transitions. Currently, her research group includes six PhD. students. Two PhD. and two M.Sc. students have graduated under her guidance. The group's research focuses on:

- Growth of high quality crystalline thin films.
- Growth of nanostructures.
- Study of Structure-Property relationships in materials.
- Functional Oxides and Devices based on that.

### Events/Seminars Organized:

Vigyan-Jyoti workshop for 3 weeks during June 2018 under the title, "Knowledge, Personality and Skill Development Activities for Aspiring School-Girls".

### Research Projects:

1. Terahertz spectroscopic investigations on oxygen adsorption-desorption effects in nanoporousZnO films for visible-blind UV photodetection (Funded by SERB, GOI).
2. Influence of Strain and Carrier Injection on Electrical and Magnetic Properties of RNi1-xDxO3 (R=Rare earth metal, D = Dopant) Thin Films and Multilayers (Funded by BRNS).

**Dr. Subhendu Rakshit**
Professor
rakshit@iiti.ac.in

**Prof. Subhendu Rakshit** has done his PhD. from Calcutta University and was Visiting Scientist in TIFR, India, postdoctoral fellow at University of Dortmund, Germany; Saha Institute of Nuclear Physics, India; Technion University, Israel; and, Harish Chandra Research Institute, Allahabad. His work relates to the IceCube experiment located at the Antarctica measuring high-energy neutrinos of more than 60 TeV coming from extra-galactic sources.

**His Broad Area of research is:** Theoretical High Energy Physics.

**Selected Publications:**

1. Alignment Limit in 2HDM: Robustness put to test By Siddhartha Karmakar, SubhenduRakshit. arXiv:1802.03366 [hep-ph]. 10.1007/JHEP09 (2018) 142. JHEP 1809 (2018) 142.
2. Interactions of Astrophysical Neutrinos with Dark Matter: A model building perspective By Sujata Pandey, Siddhartha Karmakar, SubhenduRakshit.arXiv:1810.04203 [hep-ph]. 10.1007/JHEP01(2019)095. JHEP 1901 (2019) 095.

**Research Highlights:**

Extremely high energetic neutrinos arrive at Earth from extragalactic sources. We proposed that these may interact with dark matter particles on its way to a detector named IceCube placed at the Antartica. As a result, the observed neutrino spectrum may actually turn out to be an absorption spectrum, containing information about these interactions. We presented a few particle physics models that can give rise to such interactions of desired strength. We have also explored if additional Higgs like scalars do exist in Nature and how would they may leavetheir imprints in experimental measurements, like in the Large Hadron Collider at CERN: Especially, if new physics beyond the Standard Model of Particle physics do exist at a very high energy, what could be its possible implication while deciphering such measurements.

**Research Projects:**

1. Flavour physics and dark matter: reconnecting the dots (Funded under DAAD-DST, GOI).
2. Challenges of Particle Physics after Higgs Discovery (Funded by SERB-DST, GOI).

**Dr. Sarika Jalan**
Professor
sarika@iiti.ac.in

**Prof. Sarika Jalan** has done her PhD.in non-linear dynamics and Complex Systems from Physical research laboratory and was Senior research fellow at the National University of Singapore, Singapore and guest Scientist and Post doctorate fellow, respectively, at Max Planck Institute for the Physics of Complex Systems, Dresden, and Max-Planck Institute of Mathematics in the Sciences, Leipzig Germany. Dr. Jalan holds an Adjunct Professorship at Lobachevsky University, Nizhny Novgorod, Russia, for 2018-2019.

Her main area of research is Experimental Condensed Matter Physics, with specific focus on:

(I) Study of Surface and Interfaces – nanomaterials, thin-films, structure property relationship - optical properties, photocatalytic activity, application in solar cell;

(ii) Electrical Energy Storage- building better batteries and supercapacitors – Li and Al ion batteries.

(iii) Soft matter physics.

(iv) Biomedical Applications of Nanotechnology: Bio-instrumentation

**Selected Publications:**

1. Inhibition induced explosive synchronization in multiplex networks, Sarika Jalan, Vasundhara Rathore, Ajay Deep Kachhvah and Alok Yadav, Phys. Rev. E 99, 062305 (2019).

2. Delay Regulated Explosive Synchronization in Multiplex Networks, Ajay Deep Kachhvah and Sarika Jalan, New Journal of Physics 21, 015006 (2019).
3. Engineering chimera patterns in networks using heterogeneous delays, Saptarshi Ghosh and Sarika Jalan, Chaos: An Interdisciplinary Journal of Nonlinear Science (Fast Track) 28 (7), 071103 (2018).

**Research Highlights:**

Dr. Jalan primarily explores into structural and dynamical behaviors of real-world complex systems where the underlying network can be expressed in multiplex framework, these can be broadly stated as:

- Complex Networks.
- Spatio-temporal Chaos.
- Synchronization in Spatially Extended Systems.
- Spectral Graph Theory.
- Computational Biology.

**Events and Seminars Organized:**

1. Mini-symposium "Coupled dynamics on multiplex networks" at SIAM meeting, May 18-23, 2019, Snowbird, USA.
2. Mini-Symposium "Dynamics and control of multilayer networks" at DPG Spring meeting, Regensburg, March 31 – 05 April, 2019.
3. Mini-symposium "Complex Networks" at CNSD 2018, October 2018, JNU, New Delhi.

**Research Projects:**

1. Spectral Analysis of Multiplex Networks (Funded by BRNS).
2. Extreme Value Statistics and evolution of various patterns in real world complex systems (Funded by CSIR, GOI).
3. Analysis of Interplay of Multiplexing and Optimization in Complex Networks (Funded by DST, GOI)
4. Chimera in Multiplex Networks (DST-DAAD Exchange Programme).

## Dr. Sudeshna Chattopadhyay

Associate Professor
sudeshna@iiti.ac.in


**Dr. Sudeshna Chattopadhyay** (Bandyopadhyay) is an Associate Professor in Discipline of Physics, and adjunct faculty in the Discipline of Metallurgy Engineering and Materials Science and the Discipline of Biosciences and Biomedical Engineering at IIT Indore. Dr. Chattopadhyay has done her PhD. from the Saha Institute of Nuclear Physics, Calcutta, India, and postdoctoral research at the Department of Physics, Northwestern University, USA (2008-2010), and subsequently joined as a Research Associate in the Department of Materials Science and Engineering, Northwestern University, USA, under Energy Frontier Research Center (EFRC) project in collaboration with Argonne National Lab, (2010-2012), before starting to work as an Assistant Professor at IIT Indore from June 2012. She is an affiliated Assistant Professor of Physics in Department of Physics, New Mexico State University (NMSU), USA (since Sept 1, 2015).

**Selected Publications:**

1. "An efficient pH sensitive hydrogel, with biocompatibility and high reusability for removal of methylene blue dye from aqueous solution" Rinki Singh, Dipayan Pal, AakashMathur, Ajaib Singh, Mena Asha Krishnan, Sudeshna Chattopadhyay, Reactive and Functional Polymers, 144, 104346 (2019).
2. "Structure and morphology of atomic layer deposition grown ZnO thin film / nanostructure on polymeric template" Ajaib Singh, AakashMathur, Dipayan Pal, Amartya Sengupta, Rinki Singh, Sudeshna Chattopadhyay, Materials Today Proceedings,18 (3), 1517-1523 (2019).

3. "Dual ion beam grown silicon carbide thin films: variation of refractive index and band gap with film thickness"Aakash Mathur, Dipayan Pal, Ajaib Singh, Rinki Singh, Stefan Zollner and Sudeshna Chattopadhyay, Journal of Vacuum Science & Technology B, 36,041802 (pg. 1-10) (2019).

**Patent:**

"Method of enhanced lithiation of doped silicon carbide via high-temperature annealing in an inert atmosphere" Mark C. Hersam, Albert L. Lipson, Sudeshna Bandyopadhyay (Chattopadhyay), Hunter. J. Karmel, Michael J. Bedzyk, U.S. Patent No.: US 8,734, 674 B1; Date of Patent: May 27, 2014.

**Research Highlights:**

Her research is focused on Experimental Condensed Matter Physics:

- Study of Surface and Interfaces – nanomaterials, thin-films, structure property relationship - optical properties, photocatalytic activity, application in solar cell.
- Electrical Energy Storage- building better batteries and supercapacitors – Li and Al ion batteries.
- Soft matter physics.
- Biomedical Applications of Nanotechnology: Bio-instrumentation.

**Events and Seminars Organized:**

Organized/Conducted A Short Term Course on "Differential Equations: Theory, Computation and Applications" under Continuing Education Program (CEP) at IIT Indore 11-14 December 2017. Program organizing committee of the four-day interdisciplinary course: Drs. Santanu Manna (Mathematics), Parimal Kar (BSBE), Antony Vijesh (Mathematics), Sudeshna Chattopadhyay (Physics).

**Research Projects:**

Study of structural and electronic properties of low-dimensional systems of technological importance (Funded by DAAD).

DST-FIST grant proposal for Raman Spectrophotometer (Funded under DST-FIST).

**Dr. Rajesh Kumar**
Associate Professor
rajeshkumar@iiti.ac.in

**Dr. Rajesh Kumar** is an experimental solid state physicist. He completed his PhD. from IIT Delhi and was a post-doctoral Scientist at NRC-NINT, University of Alberta, Canada before joining IIT Indore. His area of interest includes Nanoscience & Nanotechnology, Raman Spectroscopy, Electrochromic Devices, Silicon nanostructures, synthesis and applications of functional nanomaterials, organic and inorganic semiconductors, Sensors.

**Selected Publications:**

1. Rajesh Kumar, "Expressing Raman Spectral Details Through Raman Parameter Informa tion Diagram", ChemText, 05, 14(2019).
2. Anjali Chaudhary , Devesh K. Pathak, Manushree Tanwar, Pankaj R. Sagdeo and Rajesh Kumar, "Prussian Blue-Viologen Inorganic Organic Hybrid Blend for Improved Electrochromic Performance", ACS Appl. Elect. Mater., 01, 892 (2019).
3. Manushree Tanwar, Anjali Chaudhary, Devesh K. Pathak, priyanka Yogi, Shailendra K. Saxena, P.R. Sagdeo and Rajesh Kumar, "Deconvoluting Diffused Reflectance Spectra for Retrieving Nanostructures Size Details: An Easy and Efficient Approach",J. Phys. Chem. A, 123, 3607(2019) 6.

**Research Highlights:**

His approach towards research is two fold where he not only investigates the basic physical phenomena taking place at microscopic level but also designs materials for real applications like field emission and electrochromic displays, sensors and energy storage. Recently his group has synthesized different organic, inorganic and hybrid nanomaterials for such applications. His group has discovered a new method for quantification of short-range order in amorphous materials by simply utilizing Raman spectroscopy. The

metal oxide nanothorns developed in his group has shown thousand times improvement in field emission properties and has potential in application as display devices. A recent development has been done in obtaining multiple color switching from designed electrochromic device using conducting polymer. His group has also developed a method to design nanomaterials for a specific purpose.

### Events and Seminars Organized:

Demonstration in Outreach activity on Science Day.

### Research Projects:

1. Pathogenesis of epstein-barr virus and chlamdia pneumonia in multiple sclerosis (Funded by CSIR, GOI).

**Dr. Pankaj R. Sagdeo**
Associate Professor
prs@iiti.ac.in

**Dr. Pankaj R. Sagdeo** has done his PhD. from UGC-DAE CSR Indore and held positions of Officer/Coordinator at Bhabha Atomic Research Centre, Visakhapatnam and Research Associate/Postdoctoral Researcher at UGC-DAE-CSR Beamline on Indus-I and Indus-II, /Indian Synchrotron source.

The research group headed by Dr. Pankaj Sagdeo is mainly working on the physics of highly correlated electron systems such as Manganite, High Tc superconductors, titanates, nickelite, cuperates etc.

### Selected Publications:

1) Anil Kumar,Vikash Mishra, Archna Sagdeo, Aanchal Sati, Kamal Warshi, Rajesh Kumar and P.R. Sagdeo, Strain Induced Disordered Phonon Modes in Cr doped PrFeO3, J. Phys.: Cond. Matter, vol no.31, page no. 275602, 2019.

2) Anil Kumar, MK Warshi, V Mishra, A Sati, S Banik, A Sagdeo, Rajesh Kumar and P. R. Sagdeo Optical spectroscopy: An effective tool to probe the origin of dielectric loss in Cr doped PrFeO3, Ceramics International 45 8585 2019.

3) M. Kamal Warshi, Vikash Mishra, Vinayak Mishra, Rajesh Kumar, P.R. Sagdeo, Possible Origin of Ferromagnetism in Antiferromagnetic Orthorhombic-YFeO3: A First-Principles Study, Ceramic International 44 13507 (2018).

### Research Highlights:

- Physics of Highly correlated electron systems: To improve the efficiency of CMR, Multiferroic and high temperature superconductivity materials.
- Physics of solar Cell: Optical Spectroscopy to probe the electronic structure near band edge to stretch the efficiency of solar cell and photovoltaic devices.
- Instrumentation Developments: Design and development of specialized scientific instruments to investigate and critical characterization of materials.
- X-ray and neutron scattering and material characterization: Using synchrotron-based x-ray source and nuclear reactors for critical characterization of materials.

### Research Projects:

Exploring new methodology to estimate the values of onsite coulombic repulsive energy (U) and charge transfer energy in transition metal oxides through combined optical and structural studies (Funded by SERB, DST, GOI).

**Dr. Preeti A. Bhobe**
Associate Professor
pbhobe@iiti.ac.in

**Dr. Preeti Bhobe** has done her PhD. from Goa University and was JSPS postdoctoral fellow at Institute for Solid state physics (ISSP), University of Tokyo and RIKEN, Spring8 synchrotron source, Japan and postdoctoral fellow at Tata Institute of Fundamental Research, Mumbai, before joining IIT Indore in 2011. She went for 3 months of scientific visit to Texas A&M University, College Station, Texas, USA this year.

Specialization: X-ray Absorption Fine Structure (XAFS), Photoemission Spectroscopy (PES), and Magnetism. We employ advanced experimental probes like XAFS, XMCD, and PES to investigate and understand a variety of properties and phenomena in solids.

**Selected Publications:**

1. S. Chaudhuri, P. A. Bhobe, and A. K. Nigam "Unraveling the physical properties and superparamagnetism in anti-site disorder controlled Fe2TiSn" J. Phys.: Condens. Matter. Vol. 31, 045801 (2019).
2. Tamalika Samanta, A. Das, A. K. Nigam, P. A. Bhobe, "Reentrant cluster glass and stability of ferromagnetism in Ga2MnCo Heusler alloy " Phys. Rev. B Vol. 97, 184421 (2018).
3. S. Gowthamaraju, P. A. Bhobe, and A. K. Nigam, "Improved Figure of Merit and Other Thermoelectric Properties of Sn1-xCuxSe" Appl. Phys. Lett. Vol. 113, pp. 24 (2018).

**Research Highlights:**

Her broad area of research is on Experimental Condensed Matter Physics, with specific focus on: X-ray Absorption Fine Structure (XAFS), Photoemission Spectroscopy (PES), and Thermoelectric power measurement.

Our research group focuses on the study of crystal and electronic structure of materials that have potential for technological applications. This includes, (a) Half-metallic Heusler alloys for spintronics applications (b) Tin Chalogenides and (c) Delafossite oxides for thermoelectric application.

**Our recent findings demonstrate:**

(a) the role of anti-site disorder in controlling the electronic and magnetic properties in functional Heusler alloys like Fe2TiSn, Ga2MnCo, (b) Improvement in the thermoelectric properties of SnSe, (c) Unusual magnetic ground states in CuCrO2 delafossite oxide.

**Research Projects:**

Half- Metallic Heusler Alloys for Spintronics Applications (Funded by SERB, GOI).

**Dr. Somaditya Sen**
Associate Professor
sens@iiti.ac.in

**Dr. Somaditya Sen** is an Associate Professor in the Physics discipline of IIT Indore since Feb 2013. Dr. Sen has done his PhD. from Jadavpur University, Indian Association for the Cultivation of Science, Kolkata. He has served as a member of the Board of Governors of IIT Indore from Jan 2016 till Dec 2017 and as Dean Planning (Acting) for a while in 2017. He is also serving as an Adjunct Associate Professor at the Ming Chi University of Technology at Taiwan. Investigations on photosensitivity and chemosensitivity properties are some routine experiments performed in his lab. A new look of utilizing some high dielectric constant materials with low losses are being investigated in the light of dielectric resonator antennas. Single phase materials is a major criteria of his research of which electrical (conductivity, dielectric, ferroelectric, piezoelectric, thermoelectric, sensitivity, etc.), optoelectronic (bandgap, defects, bandtayloring, etc.), mechanical, and many more aspects are investigated.

**Selected Publications:**

1. Anita Verma, A. K. Yadav, S. Kumar, V. Srihari, R. Jangir, H. K. Poswal, S. Biring, S. Sen,"Enhanced energy storage properties in A-site substituted Na0.5Bi0.5TiO3 ceramics" J. Alloys Compd. 792 (2019) 95-107, (Impact Factor: 3.779).
2. S Tiwari, G Rathore, N Patra, AK Yadav, D Bhattacharya, SN Jha,S. Sen,"Oxygen and cerium defects mediated changes in structural, optical and photoluminescence properties of Ni substituted CeO2", J. Alloys Compd. 782 (2019) 689-698, (Impact Factor: 3.779).
3. T Srivastava, G Bajpai, SW Liu, S Biring, S Sen, "Zn1−xSixO: Reduced photosensitivity, improved stability and enhanced conductivity" Scripta Materialia150 (2018) 42-44. (Impact Factor: 4.5).

**Research Highlights:**

His broad area of research is "Condensed Matter Physics: Structure Correlated Properties of magnetic oxide semiconductors." Co-doping in simple and complex (perovskite/double perovskite) oxides and explores functionalities on the application side; and Dielectric Resonator Antennas.

Main research highlights are: (i) The effect of high temperature annealing on the antisite defects in ferromagnetic $La_2NiMnO_6$ double perovskite, (ii) Role of $Li^+$ and $Fe^{3+}$ in modified ZnO: Structural, vibrational, opto-electronic, mechanical and magnetic properties.

**Research Projects:**

First Principle Studies and Synthesis, characterization, physical properties of multiferroics nanoparticles (DST, GOI PI: Dr. Rini E.G.).

**Dr. Manavendra N. Mahato**
Associate Professor
manav@iiti.ac.in

**Dr. Manavendra Mahato** has done his PhD. from the University of Michigan, Ann arbor, USA and was Visiting fellow in TIFR, Mumbai. Dr. Manavendra Mahato's recent research includes finding quasinormal modes in the background of nh-stu black holes. Quasinormal modes are perturbations in the background of black holes with certain boundary conditions. They fall into the black hole horizon and decay far away from at spatial infinity. For asymptotic AdS spaces, they are outgoing at the boundary. These more play an important role in the thermalization of any perturbation in the black hole background.

**Selected Publications:**

"Quasinormal modes for nh-stu black holes" by M. Mahato and Ajay Pratap Singh, EPJC, 2018, 78:822.

**Research Highlights:**

Dr. Mahato works in the broad area of Theoretical high energy physics. He focuses on string theory topics in high energy physics mainly related to gauge gravity correspondence. The correspondence relates certain strongly coupled quantum field theories with certain gravitational solutions. Recently we calculated quasinormal frequencies of certain black holes numerically and studied their properties with temperature and size of the black hole. Thus, we pointed out to certain generic features of the black hole decay which are related to dynamics of decay of perturbations in corresponding field theories.

**Dr. Ankhi Roy**
Associate Professor
ankhi@iiti.ac.in

**Dr. Ankhi Roy** has done her PhD. from IIT Bombay. Her group is working in main two domains of experimental heavy ion collisions. In one domain, Quark Gluon Plasma (QGP) is supposed to be produced at very high temperature but low baryon density. In this domain, we work on the analysis of the data available from the ALICE experiment, which is situated, at CERN. Mainly, they measure the electrons from the heavy flavour hadron decays using data driven method and also some phenomenological work related to this field. In another domain, QGP is supposed to be formed due to high baryonic density. In this domain, they are involved in another experiment known as CBM (Compressed Baryonic Matter) which is situated at GSI, Germany. Their group mainly works in the simulation of the detector performance for this upcoming experiment.

### Selected Publications:

1. Kinetic freeze-out conditions in nuclear collisions with 2A–158AGeV beam energywithin a non-boost-invariant blast-wave model, Sudhir Pandurang Rode, Partha Pratim Bhaduri, Amaresh Jaiswal, and Ankhi Roy, Physical Review C98, 024907 (2018).
2. Exclusive photoproduction of π0 up to large values of Mandelstam variables s, t, and u with CLAS , M.C. Kunkel, M. J. Amaryan, …, S..Ghosh,…, A.Roy, (CLAS collaboration ) et al., Physical Review C 015207 (2018).
3. Isotensor Dibaryon in the pp→ppπ+π− Reaction? P. Adlarson…A. Goswami, A. Roy et al. (WASA-at-COSY Collaboration) Phys. Rev. Lett. 121, 052001.

### Research Highlights:

Dr. Roy works on Experimental High Energy Physics, and her research highlights on:

- Semi-leptonic decays of Heavy Flavour Hadrons using ALICE data.
- Data rate of MUCH detector, CBM@FAIR experiment.
- Electron-Hadron Correlation of heavy Flabour hadrons study using ALICE data.
- Application of Support Vector Machine.

### Events and Seminars Organized:

International Conference "Third Heavy Flavour Meet" was organized from 18-20th March, 2019 by Dr. Ankhi Roy from the Discipline of Physics, IIT Indore.

### Research Projects:

Leptons from heavy-flavour hadron decays in proton- proton collisions at the LHC (Funded by DST-DAAD).

**Dr. Raghunath Sahoo**
Associate Professor
raghunath@iiti.ac.in

**Dr Raghunath Sahoo** has done his PhD. from the Institute of Physics, Bhubaneswar and was Postdoctoral fellow in Subatech, France, INFN fellow in INFN Padova, Italy.

Dr. Raghunath Sahoo's research group is active in ALICE with light flavour spectra and has made a visible contribution in ALICE in terms of number of analysis notes and research papers. They have also contributed to the understanding of quarkonia production at the forward rapidities in ALICE.

Dr. Sahoo is also Visiting Scientist at the University of Cape Twon, South Africa; Brookhaven National Laboratory, USA; CERN, Geneva, Switzerland; GSI, Dramstadt, Germany; and Institute of Physics, Bhubaneswar.

### Selected Publications:

1. "Role of Multiparton Interactions on J/ production in p+p collisions at LHC Energies." Dhananjaya Thakur, Sudipan De, Raghunath Sahoo, and Soumya Dansana, arXiv:1709.06358, Phys. Rev. D 97, 094002 (2018).
2. "Electrical conductivity of Hot and Dense QCD matter at RHIC BES energies: A Color String Percolation Approach." Pragati Sahoo, Swatantra Kumar Tiwari, and Raghunath Sahoo, arXiv:1804.07980, Phys. Rev. D 98, 054005 (2018).
3. "Effect of Hagedorn States on Isothermal Compressibility of Hadronic Matter formed in Heavy-Ion Collisions: From NICA to LHC Energies."Arvind Khuntia, Swatantra Kumar Tiwari, Pramod Sharma, Raghunath Sahoo, and Tapan Kumar Nayak, arXiv:1809.03780, Phys. Rev. C 100, 014910 (2019).

### Research Highlights:

Dr. Sahoo's research group works on -Relativistic proton+proton (pp) and Heavy-Ion Collisions; -Quark-Gluon Plasma (Experiment and Phenomenology) ; -Exploration of QCD Phase diagram and search for the critical point.

### His group's research highlights include:

- Search for QGP-droplets in hadronic (pp) collisions at the LHC energies.
- Transport properties of the systems produced in heavy-ion and pp collisions, in contrast to condensed matter systems.
- Applicability of non-extensivity in high-energy physics.
- Resonances and Quarkonia production in proton+proton collisions at the Large Hadron Collider energies.

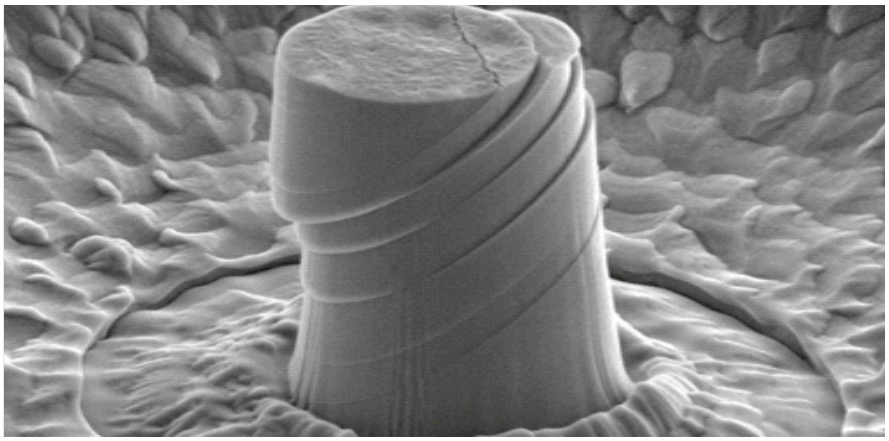
### Events and Seminars Organized:

- Member, National Organizing Committee, DAE-BRNS Symposium on High Energy Physics, IIT Madras (2018).
- Member, National Organizing Committee, DAE-BRNS Symposium on Nuclear Physics, BARC, Mumbai (2018).
- Colloquia by: Dr. D.K. Srivastava, FNA, FNASc; Dr. Y.P. Viyogi, FNA, FNASc.

### Research Projects:

A Large Ion Collider Experiment (ALICE) Upgrade, Operation and Utilization (Funded by DST, GOI).

# Discipline of Metallurgy Engineering and Materials Science



### Research Thrust/Facility

- Physical & Mechanical Metallurgy
- Welding & Failure Analysis
- Non-destructive Evaluation of Materials
- Electronic & Energy Materials
- Nano Materials, Soft Materials
- Corrosion & Surface Engineering

### Application Areas

- Synthesis & Design of Novel Materials for Energy Applications
- Alloy Development for Light weight Automative applications
- Surface Engineering of Materials
- Characterizing the Physical & Mechanical Properties of Materials

## From the HoD's Desk

**Dr. Parasharam Shirage**
Associate Professor
pmshirage@iiti.ac.in

The overarching aim of the discipline of Metallurgy Engineering and Materials Science is to promote multidisciplinary research in a bid to find solutions for real-world intricate problems and to work on cutting-edge research problems that benefit society. The research focus of the discipline is to understand the processing and structure of several classes of materials; and then correlate these to the properties, thus enhancing their performance.

The discipline has 14 core faculty members (including one Ramanujan Fellow and one DST Inspire Faculty Fellow), 19 associated faculties from the disciplines of Chemistry, Physics, Biosciences & Biomedical Engineering, Mechanical Engineering, and Electrical Engineering, and one adjunct faculty, Dr. Vilas Pol from Purdue University. The faculty members of the discipline work in broad research areas ranging from conventional metallurgy to modern materials science. The major research areas are spread across energy conversion and storage materials (Solar Cells, Supercapacitors, Li-ion batteries, etc.), structural materials

(Steels, Titanium alloys, High entropy alloys, Magnesium alloys, and Composite materials), functional materials (Piezoelectrics, Gels, and Shape memory alloys), and computation materials science.

The discipline offers several courses at undergraduate and graduate levels. Besides PhD. program, there are currently 2 M.Tech programs (Materials Science & Engineering and Metallurgy Engineering) and an undergraduate program. 2 M.Tech batches have graduated and 5 PhD. students have completed their PhD. and more than 50 PhD students are currently working.

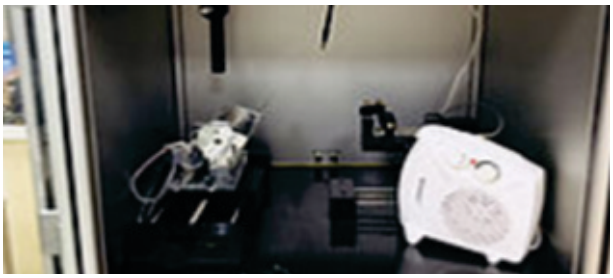
MEMS Faculty members

## Facilities in MEMS

The discipline is well-equipped with the state-of-the-art facilities for synthesis/fabrication and characterization of a wide range of materials for various physiochemical properties and device fabrication.

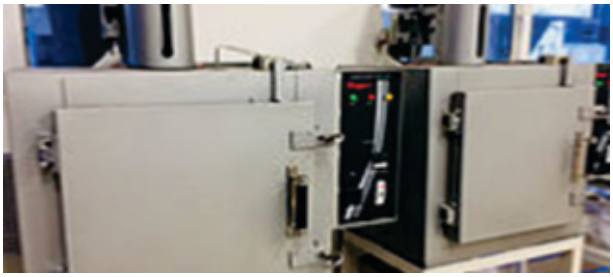
UV-Vis Spectroscopy

Hot Filament CVD



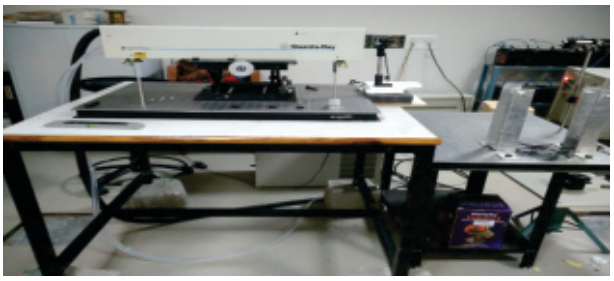
Electros pining

Rotary Evaporator

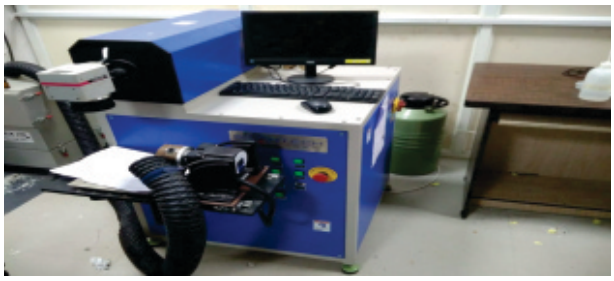


High Temperature Oven

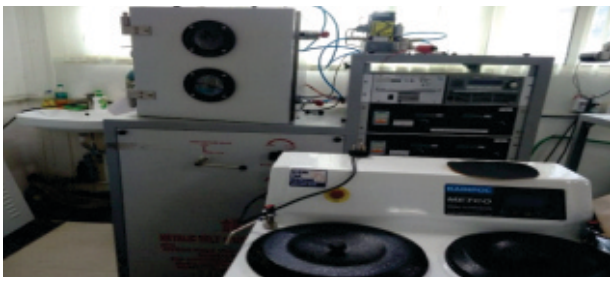
Ultra Senicator



Nd:YAG Laser



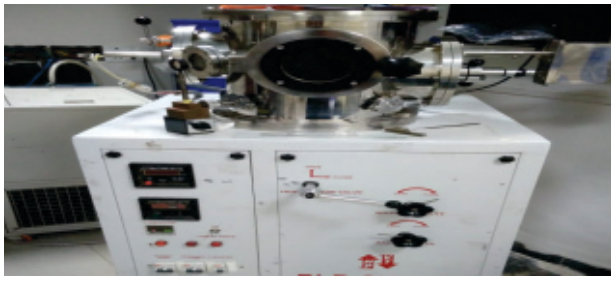
Continuous Fibre Laser



DC + RF Sputtering

Flash Evaporation

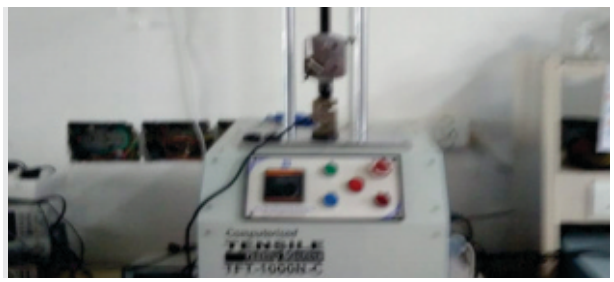
Arc Melting



Pulsed Laser Deposition

GMAW based Wire Arc Additive Manufacturing

Optical Microscope



Straining Setup for SMA

Thermal Evaporation

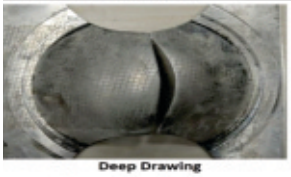
Muffle Furnace
Atm. Control, 1400°C

Tubular Furnace
2 Zone Heating, 1100°C

Optical Microscope
Max 1000X

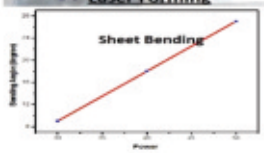
1) Ultrasonic Flow Detector
2) Electro-chemical Marker

## Experiments performed by UG Students



Deep Drawing

Laser Forming



Sheet Bending

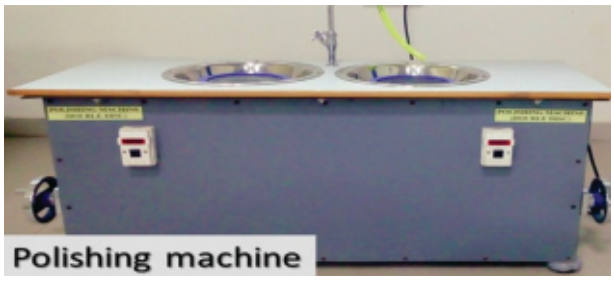
Heat Treatment & Forging

Tube Furnace

Polishing Machine

## Specimen preparation equipment

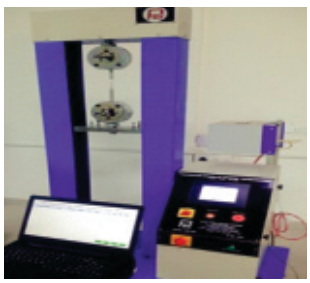
High speed saw




Polishing machine

## Mechanical testing equipment

Automatic Ball Indenter



Tensile testing m/c

Impact testing m/c

## Faculty Profiles in Metallurgy Engineering and Materials Science

**Dr. Parasharam M. Shirage**

Associate Professor
pmshirage@iiti.ac.in

**Dr. Parasharam M. Shirage** did his PhD. from Shivaji University, Kolhapur, India; and worked as Postdoc Scientist at various institutions including: Tata Institute of Fundamental Research, India (2012-13); Institute postdoctoral Fellow: AIST, Tsukuba, Japan (2008-2012); JSPS Postdoc. Fellow: AIST, Tsukuba, Japan (2006-2008); Visiting Scientist: KERI, Changwon, South Korea (2004-2006); and he was lecturer at Rajaram College, Kolhapur (Maharashtra Govt.) (2003-2004). Dr. Shirage is Visiting Fellow at Toyota Technological Institute Nagoya, Japan and National Institute of Advanced Industry, Science and Technology (AIST, Tsukuba, Japan.

### Selected Publications:

1. Prateek Bhojane, Armel Le Bail, Parasharam M Shirage, "A quarter of a century after its synthesis and with> 200 papers based on its use, Co (CO3) 0.5 (OH) 0.11 H2O' proves to be Co6 (CO3)2(OH)8 H2O from synchrotron powder diffraction data", IUCr Acta Crystallographica Section C: Structural Chemistry, C75, 61-64, 2019 (IF=8.678).
2. Prateek Bhojane, Lichchhavi Sinha, Uttam K Goutam and Parasharam M. Shirage, "A 3D mesoporous flowers of nickel carbonate hydroxide hydrate for high-performance electrochemical energy storage application" Electrochimica Acta, 296, 112-119, 2019. (IF=5.116).
3. S Arumugam, Manikandan Krishnan, Kent Ishigaki, Jun Gouchi, Rukshana Pervin, G Kalai Selvan, Parasharam M Shirage, Y Uwatoko, "Enhancement of superconducting properties and flux pinning mechanism on Cr0.0005NbSe2 single crystal under Hydrostatic pressure", Nature Scientific Reports, 9, 347(1-12), 2019. (IF=4.122).

### Research Highlights:

His broad area of research is Advanced Functional Materials: including Next Generation Photovoltaic Devices, Energy Storage Devices (Batteries and Supercapacitors), Piezoelectric Materials, and Sensors (Environmental monitoring and Health monitoring). The research highlights of his work is on development of Flexible and High Efficiency Solar Cells: The effect of PMMA in reducing the thermal degradation of Perovskite Solar cells (PSCs) is being studied.

Development of Sensors: we have successfully demonstrated synthesis of α-MnO2/Co3O4 hybrid nanostructure by decorating 1D α-MnO2 with Co3O4 nanoparticles for glucose sensing and properties were investigated.

### Events and Seminars Organized:

He organized two GIAN courses in December 2018 and April 2019 respectively. The courses are listed in GIAN courses Section of this report.

Organized 6-Days short term course on '"Characterization of Materials for Renewable and Sustainable Energy" (TEQIP sponsored) Discipline of Metallurgy Engineering and Materials Science, Indian Institute of Technology Indore, March 04-09, 2019.

### Research Projects:

Development of The Technique For The Growth of Metal Oxide Nano-Porous Materials For Supercapacitors Applications" (Funded by CSIR, GOI).

**Dr. Rupesh S. Devan**
Assistant Professor
rupesh@iiti.ac.in

**Dr. Rupesh S. Devan** (Assistant Professor: IIT Indore, 2017-till date; Associate Professor: Central University of Punjab, 2016-2017; INSPIRE Faculty: University of Pune, 2014-2016; Post-Doctoral Fellow: National Dong Hwa University Taiwan, 2007-2013) and his research group's activities are focused on the nano-hetero-architectures and core-shell nanostructures for the fabrication of energy conversion/storage devices, field emission displays, smart windows and resistive switching devices. Consortium for Scientific Research).

### Selected Publications:

1. R. S. Chauhgule and R. S. Devan, "Applications of One Dimensional Nanomaterials" (American Scientific Publishers, USA - 2019: ISBN: 1-58883-263-5).
2. R. S. Devan*, Y. R. Ma, and R. S. Chaughule "Potentials of 1D Brookite TiO2 Nanostructures for Engineering Energy Applications" for the book "Applications of One Dimensional Nanomaterials" Edited by – Dr. Rupesh S. Devan and Prof. R. S. Chaughule (American Scientific Publishers, USA - 2019: ISBN: 1-58883-263-5).
3. N. Kitchamsetti, R. S. Kalubarme, P. R. Chikate, C. J. Park, Y. R. Ma, P. M. Shirage and R. S. Devan*, "An investigation on the effect of Li-ion cycling on the vertically aligned brookite TiO2 nanostructures" (Chemistry Select 4 (2019) 6620-6626). (DOI: 10.1002/slct.201900395).

### Research Highlights:

Dr. Devan's research area is Nanostructures for engineering applications, Photo-active materials, and Energy storage/conversion materials.

### Events and Seminars Organized:

He organized two GIAN courses in December 2018 and April 2019 respectively. The courses are listed in GIAN courses Section of this report.

He also organized 6-Days short term course on 'Industrial Metallurgy and Quality Control' (TEQIP sponsored) Discipline of Metallurgy Engineering and Materials Science, Indian Institute of Technology Indore, 11$^{th}$ to 16$^{th}$ Feb. 2019.

### Research Projects:

Role of Boron passivated 1D NiO nanostructures in the next generation charge/energy storage devices (Funded by UGC-DAE, GOI).

**Dr. Mrigendra Dubey**
Assistant Professor
mdubey@iiti.ac.in

**Dr. Mrigendra Dubey** did his PhD: from Indian Institute of Technology Guwahati. After completion of his PhD in 2011 Dr. Dubey has worked as DST-INSPIRE Faculty at IIT (BHU) Varanasi; UGC-DS Kothari Postdoctoral Fellow at BHU, Varanasi and Postdoctoral Fellow at Academia Sinica, Taipei, Taiwan.

His main research work includes Synthesis of Soft Materials- Metallogel, Superabsorbent Materials, Structural Supramolecular Materials Chemistry based on chiral ligands, Quantum dots etc. Soft materials, particularly gels, have attracted substantial interest owing to their fascinating morphology, optical, rheology and various physical properties.

### Selected Publications:

1. $Cd^{2+}$-induced Fluorescent Metallogel: A case of CHEF and ACQ phenomenon K. Dixit C. Mahendar and Mrigendra Dubey – An Asian Journal, 2019, https://doi.org/10.1002/asia.201900559.
2. Li+-induced Fluorescent Metallogel: a case of ESIPT-CHEF and ICT phenomenon K. Dixit and Mrigendra Dubey. Chem. Chem. Phys, 2018, 20, 23762-23772.
3. Multi-stimuli responsive conductive sonometallogel: a mechanistic insight into role of ultrasound in gelation Vinay K. Pandey, Manish K. Dixit, Sébastien Manneville, Christophe Butcher and Mrigendra Dubey of Materials Chemistry A, 2017, 5, 6211-6218.

### Research Highlights:

Dr. Dubey is actively involved in the development of various kinds of soft materials (particularly gel materials) with special attention to - (i) Superabsorbent, (ii) Conductive, (iii) Charge transfer, (iv) Aggregation induced emission, (v) Chiro-optical, (vi) photophysical, (vii) morphological, (viii) Rheological and (ix) crystal engineering importance.

The direct applications as well as interesting chemistry of gels motivated me to establish my research lab for the synthesis of chiral inorganic gelators. Chirality tunes the morphology and exhibits the chiro-optical effects. The incorporation of metal with gelators may be associated with additional physicochemical properties such as magnetism, color, rheology, adsorption, emission, catalytic activity and redox behaviour. To the date very few chiral inorganic gels are reported because of difficulty in the synthesis of enantiopure chiral gelator molecules as well as the incorporation of metal more often than not inhibits the gelationpure chiral gelator molecules as well as the incorporation of metal more often than not inhibits the gelation.

### Research Projects:

DST-INSPIRE Faculty Award (Funded by DST, GOI).

**Dr. K. Eswara Prasad**
Assistant professor
eswar@iiti.ac.in

**Dr. Eswara Prasad Korimilli** earned his ME and PhD. from the Indian Institute of Science, Bangalore. Prior to joining IIT Indore, he worked as a Postdoctoral fellow at the Department of Mechanical Engineering, The Johns Hopkins University, Baltimore, USA and was Assistant Professor at the School of Engineering, Mahindra Ecole Centrale, Hyderabad. He is also a Visiting Faculty at the Institute of Nanotechnology, Karlsruhe Institute of Technology, Germany (May-July, 2019); and Center for Advancing Materials Performance from the Nanoscale, Xi'an Jiaotong university, China. He heads the Mechanics of Materials group at IIT Indore and works in the broad area of mechanical behavior of materials.

### Selected Publications:

1. BY Liu, K. Eswar Prasad, N Yang, F Liu, ZW Shan, In-Situ Quantitative TEM Investigation on the Dynamic Evolution of Individual Twin Boundary in Magnesium Under Cyclic Loading, Acta Materialia (accepted 2019).
2. K. Eswar Prasad, B. Li, N. Dixit, M. Shaffer, S.N. Mathaudhu, K.T. Ramesh, The Dynamic Flow and Failure Behavior of Magnesium and Magnesium Alloys, JOM 66 (2014) 291-304.
3. K. Eswar Prasad, K. Rajesh, U. Ramamurty, Micro- and macro-pillar compression responses of Mg single crystals oriented for single slip or extension twinning, Acta Materialia 65 (2014) 316-325.

### Research Highlights:

His broad area of research is in Mechanical behavior of materials, Indentation mechanics, high strain rate deformation, Tribology. Currently his group is trying to understand the deformation behavior of materials at different length and time scales using novel experimental techniques. The current interest of materials includes HCP materials (e.g. Mg and Ti alloys), amorphous materials (e.g. metallic glasses and polymers), advanced ceramics (e.g. Piezoelectric materials and SiC), BCC metals (e.g. Mo and Ta) and polymer nanocomposites.

### Events and Seminars Organized:

1. Co-Organized a GIAN course on "Integrated Computational Materials Engineering".
2. Co-Organized a course on "Introduction to Finite Element Analysis" under the aegis of TEQIP.

**Dr. Santosh S. Hosmani**
Assistant Professor
sshosmani@iiti.ac.in

**Dr. Santosh S. Hosmani** PhD. Max - Planck - Institute, Stuttgart, Germany Post-Doc.: Max- Plan ck-Institute, Germany and CWRU, Cleveland, USA Dr. Hosmani did his PhD in 2006. He received fellowships from the prestigious Max- Planck-Society during PhD and Post-Doc. He has 12 years of Post PhD experience in research, academics and industry. He is leading the'Surface Engineering and Heat Treatment' research-group in the Discipline of MEMS. Research interests of his group are surface engineering, wear behavior of surface engineered alloys, and physical metallurgy.

### Selected Publications:

1. D. Singh, A.M. Gatey, R.S. Devan, V. Antunes, F. Alvarez, C.A. Figueroa, A.A. Joshi and S.S. Hosmani, "Surface Treatment Response of AISI 2205 and AISI 304L Steels: SMAT and Plasma-Nitriding", Surface Engineering, Vol. 35, No. 3, Pages 205-2015 (2019). DOI: 10.1080/02670844.2018.1516372.
2. A.K. Litoria, A.A. Joshi, M.D. Joshi, G. Dixit, D. Singh and S.S. Hosmani, "Wear Behaviour of Boronized and Duplex-Treated AISI 4140 Steel Against DLC-Coated Boronized AISI 4140 Disc", Surface Engineering, Vol. 35, No. 4, Pages 370-377 (2019). DOI: 10.1080/02670844.2018.1512198.

3. K.M. Mane and S.S. Hosmani, "Friction Stir Surface Processing of Al 6061 Alloy: Role of Surface Alloying with Copper and Heat-Treatment", Transactions of the Indian Institute of Metals, Vol. 71, No. 6, Pages 1411-1425 (2018). DOI: 10.1007/s12666-018-1277-0.

**Research Highlights:**

Dr. Hosmani works in the area of Surface Engineering and Heat Treatment of Ferrous and Non-ferrous Alloys. His research group on Surface Engineering and Heat Treatment (SEHT) has fabricated successfully a setup to obtain the sever deformation of metal surface using the concept of electromagnetic vibrations. This process improved the surface-hardness of AISI 2205 steel by 70–80%, and more than 100% for AISI 304L steel. Passive film formed on such deformed surface of steel was relatively more stable. Severely deformed surface of these steels demonstrated an excellent tribological behavior in dry and lubricated conditions.

**Events and Seminars Organized:**

TEQIP Sponsored 6-Days Short-term Course, "Industrial Metallurgy and Quality Control," IIT Indore. (11th to 16th February 2019). Lectures were delivered by 4 experts from industries and 3 faculties from MEMS, IIT Indore. Many participants from other institutes took the benefits of this course.

**Research Projects:**

Wear Behavior and Microstructural Studies of Surface Mechanical Attrition Treated (SMAT) and Post-Treated Stainless Steels (Funded by DST-SERB, GOI).

**Dr. Vinod Kumar**
Assistant Professor
vkt@iiti.ac.in

**Dr. Vinod Kumar** did his PhD. from IIT Kanpur in May 2012. He has worked as Guest Faculty in the Department of Metallurgical and Materials Engineering at Malaviya National Institute of Technology Jaipur (22nd Dec. 2011– 15th June 2012); and Assistant Professor in the Department of Metallurgical and Materials Engineering at Malaviya National Institute of Technology Jaipur (July 6, 2012 – March 29,2017 ).

His work largely includes research on (i) Nanomaterials; (ii) Structure-Property Correlations in High Entropy Alloys; (iii) Corrosion Engineering, (iv) Lightweight alloys for automotive and aerospace applications, and (v) Phase transformation.

**Selected Publications:**

1. Anil Kumar, Vinod Kumar, Pramod Kumar Sain, Manoj Kumar, and Kamlendra Awasthi, "Synthesis and characterization of polyaniline membranes with N, N'-dimethyl propylene urea as a secondary amine additive for fuel cell application". International Journal of Hydrogen Energy, (Nov 2018), Volume 43, Issue 47, 22, Pages 21715-21723, DOI: 10.1016/j.ijhydene.2018.04.083.
2. Saurav Kumar; A. Patnaik; A. K. Pradhan; Vinod Kumar, Room temperature wear study of Al0.4FeCrNiCox (x = 0, 0.25, 0.5, 1.0 mol) high-entropy alloys under oil lubricating conditions, Journal of Materials Research, vol. 34, pp. 841-853, (Mar 2019).
3. Saurav Kumar, Devesh Kumar, Ornov Maulik, Ajaya kumar Pradhan, Vinod Kumar, and Amar Patniak, "Synthesis and Air Jet Erosion Study of AlXFe1.5CrMnNi0.5 (x = 0.3, 0.5) High-Entropy Alloys". Accepted in Metallurgical and Materials Transactions A, (Nov,2018) Volume 49, Issue 11, pp 5607–5618 DOI: 10.1007/s11661-018-4894-7.

**Research Highlights:**

Dr. Vinod's research areas are broadly falling under Powder Metallurgy and Physical Metallurgy. Their group uses experiments and analytical theory to explore the materials-processing-structure-property relationships in structural metallic materials and energy materials and their development for required engineering application, with particular emphasis on the role of structural disorder and its effect on

environmental degradation and mechanical properties. This research also involves in non-equilibrium processing for the development of energy materials and high entropy alloys of industrial relevance using a variety of tools as well as in developing new metal-matrix composites.

### Events and Seminars Organized:

1. Coordinator of "Training Program on Active Learning: Phase C" organized from 25-06-2018 to 29-06-2018 at IIT Indore for faculty members of MITS Gwalior and GEC Sundarnagar.
2. Coordinator of "Training Program on Active Learning: Phase B" organized from 18-06-2018 to 22-06-2018 at IIT Indore for faculty members of JEC Jabalpur and MITS Gwalior.
3. Coordinator of "Training Program on Active Learning: Phase A" organized from 11-06-2018 to 15-06-2018 at IIT Indore for faculty members of JEC Jabalpur.

### Research Projects:

Economic production of iron through direct reduction of Mill Scale by low grade coal of Rajasthan (Funded by Ministry of Steel, GOI).

**Dr. Jayaprakash Murugesan**
Assistant Professor
jayaprakash@iiti.ac.in

**Dr. Jayaprakash Murugesan** did his M.S. (by research, Oct 2005) and PhD. (March 2010) from Indian Institute of Technology Madras and Nagaoka University of Technology (Japan), respectively. His areas of specialization include Mechanical behavior of materials, Materials Joining, Dissimilar welding, Fatigue, Fretting Fatigue, Fracture mechanics, Creep, Alloy development, and Surface Engineering.

The current focus of Dr. Murugesan's group is on Dissimilar welding of materials, fatigue of advanced materials, solid state welding, hybrid welding, fretting fatigue, fretting wear. Dr. Murugesan has supervised 2 UG students and 5 PG students. At present, he is supervising 2 PG and 3 PhD. students for their thesis work.

### Selected Publications:

1. Sangam Sangral, K Achyuth, Mahesh Patel, Jayaprakash M, Effect of fretting on fatigue behavior of Al alloys considering Environmental effect, Materials Today,15-1, pp 119-125, (2019).
2. K Achyuth, Sangam Sangral, Mahesh Patel, Jayaprakash M, Fretting wear degradation behavior of Al-Si-Ni based cast Aluminum alloy under different environment, Materials Today,15-1, pp 103-108, (2019).
3. Mahesh Patel, Sangam Sangral, K Achyuth, Jayaprakash M, Fretting Wear Behavior of The Hardfaced Structural Steel Under Corrosive Environment, , Materials today,15-1, pp 103-108, (2019).

### Research Highlights:

Dr. Murugesan works on Materials joining, materials testing, fatigue, alloy development, surface engineering, focusing on:

- Fatigue and fretting fatigue behaviour of high strength alloys.
- Dissimilar materials joining.
- Friction stir processing of Al, Mg alloys.
- Alloy development.

### Events and Seminars Organized:

1. Convener for "6-day short course on Advances in Materials and Processing", Organized at Discipline of Metallurgy Engineering and Materials Science, IIT Indore in Jan 2019.
2. Convener for "One day workshop on Japanese Language " Organized at IIT Indore in March 2019.

### Research Projects:

Fretting fatigue and fretting wear behavior of Titanium Foam under simulated body fluid environment (Funded under TEQIP).

**Dr. Sumanta Samal**
Assistant Professor
sumanta@iiti.ac.in

**Dr. Sumanta Samal** earned his doctorate from the department of Materials Science and Engineering, Indian Institute of Technology Kanpur in 2014, followed by three years of Post-Doctoral research experience in the Department of Metallurgical and Materials Engineering at the Indian Institute of Technology Madras.

His research and teaching interests include solidification, physical metallurgy, phase transformations and phase equilibria in materials, hot deformation behaviour in multicomponent/high entropy alloys, Phase selection kinetics in deeply undercooled metallic melts, phase field simulation for microstructural evolution.

### Selected Publications:

1. Rahul MR, Sumanta Samal, S. Venugopal, G. Phanikumar, Experimental and finite element simulation studies on hot deformation behaviour of AlCoCrFeNi2.1 eutectic high entropy alloy, Journal of Alloys and Compounds, Vol. 749, pp. 1115–1127, 2018.
2. Reshma Sonkusare, Aditya Swain, M.R. Rahul, Sumanta Samal, N. P. Gurao, Krishanu Biswas, S.S. Singh, Niraj Nayan, Establishing processing-microstrucrure-property paradigm in complex concentrated single phase CoCuFeMnNi high entropy alloy, Materials Science and Engineering A, Vol. 759, pp. 415-429, 2019.
3. Rahul M R, Sumanta Samal, Gandham Phanikumar, Effect of Niobium addition in FeCoNiCuNbx high entropy alloys, Journal of Materials Research, Vol. 34, pp. 700-708, 2019.

### Research Highlights:

Our reseach interests include phase transformations and phase equilibria in materials, Processing-Structure-Property correlation in multicomponent/high entropy alloys, metastable phase formation in deeply undercooled alloys, Phase field simulation for microstructure evolution. The main areas of research are:

- Solidification:Experiments and Simulation
- Multicomponent/High Entropy Alloys
- Processing-Structure-Property Correlations
- Material design for high temperature applications
- Phase equilibria: Materials for future
- Thermo-mechanical Processing of structural materials

**Dr. Ajay Kumar Kushwaha**
Assistant Professor
akk@iiti.ac.in

**Dr. Ajay Kumar Kushwaha** PhD: Indian Institute of Technology Bombay (2014) Scientist-I: Institute of Materials Research and Engineering, A*STAR, Singapore (2014-16)

### Research interests:

- Design and growth of nanomaterials/thin films
- Optical and transport properties of semiconductors
- 2-D materials based electronic devices
- Energy efficient coatings
- Energy conversion devices: PEC water splitting, photovoltaic, piezoelectric and thermoelectric.

### Selected Publications:

1. N. Mukurala, R.K. Mishra, S.H. Jin, and Ajay Kushwaha, Sulphur precursor dependent crystallinity and optical properties of solution grown Cu2FeSnS4 particles , Materials Research Express , 6 (8), 085099 (2019).

2. N. Mukurala, S. Suman and Ajay Kushwaha, Effect of solvents on structural, morphological and optical properties of solvothermally grown Cu2FeSnS4 particles , AIP Conference Proceedings , 2115 (1), 030603 (2019).
3. R.K. Mishra, Ajay Kushwaha, S. Kim, S.G. Seo and S.H. Jin, Vertical-slate-like MoS2 nanostructures on 3D-Ni-foam for binder-free, low-cost, and scalable solid-state symmetric supercapacitors , Current Applied Physics , 19, 1-7 (2019).

**Research Highlights:**

Dr. Kushwaha works on Nano and Energy Materials, especially emphasizing: (i) Design and synthesis of nanomaterials; (ii) 2-D Materials (Graphene and Mxenes)and Electronic Devices, (iii) Thin Films and Multifunctional Coatings, (iv) Optical and transport properties of semiconductors, (v) Electrochemistry and Electrochemical Metallurgy, (vi) Energy Conversion Devices: New Generation Solar Cell, (vii) Solar Driven Water Splitting, (viii) Solar-hydrogen Energy and (ix) Piezoelectric.

**Events and Seminars Organized:**

23rd International Symposium on VLSI Design and Test (VDAT-2019), IIT Indore.

**Research Projects:**

Wet-chemical approach to fabricate visible-near infrared light harvesting photoelectrodes (Funded by DST, GOI).

**Dr. Dhirendra Kumar Rai**
Assistant Professor
dkrai@iiti.ac.in

**Dr. Dhirendra Kumar Rai** did his PhD. from: Indian Institute of Technology Bombay Before joining IIT Indore as Assistant Professor, Dr. Rai has been DST Young Scientist and a Post doctoral research at IIT Indore. The primary research focus of Dr. Rai's research group is to develop new hybrid materials through surface tailoring of compatible inorganic colloidal nanoparticles with specific organic functionalities for particular applications. Such surface functionalized materials with a suitable organic moiety can be employed for biological probing.

**Selected Publications:**

1. "Synthesis of Novel Allene-Coordinated, Phosphido-Bridged $Ru^2Pt$ Clusters Involving Enyne to Allene Transformation" P. Mathur, D. K. Rai, R. K. Joshi, B. Jha and S. M. Mobin, Organometallics 33 (2014) 3857−3866.
2. "Structural and electrochemical aspects of tris (ferrocenyl/phenyl-ethynyl)phosphine ligated chalcogen bridged iron carbonyl clusters" P. Mathur, D. K. Rai, R. S. Ji, B. Pathak, S. Boodida and S. M. Mobin RSC Advances 3 (2013) 26025-26034.
3. "Modulation of Electronic Communication between Two Equivalent Ferrocenyl Groups Mediated Through Tricarbonylcyclobutadieneiron" D. K. Rai, M. Tauqeer, S. Chatterjee, S. Krishnan, S. M. Mobin and P. Mathur, European Journal of Inorganic Chemistry 5 (2019) 668–675.

**Research Highlights:**

Dr. Rai's research group works on Environmental Remediation and Sustainable energy conversion and storage. The rapid increase in $CO_2$ level due to the burning of fossil fuels (Coal, Petroleum oil and Natural gas) to meet the energy demand of the present days is leading to serious environmental issues such as global warming. To mitigate the rampant $CO_2$ emission, it is imperative to address the problem not only by $CO_2$ sequestration but also by breaking our reliance on fossil fuel and seeking other sustainable energy sources that are eco-friendly. In this regard, Dr. Rai's research group is actively engaged in the design of new multifunctional materials that can capture and fix the environmental $CO_2$ into valuable feedstock and can also be used for storage of electrochemical energy.

### Research Projects:

Synthesis of the metal nanoparticles functionalized with thiolate chelated metal carbonyl clusters and their application as heterogeneous biomimetic hydrogenases (Funded by DST-SERB, GOI).

**Dr. Abhijit Ghosh**
Assistant Professor
aghosh@iiti.ac.in

**Dr. Abhijit Ghosh** (PhD.: Indian Institute of Technology Kharagpur and Post. Doc.: Indian Institute of Science Bangalore). Dr. Abhijit Ghosh's broad field of expertise is in the area of Physical and Mechanical Metallurgy of steel. He has research experience in the field of crystallographic texture, grain boundary engineering, small scale mechanical testing, fracture micro mechanism and creep. Apart from experimental expertise, he also has a strong interest on the theoretical aspects of metallurgical fundamentals.

### Selected Publications:

1. Arya Chatterjee, A. Ghosh, A. Moitra, A.K. Bhaduri, R. Mitra, D. Chakrabarti, Role of hierarchical martensitic microstructure on localized deformation and fracture of 9Cr-1Mo steel under impact loading at different temperatures, International Journal of Plasticity, 104 (2018), pp. 104-133.
2. A. Ghosh, S. Patra, A. Chatterjee, D. Chakrabarti, Effect of local crystallographic texture on the fissure formation during Charpy impact testing of low carbon steel, Metallurgical and Materials Transactions A, 47 (2016), pp. 2755-2772.
3. A. Ghosh, S. Kundu, D. Chakrabarti, Effect of crystallographic texture on the cleavage fracture mechanism and effective grain size of ferritic steel, Scripta Materialia, 81 (2014) pp. 8-11.

### Research Highlights:

His research areas includes: (i) Crystallographic texture and grain boundary, (ii) Fracture mechanics and Micro-mechanism, (iii) Physical Metallurgy of Steel and (iv) Computational Materials Science. The research work being undertaken by his group includes developing Cold Rolled Grain Orientated (CRGO) electrical steel, Correlating crystallographic texture with fracture, and Understanding the Cleavage crack deviation at grain boundaries.

### Events and Seminars Organized:

Organizing member of a TEQIP Sponsored 6 day Short Course on "Advanced Materials and Processing" form January 8, 2019 to January 13, 2019 at IIT Indore.

### Research Projects:

Development of Cold Rolled Grain Oriented Electrical steel with high Si Content (Funded by DST, GOI).

**Dr. Hemant Borkar**
Assistant Professor
h.borkar@iiti.ac.in

**Dr. Hemant Borkar** (PhD: McGill University, Canada, Postdoctoral researcher: Jonkoping University, Sweden, Senior Teaching Fellow: University of Warwick, UK) His past research has concentrated on microstructural, texture and mechanical characterization of Mg and Al alloys including electron back scattered diffraction (EBSD) studies. His current work aims at inter-disciplinary research which is focussed on the product development by investigation of alloy-design-process-properties.

### Selected Publications:

1. Hemant Borkar, Salem Seifeddine, Anders Jarfors, ''In-situ EBSD study of deformation behavior of Al-Si-Cu alloys during tensile testing'', Materials and Design 84 (2015) 36-47.

2. Hemant Borkar, Raynald Gauvin, Mihriban Pekguleryuz, "Effect of extrusion temperature on texture evolution and recrystallization in extruded Mg-1%Mn and Mg-1%Mn-1.6%Sr alloys", Journal of Alloys and Compounds, 555 (2013) 219-224.
3. Hemant Borkar, Majid Hoseini, Mihriban Pekguleryuz, "Effect of strontium on the texture and mechanical properties of extruded Mg-1%Mn alloys", Materials Science and Engineering A 549 (2012) 168-175.

**Research Highlights:**

Dr. Borkar works in the area of lightweight materials Mg and Al with focus on processing-structure-property relationships. His focussed research includes: (i) Materials and manufacturing, (ii) Process-structure-property relationships in metals, (iii) Lightweight components for transport applications, (iv) Casting of light metals (Al and Mg), casting defects, casting simulation and experimental studies, (v) Deformation processing including extrusion, rolling, forming etc, deformation mechanisms, and (vi)Electron back scattered diffraction, in-situ deformation studies, crystallographic texture.

**Events and Seminars Organized:**

1. Organizing member, TEQIP 3-Day Short Course on 'Advanced Surface Science and Engineering', March 2018, IIT Indore.
2. Convener, 6-Day Short Course on 'Advanced Materials and Processing', January 2019.

## Dr. Sunil Kumar

Assistant Professor
sunil@iiti.ac.in


**Dr. Sunil Kumar** (PhD: Indian Institute of Science Bangalore; Visiting Researcher: Polytechnic University of Catalonia- Barcelona Tech, Spain; Research Fellow: National University of Singapore; Assistant Professor (ad-hoc): University of Delhi). His research focuses on the experimental investigations of structure–property–processing relationship in functional materials as a mean to develop technologically important novel materials with tailored properties. Of particular interest are materials for energy storage applications and lead-free piezoceramics.

**Selected Publications:**

1. Tanvi Pareek, Sushmita Dwivedi, Birender Singh, Pradeep Kumar, Sunil Kumar, "LiSnZr(PO4)3: NASICON-type solid electrolyte with excellent room temperature Li+ conductivity", Journal of Alloys and Compounds, 777 (2019) 602-611.
2. Tanvi Pareek, Birender Singh, Sushmita Dwivedi, Arun Kumar Yadav, Anita, Somaditya Sen, Pradeep Kumar, Sunil Kumar, "Ionic conduction and vibrational characteristics of $Al^{3+}$ modified monoclinic $LiZr^{2}(PO4)^{3}$", Electrochimica Acta, 263 (2018) 533-543.
3. Sushmita Dwivedi, Tanvi Pareek, Sunil Kumar, "Structure, dielectric, and piezoelectric properties of K0.5Na0.5NbO3-based lead-free ceramics", RSC Advances, 8 (2018) 24286-24296.

**Research Highlights:**

Dr. Sunil Kumar's work deals with Electroceramics, Materials for Electrochemical Energy Storage. The Major highlights of his work are as follows:

- Fabrication of lead-free perovskite piezoceramics which showed enhanced piezoelectric charge coefficient d33 = 130 pC/N and electromechanical coupling factor kp = 31 %. The values of piezoelectric parameters are found to be significant up to an elevated temperature 350 °C.
- Fabricated and characterized $K+/La^{3+}$ substituted Na0.5Bi0.5TiO3 ceramics that provided a stable dielectric constant over a wider temperature range. Further, superior energy storage efficiency (around 87-93 %, in the temperature range 30-140 °C) with almost thermally stable energy storage density (from ~ 0.74 J/$cm^3$ to ~ 0.71 J/$cm^3$) was achieved in another composition.

- Synthesis of novel rhombohedral structured (R-3¯c) LiSnZr(PO4)3 which shows an excellent RT bulk Li+ conductivity (0.1 mScm-1) and low activation energy (0.36 eV). The results signify the importance of inductive effect in improving the room temperature ionic conductivity by utilizing the electronegativity of counter-cations in NA-Super-Ionic-Conductor (NASICON)- framework.

**Research Projects:**

1. Development of Solid Electrolyte for All-Solid-State Rechargeable Lithium Batteries (Funded under DST INSPIRE Scheme, GOI).
2. Compositionally and Microstructurally Engineered Lead¬-Free Ceramics for Piezoelectric Applications (Funded under SERB-DST Early Career Research Award, GOI).

## Adjunct Faculty

**Dr. Vilas G. Pol**

Adjunct Faculty
vpol@purdue.edu

**Dr. Vilas G. Pol** is an Adjunct Faculty at MEMS. He has been awarded a PhD from the Center for Advanced Materials and Nanotechnology, University of Bar-Ilan, Israel in 2005. He was previously a visiting faculty at the International Center for Materials Nanoarchitectonics, National Institute for Materials Science (NIMS), Tsukuba, Japan; and a Materials scientist at the Lithium Battery Materials Group, Electrochemical Energy Storage Department, Argonne National Laboratory (ANL), IL, USA.

**Broad research area:**

1. Advanced Functional Nanoarchitectures:
2. Electrode Materials for next generation Energy Storage Devices ( Batteries and Supercapacitors)
3. CO2 Storage
4. Thermal sensors for batteries
5. Lubrication

**Patents:**

1. G. Pol, P. Thiyagarajan, Process for remediation of plastic waste, US 8,153,094 (Issued: April 10, 2012).
2. V. G. Pol, S. V. Pol, M. M. Thackeray, Autogenic pressure reactions for battery materials manufacture, US 8,568,914 (Issued: October 29, 2013).
3. V. G. Pol, M. M. Thackeray, K. K. Mistry, A. Erdemir, Materials as additives for advanced lubrication, US 08,648,019 (Issued: February 11, 2014).

**Selected Publications:**

1. B. Li, M. H. Parekh, R. A. Adams, T. E. Adams, C. Love, V. G. Pol, V. Tomar, "Lithium-ion battery thermal safety by early internal detection, prediction and prevention", Scientific Reports, 2019, 9, 13255.
2. R. A. Adams, A. Varma, V. G. Pol. "Carbon Anodes for Nonaqueous Alkali Metal-Ion Batteries and Their Thermal Safety Aspects", Adv. Energy Mater. 2019, 1900550.
3. R. A. Adams, A. Mistry, P. Mukherjee, V.G. Pol, "Materials by Design: Tailored Morphology and Structures of Carbon Anodes for Enhanced Battery Safety", ACS Applied Materials and Interfaces, 2019, 11, 14, 13334-13342.

# School of Humanities and Social Sciences

The hallmark of School of Humanities and Social Sciences is a genuine interaction between multifarious approaches to knowledge, signifying the importance of each and every approach. It believes in a multi-disciplinary kaleidoscopic approach looking at both convergence and divergence of knowledge. We emphasize on providing students with the much-needed experiences that enable them to face the opportunities and challenges of today's changing world. In this effort, we always prepare ourselves to provide excellence in teaching and research through a continuous improvement process. Currently, six disciplines- Economics, English, History, Psychology, Sociology and Philosophy- endeavor to achieve this.

In the last year, the School has organized distinguished talks on the state of diplomatic conditions between India and Pakistan, approaches to understanding the field based empirical research, the right model of Stochastic Volatility and decision-making mechanisms used as a pedagogical tool.

## Faculty Profiles

**Ambassador Gurjit Singh**

Honorary Professor

The School is also proud to host the Honorary Professor of International Relations Studies, Ambassador Gurjit Singh. He was a member of the Indian Foreign Service and retired as the Indian Ambassador to Germany. He finished his schooling at Mayo College, Ajmer and obtained his Bachelor's Degree in Politics from St. Xavier's College, Kolkata. A Post Graduate in International Studies from the School of International Studies, Jawaharlal Nehru University, New Delhi, he was appointed to the Indian Foreign Service in 1980. He has served in Indian Missions in Tokyo, Colombo, Nairobi,

Rome and was the Ambassador of India to Ethiopia, Djibouti, Indonesia, Timor-Leste, ASEAN, and the Representative of India to the African Union, the Economic Commission for Africa and IGAD. While in Nairobi, he was the Deputy Permanent Representative of India to UNEP and UN-HABITAT.

Mr. Singh has published, The Abalone Factor: An overview of India-Japan Business Relations in 1997 which won him the Bimal Sanyal Award for Research by a Foreign Service officer. His subsequent books included The Injera and the Parantha: Enhancing the Ethio-India Relationship (2009) and Masala Bumbu: Enhancing the India- Indonesia Partnership (2015). He is also the author of a comic book on the legacy of the India-Indonesia relationship. His edited book,

Opportunity Beckons: Adding Momentum to the Indo-German Partnership was released in January 2017 in Berlin. He has an abiding interest in developmental economics and issues of sustainable development and contributes frequently on economic, developmental and trade issues to various journals and books. He is currently working on a new book on Africa.

**Dr. Akshaya Kumar**
Assistant Professor
Sociology
akshaya.kumar@iiti.ac.in

**Dr. Akshaya Kumar** is an Assistant Professor. His research in Film, Media and Cultural Studies revolves around South Asian Film and Media. He has published extensively on News Media, Crime and Reality Television, Hindi Cinema, Stardom, Language Politics and the question of provinciality in Regional Cinema. Most of his work, drawing upon his Ph.D. dissertation, discusses the explosive growth of Bhojpuri Cinema and its attendant complexities with respect to labour, gender, urban resettlement, and region- formation. He finished his Ph.D. from the University of Glasgow. He also spent two months as an exchange fellow at Columbia University, New York. Prior to joining at IIT Indore, he taught for a year at Ambedkar University, Delhi.

**Broad research area:**

Cultural Studies, Film Studies [Indian Cinema], Media Studies, Music & Performance Studies, Sociology of Labour Migration.

**Research Highlights:**

Signed a contract with Oxford University Press for the academic monograph Provincializing Bollywood: Bhojpuri Cinema in the Comparative Media Crucible, to be published in 2020.

**Selected Publications:**

1. Kumar, Akshaya. (2018) 'Media Portfolios after Credit-Scoring: Attention, Prediction and Advertising in Indian Media Networks.' Postmodern Culture 28 (2), doi: 10.1353/pmc.2018.0014.
2. Kumar, Akshaya. (2019) 'Consolidating Bollywood: Spectacularity Without Stardom.' In Sharon Heijin Lee, Monika Mehta, and Robert Ji-Song Ku (eds) Pop Empires: Transnational and Diasporic Flows of India and Korea. Honolulu: University of Hawaii Press, 138-154.
3. Kumar, Akshaya. (2019) 'Insurrectionary Tendencies: The Viral Fever Comedies and Indian Media.' In Adrian Athique and Emma Baulch (eds) Digital Transactions in Asia: Economic, Informational, and Social Exchanges. Abingdon: Routledge, 192-204.

**Dr. Ananya Ghoshal**
Assistant Professor
English
aghoshal@iiti.ac.in

**Dr. Ananya Ghoshal** received her doctorate from the Department of English Literature at the English and Foreign Languages University (formerly CIEFL), Hyderabad. Her thesis was on the Influence of Music in Postcolonial Literature (2016). Her pre-doctoral research was conducted in the Department of English at the University of California, Berkeley, on a Fulbright-Nehru Fellowship. Her primary areas of interest are: Word Studies, Narratives of the Anthropocene, Performance Studies, Digital Humanities and Visual Culture. Before coming to IIT Indore, she was an academic fellow at the Forum on Contemporary theory, Baroda. Ananya is also an official alumni Ambassador of UC Berkeley and represents her alma matter in EduUSA outreach events across India.

Broad research area: Literature and the Other Arts, Word and Music Studies, Literature and the Anthropocene, Environmental Humanities, Visual Culture, Disability Studies, Indian Theories of Aesthetics.

**Research Highlights:**

1. An Anthropocene Primer (book co-authored): This innovative open access, interactive publication guides learners through the complex concepts and debates related to the Anthropocene, including climate change, pollution, and environmental justice. The Version 1.0 of the book has been highly influential and is being used across the United States in classrooms. As a team we are working on the second and the final version of the Primer.
2. Disability in Translation, The Indian Experience published by Routledge is a major intervention in translation and disability studies; the first of its kind coming out of India.

**Selected Publications:**

1. Reading interrupted: translating disability in Subha, in Disability in Translation, The Indian Experience, Edited by Someswar Sati and GJV Prasad (Routledge, 2019).
2. An Anthropocene Primer, Version 2.0: An Open Access Born Digital Book and A Companion Hard Copy, ed. Jason M. Kelly and Fiona P. McDonald, (UPUI Arts and Humanities Institute in collaboration with Indiana University Press, Forthcoming late-2019).
3. Sounding the Anthropocene, in Scenes From the Anthropocene, ed. Jason M. Kelly and Fiona P. McDonald, (University of California Press, Forthcoming late-2019).

**Dr. Ashok Kumar Mocherla**
Assistant Professor
Sociology
ashokmocherla@iiti.ac.in

**Dr. Ashok Kumar Mocherla** is an Assistant Professor of Sociology in the School of Humanities and Social Sciences, IIT Indore. He received his doctorate from the Indian Institute of Technology Bombay. Before joining IIT Indore in March 2018, he was a faculty member in the School of Humanities and Social Sciences at IIT Mandi. His areas of academic interest are: Sociology of Religion, Caste, and Indian Christianity; Sociology of Faith Healing and Public Health. He also has a keen interest in Sociology of Education (with reference to the growing transnational migration and commodification of engineering education in India). He teaches courses on Introduction to Sociology; Indian Society: Structure and Change; and, Sociology of Science and Technology. He has signed a contract with Routledge India (Taylor and Francis group) to publish his first book tentatively titled 'Dalit Christians in South India: Caste, Ideology and Lived Religion'.

**Broad research area:** Sociology of Religion, Faith Healing and Public Health, Sociology of Education and Youth, Minority Studies.

**Selected Publications:**

1. Ashok Kumar M. 2019. 'Declaration of Faith and Dissenting Voices: Two Narrations of Lived Religion among Christian Youth in South India'. In Social Compass. (forthcoming).
2. Ashok Kumar M. 2019. 'We Called Her Peddamma: Caste, Gender and Missionary Medicine in Guntur, South India: 1880 – 1930'. In International Journal of Asian Christianity. (forthcoming).
3. Ashok Kumar M. 2019. 'Communism and the Cross: A Caste-class Trajectory of Conversion to Christianity in Coastal Andhra, South India' In Peter Berger and Sarbeswar Sahoo (Ed.) Godroads: Modalities of Religious Conversions in India.

   New Delhi: Cambridge University Press. (forthcoming)

**Research Projects**:

Democratization of Indian Christianity: Dalit Christian Liberation Movement in Contemporary India (Funding by: ICSSR).

**Dr. C. Upendra**
Associate Professor
Philosophy
cupendra@iiti.ac.in

**Dr. C. Upendra** received his doctoral degree in Philosophy from the Department of Humanities & Social Sciences, Indian Institute of Technology Bombay. His doctoral work is in the area of moral philosophy with some linkages to Political Philosophy. The focus of the work was on the logic of reasoning about morality and good. Prior to joining IIT Indore as Assistant Professor, he served the Ford-Foundation funded research library; Forum on Contemporary Theory at Baroda in Gujarat.

**Broad research area:** Moral-Political Philosophy, History of Ideas, Radical Philosophy, Philosophy of Film & Music.

**Research Highlights:**

Currently, my research focuses on the identification of the radical – whether immanent and veiled by certain existential processes or it is a consequent of the conditions under one lives. The focus is on the what kind of grasp we can have about the human condition. Further it investigates the possible ontological nature of equality, justice and freedom – while also admitting to the paradox that they are mutually irreconcilable.

**Selected Publications:**

Jasmine Fernandez, C. Upendra & Amarjeet Nayak, A New Critical Notice of Robin Cook's Medical Thriller 'Coma', Socrates, vol. 6.3/4, pp. 1-26, 2019.

**Dr. Nirmala Menon**
Associate Professor
English
nmenon@iiti.ac.in

**Dr. Nirmala Menon** leads the Digital Humanities and Publishing Research Group at the IIT Indore. She has co-edited Migrant Identities of Creole Cosmopolitans: Transcultural Narratives of Contemporary Postcoloniality (Peter Lang Publishing, Germany, 2014); and authored Remapping the Postcolonial Canon: Remap, Reimagine, Retranslate (Palgrave Macmillan, UK 2017).

Prof. Menon is also on the Advisory Board of the Open Library of Humanities (OLH) and Chair, (2016-17) CLCS Global South Forum, Modern Language Association (MLA), Editor Post-colonial Indian Literature at litencyc.com. She is one of the Board members of Ubiquity Press, a consortium of Open Access university presses globally. She is one the founders of Digital Humanities Alliance of India (DHAI). She is currently working on her second monograph that critically looks at Digital Humanities in India and its ontological challenges.

**Broad research area:** Digital Humanities and Publishing Studies.

**Research Highlights:**

The Digital Humanities and Publishing Research Group at IIT Indore is involved in interdisciplinary research that investigates and examines the intersections between technology and the humanities. We are especially committed to developing a research hub that foster collaboration across disciplines from Humanities, Computer Science and allied disciplines. Our current projects include developing a digital archive for Minor Partitions, developing a multilingual database indexing project, using digital tools for algorithmic literary analysis, using visualization techniques for foregrounding gaps in scholarship. DH also has international collaborations with research groups in Australia, Austria, US and other places. Our current major project is KSHIP (Knowledge Sharing in Publishing); an Open Access scholarly publishing project that we hope will initiate a much-needed discussion on the modes and objectives of research publications in India. The Research group is led by Prof Nirmala Menon and currently has five research scholars.

**Selected Publications:**

1. T. Shanmugapriya, Nirmala Menon and Andy Campbell. "An Introduction to the Functioning Process of Embedded Paratext of Digital Literature: Technoeikon of Digital Poetry." The Journal of Digital Scholarship in the Humanities, Oxford University Press, 2018. DOI:10.1093/llc/fqy064.
2. T. Shanmugapriya, Andy Campbell and Nirmala Menon, Thanner Kuhai, the Water Cave – A VR Poetry Experience" Digimag, 2018, pp. 20–26.
3. T. Shanmugapriya, Shaifali Arora, and Nirmala Menon. "Developing Database for Scholarship in Indian Languages and Literatures." Asian Quarterly: An International Journal of Contemporary Issues (AQ), vol. 15, no. 1, 2018.

**Research Projects:**

1. Technology as Literary Artefact in the Narration of Post-Independence Indian English Novels (1947-2017).
   (Funding by: SPARC MHRD)
2. Technology as Literary Artefact in the Narration of Post-Independence Indian English Novels (1947-2017).
   (Funding by: UKEIRI UK)
3. Grand Challenges in the Humanities
   (Funding by: SPARC MHRD)
4. Samagra Process Documentation (as Co-PI with Dr. Pritee Sharma)
   (Funding by: UNICEF)

**Dr. Pritee Sharma**
Associate Professor
Economics
psharma@iiti.ac.in

**Dr. Pritee Sharma** is an Associate Professor in the Discipline of Economics. She obtained her PhD. from IIT Bombay on, 'Implications of Input Subsidies on Agricultural Productivity and Rural Poverty in India'. Her main research interests are in the areas of environmental economics and development economics. She was a team member for research assignments undertaken for the Ministry of Agriculture (MoA), Ministry of Statistics, Planning and Implimentation (MoSPI), Ministry of Environment and Forests (MoEF), Government of India. She has also done research assignments for the Rockefeller Foundation and the World Bank. Her research assignments and the supervision of doctoral research work mainly consisted of understanding and analysing food security, agricultural productivity, rural poverty and international trade concerns for India. Her research group includes PhD. students and external honorary members working on Sustainability Issues from various perspectives.

She also teaches undergraduate and post graduate level courses in environmental economics, sustainability studies and institutional economics.

**Broad research area:** Agricultural Economics, Environmental Economics

**Research Highlights:**

Agricultural Economics: food security, agricultural productivity, rural poverty, and international trade in agriculture sector.

Environmental Economics: stakeholder issues in climate change governance, resilience building, adaptive capacity aspects of climate change; and land and forest degradation from urban and rural poor's perspectives. All my work has been till date pertaining to governance, efficiency and policy in Indian context.

**Selected Publications:**

1. Joshi, S., Sharma, P., (2018) Mapping meso-economic impacts of grid connected solar PV deployments in India: A Social Accounting Matrix Approach In K. Mukhopadhyay Ed. Applications of the Input-Output Framework, Publisher Springer Nature, Singapore, ISBN: ISBN:978-981-13-1506-0 (in Press) Publisher: Springer Nature DOI: 10.1007/978-981-13-1507-7.
2. Singh, A.K. and P. Sharma (2018). Measuring the Productivity of Food Grain Crops in Different Climate Change Scenarios in India: Evidence from Time Series Investigation. Climate Change, Vol. 16, No. 4: 661-673.
3. Sharma, P., Karanth, A. and Burvey, M. (2016). Economic Loss from Floods and Waterlogging: A Case Study of Indore. IIED Working Paper Series No. 38, 2016

**Events/Seminars organized:**

Dissemination of Report on "Process Documentation of Samagra Portal: Unifying Social Registry System" jointly organized by IIT Indore and UNICEF -India on June 10, 2019 at IIT Indore.

**Research Projects:**

Process Documentation of Samagra Portal (Funding by: UNICEF).

**Dr. Ruchi Sharma**

Associate Professor
Economics
ruchi@iiti.ac.in

**Dr. Ruchi Sharma** (PhD.: IIT Kanpur; M.Phil. and M.A. (Economics) Panjab University, Chandigarh; U.G.C Doctoral Research Fellow) has worked as an Economist with Tata Services Limited. She has also worked at IIT Delhi and held visiting position at IIM Indore. Her research areas are: Economics of Innovation, Patent Policy and Technology Transfer (FDI and Licensing).

She has completed a sponsored research project funded by the Indian Council of Social Sciences Research. She has published research papers in international journals of repute such as Economics Modeling, Economics of Innovation and Technology, Journal of Economic Studies, Global Economic Review, Journal of Intellectual Property Rights and World Patent Information. Dr. Sharma has presented her research in international conferences held at the University of Illinois and Oxford University. She was awarded the Kusuma Young Faculty Incentive Fellowship at IIT Delhi.

**Broad research area:** Economics of Innovation; International Economics

**Research Highlights:**

The research group on Innovation Studies focuses on issues related to R&D and patenting by Indian firms, universities and academic institutions. Specifically, we are analysing the impact of FDI on innovation by Indian firms, product and process innovation, financial issues concerning innovation by firms, patent valuation and foreign patenting. Lastly, we are also studying the impact of patent policy on economic growth through exports and value addition in manufacturing sector.

**Selected Publications:**

1. Dhanora, Madan, Ruchi Sharma and M. Jose. 2019. Two-way relationship between innovation and market structure: Evidence from Indian high and medium technology firms. Economics of Innovation and New Technology. https://doi.org/10.1080/10438599.2019.1596575.
2. Khachoo Qayoom, Ruchi Sharma, and Madan Dhanora. 2018. Does proximity to the frontier facilitate FDI-spawned spillovers on innovation and productivity? Journal of Economics and Business, 97 (May-June): 39-49.
3. Dhanora, Madan, Ruchi Sharma and Q. Khachoo, 2018. Non-linear Impact of Product and Process Innovations on Market Power: A Theoretical and Empirical Investigation. Economic Modelling, 70 (April): 67-77.

**Research Projects:**

Knowledge Spillovers of Foreign Patenting on Indian Firms: Econometric Analysis Using Patent Citation (Funding by: ICSSR).

**Dr. Sanjram P. Khanganba**
Associate Professor
Psychology
sanjrampk@iiti.ac.in

**Dr. Sanjram P. Khanganba** (PhD: IIT Bombay) is an Associate Professor. He works as a Human Factors research practitioner and is a faculty of the discipline of Psychology and Discipline of Biosciences and Biomedical Engineering. He leads a highly motivated interdisciplinary team comprised of volunteers, U.G. students, and PG students with diverse academic background under the aegis of 'Focussed Research Group in Human Factors'. His scientific interest revolves around investigating aspects of applied cognition in system development, design, and evaluation. He has a strong dedication towards addressing issues of 'Cognitive Human Factors and Ergonomics Research' focussing on technological systems in the pursuit of technological innovation, improvement, and optimal utilization of human capabilities. He is a member of Technical Committee on Visual Ergonomics, International Ergonomics Association. He is a founding member of the HCI Professionals Association of India. He is actively associated with the Indian Society of Ergonomics as a life member.

**Broad research area:** Human Factors & Applied Cognition

**Research Highlights:**

- Cognitive Ergonomics
- Automotive and Transport Human Factors
- Virtual/Augmented Reality
- Human-System Interaction
- Community Systems
- Medical and Healthcare Human Factors
- Smart Environments and Systems
- Human Performance
- Media
- User Experience

**Selected Publications:**

1. Najar, S. A. & Sanjram P. K. (2019). Driving Errors and Gaze Behavior During In-vehicle Object and Spatial Distractions. Journal of Transportation Safety & Security. https://doi.org/10.1080/19439962.2019.1611683.
2. Najar, S. A. & Sanjram P. K. (2018). Gaze behavior and human error in distracted driving: Unlocking the complexity of articulatory rehearsal mechanism. Transportation Research Part F: Traffic Psychology and Behaviour. 59(A), 12-23. https://doi.org/10.1016/j.trf.2018.08.005.
3. Najar, S. A. & Sanjram P. K. (2018). Suppressed articulatory rehearshal mechanism and driving errors. Adavances in Intelligent Systems and Computing, Springer Nature 823, 55-61. https://doi.org/10.1007/978-3-319-96074-6_6.

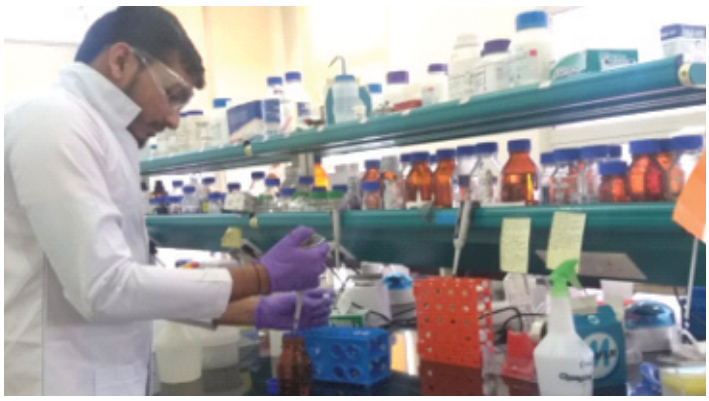
**Research Projects:**

6G Connectivity for Sustainable Development Targeted at Rural and Remote Communities (Funding by: SPARC, MHRD).

**Dr. Shomik Dasgupta**
Assistant Professor
History
shomikdasgupta@iiti.ac.in

**Dr. Shomik Dasgupta** is an Assistant Professor. His work pertains to the study of South Asian History. His research interests include the intellectual history of the 18th and 19th century, 18th-century social history and the everyday histories of work in early-colonial government and administration. At a broader level, he is interested in Indian responses to colonialism from the point of view of the role of language in the creation of social facts, intentionalities, collectivities, and institutions. He completed his PhD. from King's College, the University of London. He is currently working on the publication of a full-length book based on his PhD. thesis on the political thought of Rammohun Roy.

# Discipline of Biosciences and Biomedical Engineering



### Research Thrust/Facility

- Fluorescence-Activated Cell Sorting (FACS) Sorter & FACS Analyzer (BD)
- Confocal Microscope
- Atomic Force Microscopy (AFM) & Field Emission Scanning Electron Microscopy (FE-SEM)
- Quad Time-of-Flight (Q-TOF), Liquid Chromatography-Mass Spectrometry (LC-MS) & Gas Chromatography-Mass spectrometry (GC-MS)
- Real Time PCR, Iso Electric Focusing, Photo-luminescence Spectroscopy

### Application Areas

- Disease Diagnosis
- Personalised Therapy
- Drug Discovery & Delivery
- Vaccine Development
- Biomedical Signal Processing

## From the HoD's Desk

**Dr. Hem Chandra Jha**
Assistant Professor
hemcjha@iiti.ac.in

## Summary and Vision of the Group

The Biosciences and Biomedical Engineering (BSBE) group at the Indian Institute of Technology Indore was founded in July 2012 with a vision of establishing a Centre of Excellence that will focus on human resource development and research in Biosciences, Bioengineering and Biomedical Engineering. The BSBE group aims to be internationally recognized in Bio-related areas and produce the leaders of tomorrow in the field, with the integrated use of training, and career development efforts to improve individual, group and organizational effectiveness.

Our vibrant group of faculty members and research scientists aspire to create an ambience for the smooth pursuit of scholarly activities in research as well as training on the study of life and living organisms, ranging from simple bacteriophage to complex multi-cellular organisms such as humans; with the focus being on structure, function, growth, origin, evolution, distribution, and taxonomy. In addition to basic biology research, the BSBE group seeks to contribute towards applied research on practical problems in the country.

With the application of engineering principles, design concepts of biology, medicine and other sciences, the group hopes to devote its energy and expertise on translational technology innovations to achieve improved longevity, health, and well-being for humans; to pursue research and development activities resulting in discoveries in imaging techniques, diagnostic kits; and novel therapies. Additionally, the group actively engages with physicians and clinicians abroad and in India for undertaking patient-based research. The long-term vision is to pursue cutting-edge research that provides sustainable solutions for public health problems. A methodology is being developed by which active participation with clinicians guides patient-based research. This model must be widely practiced in India to achieve progress in improving the healthcare of its population. The group aims to take these discoveries up to clinical trials.

The group seeks to create a unique institutional environment to conduct multi disciplinary research that translates scientific and technological advancements into innovations which will not only improve public health but also contribute immensely in the areas such as agriculture, energy, and environment.

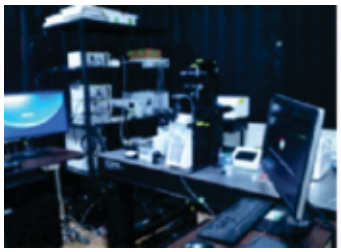
IIT Indore is recognized for its science and technology research and offers many opportunities for interdisciplinary collaborations and involvement with various departments and research centres including the disciplines of Computer Science and Engineering, Electrical Engineering, Mechanical Engineering, Physics, Chemistry, Mathematics, Humanities, and Social Sciences. Biosciences and Biomedical research will be one of the thrust areas at IIT Indore.

## Facilities

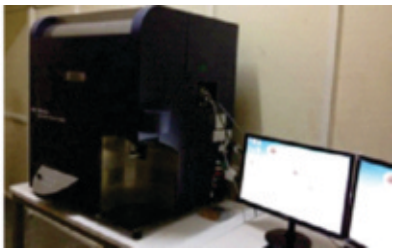
IIT Indore has many unique state-of-the-art laboratories in Chemistry, Physics and other Engineering departments. Such laboratories are also being built for Biosciences and Biomedical Engineering research. Additionally, the faculty, postdoctoral fellows, research scholars, and staff have access to the Institute library and e-resources- a combined collection of over 15,500 books and journals. Moreover, the Institute's 'Sophisticated Instrumentation Centre' (SIC) (equipped with Single Crystal X-ray Diffraction, Nuclear Magnetic Resonance, Atomic Force Microscopy, Mass Spectrometry, Elemental Analysis, and Single Molecule Imaging and Spectroscopy facilities) provides a unique opportunity to access these equipments for our research.

Currently, BSBE group have a Cell Culture Facility with Class II A2 bisafety cabinets, florescence microscopes, electroporator, $CO_2$ incubators, LN2 storage. Additionally, we have wet laboratories for performing Molecular Biology, Biochemistry and Microbiology experiments that includes Real time PCR, 96 well plate reader, gel doc, etc. Moreover, we set up a Sophisticated Instrumentation Centre with the following Sophisticated Instruments:

1. FACS Sorter [BD FACS AriaIII Fusion – 4 laser]
2. FACS Analyser [BD LSRFortess – 5 laser]
3. Confocal Microscope [Olympus including FLIM (fluorescence correlation spectroscopy), FCS (fluorescence correlation spectroscopy), Multi-photon emission imaging, and Mai Tai Femto-second laser]
4. Proteomics facility [AKTA avant, Isoelectric focusing, 2D gel electrophoresis]



Confocal Microscopy



FACS Facility

Isoelectric Focusing

2D Gel Electrophoresis

Gel Doc. System

Discovery Studio

AKTA Avant

## Introducing BSBE members

In BSBE there are ten core faculty members along with one other core faculty fellows. Ten more are associated from other disciplines.

- Dr. Amit Kumar
- Dr. Avinash Sonawane
- Dr. Debasis Nayak
- Dr. Kiran Bala
- Dr. Prashant Kodgire
- Dr. Rajesh Kumar
- Dr. Shanmugam Dhinakaran
- Dr. Sanjram Premjit Khanganba
- Dr. Shaikh M Mobin
- Dr. Sudeshna Chattopadhyay
- Dr. Sushabhan Sadhukhan
- Dr. Abhijeet Joshi
- Dr. Chelvam Venkatesh
- Dr. Hem Chandra Jha - Head
- Dr. Mirza S Baig
- Dr. Parimal Kar
- Dr. Ram Bilas Pachori
- Dr. Srivathsan Vasudevan
- Dr. Sarika Jalan
- Dr. Sharad Gupta
- Dr. Suman Mukhopadhyay

BSBE currently runs a PhD. program with 55 students in different areas of modern biology.

## Key Research Areas

- Bio-sensors and Bio-electronics
- Biomedical Signal Processing
- Biofluid mechanics, CFD and Heat Transfer, Blood flow analysis, Non-Newtonian fluid flows
- Biological Networks
- Biophotonics
- Cancer Biology
- Chromatin structure and gene regulation
- Cytoplasmic flows
- Detection and role of delay in large extended systems
- Disease spreading, co-evolution, and adaptation
- Drug delivery systems, near-infra red fluorescence, nuclear Imaging, and bio-conjugate chemistry
- Human factors
- Molecular Biology
- Molecular Immunology
- Photo-acoustic microscopy for biomedical applications
- Photothermal response and photothermal imaging Design, synthesis and diagnostic applications of new targeting ligands for cancers and inflammatory diseases
- Raman imaging and Spectroscopy
- Systems Biology
- Somatic hypermutation of immunoglobulin genes
- Spectral analysis of gene expression profile of zebra-fish under various toxic/environmental perturbation
- Spectral properties of directed networks
- Synchronization of coupled dynamics on networks and its application to neurosciences
- Synthesis of Inhibitors for drug targets
- Metals in biology

## The Faculty

**Dr. Prashant Kodgire**

Associate Professor

pkodgire@iiti.ac.in

**Dr. Prashant Kodgire's** current research is broadly in the area of Molecular Immunology and Molecular Biology with a focus on Chromatin structure and immunoglobulin gene regulation and understanding the molecular basis of somatic hypermutation (SHM) of immunoglobulin (Ig) genes. His group's efforts are geared towards identifying molecular mechanisms of action and targeting of activation-induced cytidine deaminase (AID) on the Ig genes.

These studies are important for determining how varied repertoire of antibody genes are created with the potential to react against any foreign antigenic substance (including tumor cell antigens). Besides aiding the defense against tumors by creating potent anti-cancer antibodies, SHM can have a negative effect as a promoter of cancer by giving rise to B cell lymphomas and leukemias. Understanding somatic mutation will aid in the investigation of the cellular, genetic and environmental causes of B lymphocyte malignancies as well as in learning how to influence the production of high-affinity antibodies against infectious agents and tumor antigens.

### Selected Publications:

1. Singh AK, Jaiswal A, Kodgire P., AID preferentially targets the top strand in nucleosome sequences, Mol Immunol. 2019, 112:198-205.
2. Jain M, Yadav P, Joshi A, Kodgire P., Advances in detection of hazardous organophosphorus compounds using organophosphorus hydrolase based biosensors. Crit Rev Toxicol. 2019, 3:1-24.
3. Choudhary M, Tamrakar A, Singh AK, Jain M, Jaiswal A and Kodgire P, AID Biology: A Pathological and Clinical Perspective, International Reviews of Immunology, 2018, 37(1):37-56.

**Research Projects:**

1. Exploration of cis elements in attracting AID to proto-oncogenes BCL6 and MYC leading to B-lymphoma (Funded by SERB-DST).
2. Flourimetric biosensor for detection and quantification of insecticides and pesticides using recombinant organo-phosphorus hydrolase expressed in E. colii (Funded by DBT).
3. Quantum dot based biosensor for early detection of prostate cancer using multiple biomarkers in biological samples (Funded by DBT, NER Twinning Project).

**Dr. Sharad Gupta**
Assistant Professor
shgupta@iiti.ac.in

**Dr. Sharad Gupta** (PhD.: IIT Kanpur, India; Postdoctoral Fellow: Tufts University, MA, USA; Visiting Research Associate: Bio systems, KAIST, Korea; Assistant Project Scientist, Academic Coordinator and Lecturer: University of California, Riverside) focuses on the development of biocompatible nano-carriers for in-vivo molecular imaging. He plans to use these nano-carriers for cancer diagnosis and therapy. He also develops new biomaterials for the development of biologic wound dressings.

Dr. Gupta's research lies at the intersection of Biophotonics, Biology, and Biomaterials with a focus on its application in biomedical science and engineering. is the development of optical techniques for biomedical applications, bio-nanotechnology and biomaterials.

He has recently demonstrated the S2 state mediated two photon excitation of FDA approved dye. Additionally his group has developed near infrared absorbing biocompatible iron-oxide nanoparticles for biomedical applications. These particles have shown photothermal ability and improved contrast in optical coherence tomography (OCT).

**Selected Publications:**

1. Kumari, A., Kumari, K., and Gupta, S., "The effect of nanoencapsulation of ICG on two-photon bioimaging," RSC Advances, 9, 18703-18712, 2019.
2. Dutta, S. B., Shrivastava, R., Krishna, H., Khan, K. M., Gupta, S., and Majumder S. K., "Nanotrap-enhanced Raman spectroscopy: An efficient technique for trace detection of bioanalytes," Analytical Chemistry, 91(5), 3555-3560, 2019.
3. Kumari, A., and Gupta, S., "Two-photon excitation and direct emission from S2 state of FDA approved NIR dye: Application of anti-Kasha's rule for two-photon fluorescence imaging," Journal of Biophotonics. 12(1), e201800086, 2019.

**Patents:**

1. Non-invasive optical characterization of biomaterial mineralization", Georgakoudi, I., Gupta, S., Hunter, M., and Kaplan, D. L., WO 2009105537, A2, August 27, 2009.
2. "Site-targeted nano-liposomal nitroglycerin therapeutics", Ardekani, S., Ghosh, K., Gupta, S., and Mohideen, U., US Patent Application No. 15738976.
3. "Essential amino acid based biocompatible and biodegradable nanoparticle for disease diagnosis and targeted drug delivery", Gupta, S., and Mishra, A., Patent Application No. 201721027869, 2017.
4. "Green synthesis of biocompatible and near infrared active Eugenate (4-allyl-2-methoxyphenolate) capped iron oxide nanoparticles for deep tissue imaging and therapy", Gupta, S., and Kharey, P., US Patent Application No. 16/043901, 2018.

**Research Projects:**

1. Development of a vesicular stomatitis virus glycoprotein-based virus-like nanoparticles platform for targeted drug delivery (Funded by: DST).
2. Optically active biocompatible nanoparticles for imaging and photothermal therapy (Funded by: Indian Council of Medical Research).

**Dr. Debasis Nayak**
Assistant Professor
nayakdn@iiti.ac.in

**Dr. Debasis Nayak** (PhD., University of Nebraska-Lincoln, USA in Molecular Virology and Viral Pathogenesis, 2008) conducts research on the studying vesicular stomatitis virus (VSV). He works in the area of viral immunology and infectious viral disease. His current research is on the development of novel viral vector vaccines against human enterovirus and Chikungunya virus infection. His research group is also engaged in the development of a field-based diagnosis kit for viral diseases affecting livestock population. These include bovine ephemeral fever and contagious ecthyma.

The research interest of the group lies in developing a multidisciplinary approach spanning three major disciplines of life sciences - virology, immunology, and biomedical engineering. The research portfolio comprises of two distinct disciplines; i. Virology and vaccine development, and ii. Assisted reproductive technology for veterinary and animal husbandry sector. In virology, the group has established the reverse genetic system for Vesicular Stomatitis Virus (VSV) and would like to continue in the direction of viral vaccine development by using this powerful system. Dr. Nayak's group would like to continue on the path of research and translation and are committed to push research through collaborative activities and bring tangible outcomes in the near future.

### Selected Publications:

1. Giri S, Madani S, Sahu, BP, Nayak D and Sarma T. 2019. AIE active fluorescent organic nanoaggregates for selective detection of phenolic-nitroaromatic explosives and cell imaging. J. Photo Chem and Photo Bio-A, 374:194-205.
2. Kundu, BK, Mandal P, Mukhopadhyay BG, Tiwari R, Nayak D, Ganguly R, and Mukhopadhyay S. 2019. Substituent dependent sensing behavior of Schiff base chemosensors in detecting $Zn^{2+}$ and $Al^{3+}$ ions: Drug sample analysis and living cell imaging. 2019 Sensors & Actuators: B. Chemical ,282:347-358.
3. Urata S, Kenyon E, Nayak D, Cubitt E, Kurosaki Y, Yasuda J, Juan C, McGavern DB. 2018. BST-2 controls T cell proliferation and exhaustion by shaping the early distribution of a persistent viral infection. PLOS Pathogens 14 (7), e1007172.

### Research Projects:

I. Development of chikungunya candidate vaccine in vesicular stomatitis virus (VSV) gene delivery platform (Funded by: DBT).

**Dr. Amit Kumar**
Associate Professor
amitk@iiti.ac.in

**Dr. Amit Kumar** (PhD.: IIT Roorkee, India; Postdoctoral Research Associate: The Scripps Research Institute, U.S.A.; Postdoctoral Fellow: SUNY Buffalo, U.S.A) conducts his research in: Structure Biology, Neurobiology, Chemical Biology, Target Identification, and Drug discovery. His current research intends to advance the diagnostics and therapeutics discovery and also to our understanding of pathogenesis by providing an effective strategy to target various diseases. Additionally, the therapeutic candidate identified, and the cellular target his group validate, may provide an exciting new pathways for genetic and pharmacologic approaches to recognize and study further more potent ligands. In view of this, potent natural products and new drug targets were discovered to control cancer, neurological diseases like HD, fragile X-syndrome, SCAs and other infectious diseases that have been highlighted in news and media.

### Selected Publications:

1. S. K. Mishra, U. Shankar, N. Jain, A. Tawani, K. Sikri, J. S. Tyagi, T. K. Sharma, J.-L. Mergny, Amit Kumar, Characterization of G-quadruplex motifs in espB, espK and cyp51 genes of Mycobacterium tuberculosis as a potential drug targets, Molecular Therapy-Nucleic Acids, P698-706, 2019.

2. A. K. Verma, E. Khan, S. K. Mishra, N. Jain and Amit Kumar, Piperine modulates protein mediated toxicity in FXTAS through interacting expanded r(CGG)exp RNA, ACS Chemical Neurosciences, 10(8):3778-3788, 2019.
3. A.K. Verma, E. Khan, S. Bhagwat; Amit Kumar, Exploring the potential of small molecules based therapeutic approaches for targeting Trinucleotide repeats Disorders, Molecular Neurobiology, pp1-19, 2019.

**Events/Seminar Organized:**

1. Workshops on " Modern Spectroscopic Techniques I & II".
2. Workshop on " Molecular Characterization Techniques.

**Research Projects:**

Recognition of Human G-quadruplex structure by natural product Piperine and its derivative for mechanistic insight of its anti cancer activity (Funded by: DST SERB).

**Dr. Abhijeet B. Joshi**

INSPIRE Faculty

abhijeet.joshi@iiti.ac.in

**Dr. Abhijeet B. Joshi** (PhD.: IIT Bombay, Lecturer: NIPER-Ahmedabad, IYBA Fellow: IIT Bombay) works in the field of Biomedical Engineering; specifically, biosensor development, drug delivery, diagnostics, and theranostics. The main focus of Dr. Joshi's group is the development of nano/micro technologies for diagnostics and therapeutics. His group is involved in the development of biomaterials, nano-materials and using them for biosensors and novel drug delivery systems. His group works towards developing drug-loaded nano-carriers for delivery of drugs at sites which are less accessible.

**Patents:**

1. Saumya Jaiswal, Sharad Gupta, Abhijeet Joshi, Ultrasonic Atomizer based Fabrication of Silk Nano-Particles for Theranostics, 201921031158, 1st August, 2019.
2. Abhijeet Joshi, Bhavana Joshi, Gaurav Pandey, Jaspreet Kaur, Ultrasonic Atomizer based method for development of biodegradable anticancer nanoparticles, microspheres and hybrid microparticles< Indian Patent Application 2019101573, Filing date: 19th April 2019.

**Selected Publications:**

1. Sandeep Choudhary Bhavana Joshi, Gaurav Pandey, AbhijeetJoshi, Application of single and dual fluorophore-based pH sensors for determination of milk quality and shelf life using a fibre optic spectrophotometer, Sensors and Actuators B: Chemical, 2019, In press.
2. Monika Jain, Priyanka Yadav, Abhijeet Joshi, Prashant Kodgire, Advances in Detection of Hazardous Organophosphorus Compounds Using Organophosphorus Hydrolase Based Biosensors, Critical Reviews in Toxicology, 1-24, 2019.
3. Joshi A. B., Chaudhari R, and Srivastava R., pH and Urea Estimation in Urine Samples using Single Fluorophore and Ratiometric Fluorescent Biosensors, Nature Scientific Reports, 7: 5840, 2017.

**Events/Seminar Organized:**

TEQIP course on "Modern Tools and Techniques in Drug Design, Discovery and Development", March 4-9, 2019.

**Research Projects:**

1. Nasal delivery of anti-retroviral theranostic nano-enabled carriers (Funded by: DST INSPIRE).
2. Multi-analyte nano-engineered quantum dot based florescent biosensors for clinical quantification of biomarkers in diabetes related kidney diseases (Funded by: SERB).

3. Quantum dot based biosensor for early detection of prostate cancer using multiple biomarkers in biological samples (Funded by: DBT).
4. Flourimetric biosensor for detection and quantification of insecticides and pesticides using recombinant organo-phosphorus hydrolase expressed in E. Coli (Funded by: DBT).

**Dr. Parimal Kar**
Assistant Professor
parimal@iiti.ac.in

**Dr. Parimal Kar** (PhD.: Michigan Technological University) The broad areas of research for Dr. Parimal are Theoretical and Computational Biophysics He works towards Multiscale modeling of kinases implicated in hypertension and autoimmune diseases, understanding protein-drug interactions and mutation-induced drug resistance at the atomic level, and Glycan modeling and structure predictions and elucidating their roles in host-pathogen interactions.

**Selected Publications:**

1. Nisha A. Jonniya, Md Fulbabu Sk, Parimal Kar, Investigating phosphorylation-induced conformational changes in WNK1 kinase by molecular dynamics simulations, ACS Omega, 2019 (In Press).
2. Nisha A. Jonniya, Parimal Kar, Investigating specificity of the anti-hypertensive inhibitor WNK463 against With-No-Lysine kinase family isoforms via multiscale simulations, J. Biomol. Struct. Dyn. 2019 (In press).
3. Parimal Kar, Michael Feig. Hybrid all-atom/coarse-grained simulations of proteins by direct coupling of CHARMM and PRIMO force fields, J. Chem. Theory Comput, 2017, 13, 11, 5753-5765.

**Events/Seminar Organized:**

TEQIP course on "Modern Tools and Techniques in Drug Design, Discovery and Development", March 4-9, 2019.

**Research Projects:**

1. Investigating Conformational Dynamics of N-Glycans and the Effect of Glycosylation on the Structure and Dynamics of Hepatitis C Virus Glycoproteins via Molecular Dynamics Simulations (Funded by: DST-SERB).
2. Multiscale Simulations of Protein-Glycan Complexes: Toward Understanding the Molecular Basis of Host-Pathogen Interactions and Immune Response (Funded by: DBT).

**Dr. Kiran Bala**
Assistant Professor
kiranb@iiti.ac.in

**Dr. Kiran Bala's** areas of research are Bioenergy, Bioremediation, Bioplastic production. In Biofuels Research lab, she has been working with various green and blue-green algae species indigenously isolated from contaminated sites. These algae species are being explored for their biomass and lipid profile in context to bio diesel generation, carbon fixation potential, and waste water treatment. Selecting tolerant micro algal strains and further enhancing their ability to tolerate higher concentrations of contaminant by gradually increasing the concentration is very important in making the overall process efficient and economically feasible. Main goal is combining the process of algal.

**Selected Publications:**

1. Kashyap, M., Samadhiya, K., Ghosh, A., Anand, V., Shirage, P.M., Bala, K., 2019. Screening of microalgae for biosynthesis and optimization of Ag/AgCl nano hybrids having antibacterial effect, RSC Advances

2. Anand, V., Kashyap, M., Samadhiya, K., Ghosh, A., Kiran, B. (2019). Salinity driven stress to enhance lipid production in Scenedesmus vacuolatus: A biodiesel trigger?. Biomass and Bioenergy, 127, 105252.
3. Ghosh, A., Kiran, B., 2017, Carbon concentration in algae: Reducing CO2 from exhaust gas, Trends in Biotechnology, 35 (9), 806-808.

**Events/Seminar Organized:**

1. TEQIP short term course (Co-coordinator)-Recent Advancements in Water Resources and Environment Engineering, April 22-27, 2019.
2. TEQIP short term course (Co-coordinator)-Characterization of Materials for Renewable and Sustainable Energy, March 4-9, 2019.
3. BSBE symposium (Convener) - Water: Resources, Challenges & Sustainability, 10th March, 2018.
4. BSBE conference organizing committee (Member) - 2017-18 (eBBT 5th-6th January, 2018).
5. GIAN course on "Biological treatment of metals and metalloids laden wastewater: Microbiology, Process technology and Resource Recovery" from 5th - 9th March, 2018. (Foreign faculty Prof. Eric van D. Hubellsch, IHE-Delft).
6. TEQIP Faculty Induction Program (Coordinator) - June 17-21, 2019 (Phase I).
7. TEQIP Faculty Induction Program (Coordinator) - June 24-28, 2019 (Phase II).

**Research Projects:**

1. Exchange grant LUH-IIT Indore (Funded by German Academic Exchange Service, DAAD).
2. An innovative approach for development of an efficient and integrated algae bioenergy production system using biosynthesized nanoparticles (Funded by: DST SERB).
3. Demonstration of sustainable algal biomass production in outdoor environment for cost-effective biofuel production (Funded by: DBT).

**Dr. Hem Chandra Jha**
Assistant Professor
HoD
hemcjha@iiti.ac.in

**Dr. Hem Chandra Jha** (PhD.: Birla Institute of Technology & Sciences, Pilani; Postdoctoral Fellow and Research Associate: University of Pennsylvania, Philadelphia) conducts his research in Host Pathogens interactions in cancer and neurodenerative diseases. The focus of his research is in Helicobacter pylori and Epstein-Barr virus co- infection in gastric cancer progression, Epstein-Barr virus infection in nuro-inflammation and neurodegeneration, and Malaria and Epstein-Barr virus co-infection and associated disease pathogenesis.

**Selected Publications:**

1. Pandey S, Jha HC, Shukla SK, Shirley MK, Robertson ES. Epigenetic Regulation of Tumor Suppressors by Helicobacter pylori Enhances EBV-Induced Proliferation of Gastric Epithelial Cells. MBio. 2018 Apr 24;9(2).
2. Jakhmola S, Jha HC. Title: "Reduce the risk of Dementia; Early Diagnosis of Alzheimer's Disease", Advances in Intelligent Systems and Computing. Springer Nature Singapore Pte Ltd. 2018, 748; 621-632. *Corresponding Author.
3. Tiwari D, Jha HC. Detection and Analysis of Human Brain Disorders. Advances in Intelligent Systems and Computing. Springer Nature Singapore Pte Ltd. 2018, 748; 748-758.

**Patents:**

Robertson ES, Jha, HC. Therapeutic targets for gammaherpesvirus infected neuronal cells. Disclosure submitted to the University of Pennsylvania technology Transfer Office. 2015. Appl. No. PENN ref. 16-7745, Filing Date – 11/16/2015.

### Events/Seminar Organized:

1. Organized first In-house Symposium on "Advances in Biosciences and Bio-engineering." on February 23, 2019 at IIT Indore.
2. Organizing committee member- International conference entitled "Water: Resources, Challenges & Sustainability" on March 10, 2018 at IIT Indore.
3. Organizing committee member- International conference entitled "Emerging Areas in Biosciences and Biomedical Technologies" (eBBT) from Jan 5-6, 2018 at IIT Indore.
4. Program Chair "International Conference on Machine Intelligence and Signal Processing" from December 22-24, 2017 at IIT Indore.
5. Host Faculty: GIAN- 10 days course entitled" How next generation sequencing untying the knot in viral pathogenesis" from Oct 22 to Nov 1, 2017.
6. Organizing committee member "Industry Academia Conclave 2017" organized at IIT Indore on October 2017.

### Research Projects:

1. Role of kinases in Epstein-Barr virus associated cancer progression (Funded by: DST).
2. Pathogenesis of Epstein-Barr virus and Chlamydia pneumoniae in Multiple Sclerosis (Funded by: CSIR).
3. Role of Helicobacter pylori and Epstein Barr virus in gastric cancer progression (Funded by: DST).

**Dr. Mirza Baig**
Assistant Professor
msb@iiti.ac.in

**Dr. Mirza Baig** received his PhD. from Central Drug Research Institute, Lucknow in 2008. His post-doctoral work in Immunology was carried out at the Department of Medicine, the University of Illinois at Chicago. In 2014, Dr. Baig was appointed as Research Scientist at the Department of Gastroenterology and Hepatology, Mayo Clinic, Rochester, Minnesota. Dr. Baig's research focuses on the Innate Immunity and Inflammation, and drug discovery and development for inflammatory diseases.

### Selected Publications:

1. Srivastava M, Saqib U, Banerjee S, Wary K, Kizil B, Muthu K, Baig MS. Inhibition of the TIRAP-c-Jun interaction as a therapeutic strategy for AP1-mediated inflammatory responses. Int Immunopharmacol. 2019 Mar 22;71:188-197. doi: 10.1016/j.intimp.2019.03.031. [Epub ahead of print] PubMed PMID: 30909134.
2. Saqib U, Baig MS. Scaffolding role of TcpB in disrupting TLR4-Mal interactions: Three to tango. J Cell Biochem. 2019 Mar;120(3):3455-3458. doi: 10.1002/jcb.27619. Epub 2018 Sep 22. PubMed PMID: 30242887.
3. Roy A, Banerjee S, Saqib U, Baig MS. NOS1-derived nitric oxide facilitates macrophage uptake of low-density lipoprotein.J Cell Biochem. 2019 Feb 25;. doi: 10.1002/jcb.28439. [Epub ahead of print] PubMed PMID: 30805961.

### Research Highlights:

A breakthrough research demonstrated the role of Neuronal Nitric Oxide Synthase (NOS1)-derived Nitric Oxide (NO) in turning-on the inflammatory response during chronic inflammatory diseases (Baig et al; JEM,2015). This discovery leads investigators across the globe to understand and research macrophage NOS1-derived NO in the context of various chronic inflammatory conditions including some cancers, rheumatoid arthritis, atherosclerosis etc. Two anti-inflammatory drugs have been identified through drug repurposing/repositioning studies:

1. Thioridazine hydrochloride is a phenothiazine antipsychotic used in the management of psychoses, including schizophrenia, and in the control of severely disturbed or agitated behavior. Our group has shown that Thioridazine hydrochloride has anti-inflammatory activity.
2. Gefitinib is a drug used for certain breast, lung and other cancers. Gefitinib is an EGFR inhibitor, likeerlotinib, which interrupts signaling through the epidermal growth factor receptor(EGFR) in target cells. Our group has shown that Thioridazine hydrochloride has anti-inflammatory activity.

**Research Projects:**

1. Neuronal nitric oxide synthase (NOS1) driven macrophage phenotype polarization (Funded by: DBT).
2. Role of neuronal nitric oxide synthase (NOS1) in the TLR4-triggered inflammatory resonse via the SOCS1-P38-AP1 signalling axis (Funded by: DST)
3. Non-Canonical Role of Macrophage Matrix Metallo-Proteinases (MMPs) in Alcoholic Liver Disease (Funded by: CSIR).

**Dr. Avinash Sonawane**
Associate Professor
asonawane@iiti.ac.in

Before joining IIT Indore, **Prof. Avinash Sonawane** (PhD. in Molecular Enzymology, at the University of Marburg, Germany) served as a Professor at the School of Biotechnology, KIIT University, Bhubaneshwar. He works in the area of Tuberculosis pathogenesis. The key focus areas of his research is Mycobacterium Glycobiology. His groups studies the molecular mechanisms of Mtb dormancy in bone marrow stem cells and the implications of cross-talk between stem cells, macrophages, and T-cells on the fate of Mtb infection.

**Selected Publications:**

1. Padhi A, Pattanaik K, Biswas M., Jagadev M, Behera A, and Sonawane A (2019). Mycobacterium tuberculosis LprEsuppress TLR-2 dependent cathelicidin and autophagy expression to enhance bacterial survival in macrophages. The Journal of Immunology (Accepted).
2. Pati R, Shevtsov M., and Sonawane A. (2018). Nanoparticle Vaccines Against Infectious Diseases. Frontiers in Immunology. 9:2224. doi: 10.3389/fimmu.2018.02224.
3. Jagadeb M, Rath SN, Sonawane A (2018).Computational discovery of potent drugs to improve the treatment of pyrazinamide resistant Mycobacterium tuberculosis mutants. Journal Cellular Biochemistry. 119(9):7328-7338.

**Patents:**

Venkatesh Chelvam, Premansh Dudhe, Mena Asha Krishnan, and Avinash Sonawane (2019). Metal-free, solvent-free synthesis of fused-pyrido heterocycles: Biological efficacy against cancer and multi-drug resistant pathogens (Filed).

**Events/Seminar Organized**

Distinguished Lecture by Prof. Tapas Kundu, Director, CDRI-Lucknow, 22nd April, 2019.

**Research Highlights:**

1. Demonstrated that Mycobacterium tuberculosis modulate peptide synthesis in stem cells to facilitate its survival in bone marrow.
2. Demonstrated that M. tuberculosis inhibit calcium ion channel to bipolarize host immunity during tuberculosis disease progression.
3. Developed novel asparaginase enzyme that can improve treatment of primary and relapse acute lymphatic leukemia.

**Research Projects:**

1. To study the role of mesenchymal stem cells in the pathogenesis of tuberculosis in bone marrow (Funded by DBT).
2. Pharmacological evaluation of a novel asparaginase used for the treatment of acute lymphoblastic leukemia (Funded by BRNS).

## Associate Members

**Dr. S. Dhinakaran**
Associate Professor
Mechanical Engineering

**Dr. Chelvam Venkatesh**
Assistant Professor
Chemistry

**Dr. Srivathsan Vasudevan**
Associate Professor
Electrical Engineering

**Dr. Premjit K. Sanjram**
Associate Professor
Humanities and
Social Sciences

**Dr. Ram Bilas Pachori**
Professor
Electrical Engineering

**Dr. Shaikh M. Mobin**
Associate Professor
Chemistry

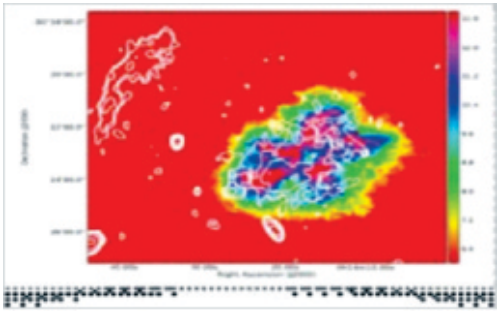
**Dr. Rajesh Kumar**
Associate Professor
Physics

**Dr. Sarika Jalan**
Associate Professor
Physics

**Dr. Sudeshana Chattopadhyay**
Associate Professor
Physics

**Dr. Suman Mukhopadhyay**
Professor
Chemistry

# Discipline of Astronomy, Astrophysics and Space Engineering



## From the HoD's Desk

**Dr. Abhirup Datta**
Associate Professor
abhirup.datta@iiti.ac.in

**Dr. Abhirup Datta** has done his PhD. from New Mexico Tech/National Radio Astronomy Observatory in 2010. He was a Research Associate at University of Colorado, Boulder, USA from 2013 to 2015. Later he joined as a NASA Post-Doctoral Fellow at University of Colorado, Boulder, USA from 2011 to 2013. He is associate of Inter University Center for Astronomy and Astrophysics (IUCAA) since July, 2016. His thrust areas for research are:

- Observational Cosmology - 21cm Cosmology
- Radio Astronomy - Aperture Synthesis
- Galaxy Clusters - Large Scale structures
- X-ray Astronomy - Shocks in Galaxy Clusters
- Atmospheric Corruptions to Astronomical Observations
- Synergy between Study of Ionosphere and Radio Astronomical Observations

### Selected Publications:

1) Datta, A., Burns, J.O., et al. “Effects of Ionosphere on the Ground-Based Detection of Global 21CM Signal from The Cosmic Dawn”, 2016, Astrophysical Journal, 831, 6D.
2) Malu, S.S., Datta, A., et al., “Relativistic Inverse Compton Scattering of Photons from the Early Universe”, 2017, Scientific Reports,7, 16918.
3) Chakraborty, A., Datta, A. et al., "Detailed study of the ELAIS N1 field with the uGMRT - I. Characterizing the 325 MHz foreground for redshifted 21 cm observations", 2019, Monthly Notices of Royal Astronomical Society, 487, 4102.

### Research Highlights:

1. Study of Early Universe using the redshifted HI 21cm spectral line – pathfinder studies with the uGMRT and future observations with the SKA.
2. Demonstrated a novel methodology to detect 21cm signal in power spectrum domain without removing the bright foregrounds in 21cm data-sets.
3. Using novel Machine Learning techniques to extract faint cosmological signal in presence strong interfering signals from foregrounds.
4. Demonstrated the need of future Astronomy space missions to pursue low radio frequency astronomy from the space (either orbiting around the Moon or from Lunar farside).
5. Showed the critical corruption effects due to ionosphere on such cosmological faint radio signals.
6. Designed a pipeline to make high fidelity x-ray temperature maps for galaxy clusters and compare them with high fidelity radio maps to study shocks in intra-cluster medium to determine physics behind formation of radio diffuse emission in radio relics and halos.
7. Study NaVIC signals to establish it as a potential probe for Space Weather studies.
8. Characterize ionospheric effects using sensitive radio interferometric observations – synergy between Astronomy and Atmospheric/Space Weather studies.
9. Developing radio instrumentation in IIT Indore using the demonstration array of four element radio interferometer at 1.4 GHz.

### Events/Seminars Organized:

1. International Conference and School on Observing the First Billion Years of the Universe Using Next Generation Telescopes (20-31 January 2020).
2. Organizing chair of "Multi-wavelength Sky Observations – AstroSat and Beyond" workshop and symposium at IIT Indore during February 3-9, 2019 in association with TIFR and IUCAA.
3. Organizing Chair of International CMNA Conference in IIT Indore, 2018.
4. Served in Scientific Organizing Committee of "Universe After First 200 Million Years", December 11-13, 2017, Presidency University, Kolkata, India.
5. LOC member in the AP-RaSc Conference (URSI Asia-Pacific Radio Science Conference), March 9-15, 2019.
6. Initiated Astronomy Outreach program in the Discipline of Astronomy, Astrophysics and Space Engineering. We have regular monthly outreach programs as well as dedicated outreach events involving local schools and colleges in and around Indore.
7. Initiated a collaboration with Nehru Planetarium, New Delhi for celebration of Bapu Khagol Mela, to commemorate 150 years of Mahatma (a Ministry of Culture, GoI, initiative).

### Research Projects:

1. Unveiling Mergers of Galaxy clusters with radio haloes/relics: Using high Fidelity Radio and X-ray observations (Funded by: SERB, DST, ECRA scheme).
2. Pilot survey of CMB polarized foregrounds using a Single Dish (Funded by: MHRD).
3. Differential NavIC and GAGAN aided Inertial Navigation with applications to Air, Land and Space Vehicles (Funded by: ISRO GAGAN and NaVIC UP Scheme).
4. C and L-Band Interferometer as Galaxy Cluster Observatory Pathfinder ((Funded by: SERB, DST, EMRA scheme).
5. Imaging the first billion years of the universe with next-generation telescopes (Funded by: MHRD)
6. Synthetic Observatory for X-shaped Radio Galaxies (Funded by: CSIR).

**Saurabh Das**
Assistant Professor
saurabh.das@iiti.ac.in
das.saurabh01@gmail.com

**Dr. S. Das** was a Junior Research Fellow at Space Applications Centre ISRO from 2006 to 2009. He worked as an assistant professor in University of Calcutta from 2009-2015. He was a DST INSPIRE faculty in Indian Statistical Institute from 2015-2018 before joining IIT Indore.

**Selected Publications:**

1. S. Bandopadhyay, S. Das, A. Datta, "A Hybrid Fuzzy Filtering - Fuzzy Thresholding Technique for Region of Interest Detection in Noisy Images", Applied Intelligence, Accepted for publication, 2019.
2. S. Das and A. R. Jameson, "Site Diversity Prediction at a Tropical Location from a Single Site Rain Measurements using a Bayesian Technique", Radio Science, 53(6), 830-844, 2018, DOI:10.1029/2018RS006597.ions.

**Events/Seminars Organized:**

1. 2019, Member LOC, "Multi-wavelength Sky Observations - AstroSat and Beyond", held during 3-9 February, 2019 at IIT Indore.
2. 2018, Convenor, "National workshop on remote sensing and signal processing", held during November 26 – December 1, 2018 at Gauhati, University, Assam.
3. 2018, Convenor, "International School on Deep Learning in SAR and Hyperspectral Remote Sensing (DL-SHyRS)" held during October 29-November 2, 2018 at Indian Statistical Institute, Kolkata.

**Research Project:**

1. Retrieval of atmospheric water vapor from NavIC/GAGAN data and prediction of extreme weather events based on machine learning techniques (Funded by: ISRO).
2. Integrated studies of cloud-aerosol-precipitation system in the Indian region in a climate change scenario (Funded by: DST INSPIRE).

**Manoneeta Chakraborty**
Assistant Professor
manoneeta@iiti.ac.in

**Dr. Chakraborty** has done her PhD. from Tata Institute of Fundamental Research, Mumbai, India. She was a Visiting Researcher at Inter-University Centre for Astronomy and Astrophysics and INAF-Brera, from October 2014 to December 2014. She was a post-doctoral research fellow in Sabanci University, from January 2015 to April 2017. She was a DST INSPIRE faculty fellow in Discipline of Astronomy, Astrophysics and Space Engineering at Indian Institute of Technology Indore, from June 2017 to July 2019 before joining as assistant professor in IIT Indore. Her thrust areas are Multi-wavelength timing and spectroscopic studies of stellar and supermassive black holes, neutron stars, pulsars and magnetars; electromagnetic counterparts of Gravitational waves; Physics and detection techniques of transients like FRBs.

**Selected Publications:**

Eda Vurgun, Manoneeta Chakraborty, Tolga Guver and Ersin Gogus, Variable Absorption Line of XTE J1810–197, New Astronomy, 67, 45 (2019).

N. Degenaar, D.R. Ballantyne, T. Belloni, M. Chakraborty, Y.P. Chen, P. Kretschmar, E. Kuulkers, L. Ji, T.J. Maccarone, J. Malzac, S. Zhang and S.N. Zhang, Accretion disks and coronae in the X-ray flashlight, Space Science Reviews, 214, 15 (2018)

Manoneeta Chakraborty, Yunus Emre Bahar and Ersin Gogus, Time and energy dependent characteristics of thermonuclear burst oscillations, ApJ, 851, 79 (2017)

**Events/Seminars Organized:**

Organizing chair of "Multi-wavelength Sky Observations-AstroSat and Beyond" workshop and symposium at IIT Indore during February 3-9, 2019 in association with TIFR and IUCAA focusing on Astrosat data analysis and hands-on training. Around 30 participants from all over India took part in the workshop.

**Research Project:**

Probing the extreme physics around compact objects in binary and isolated systems through investigations of their burst and outburst behavior (Funded by DST)

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**Dr. Bhargav Pradeep Vaidya**
Assistant Professor
bvaidya@iiti.ac.in

**Dr. Bhargav P. Vaidya** has done his PhD. from Max Planck Institute for Astronomy, Heidelberg in 2011. Post PhD, he worked as a postdoctoral fellow at University of Leeds, UK from 2011 to 2014 and at University of Torino, Italy from 2014 to 2017. His thrust areas are Computational Astrophysics: Astrophysical and Space Plasma simulations.

**Selected Publications:**

1. Modeling Star-Planet Interactions in Far-Out Planetary and Exo-planetary systems: Srijan Das, Arnab Basak, Dibyendu Nandi, Bhargav Vaidya, The Astrophysical Journal, vol. 877, article 80, 2019.
2. A Particle Module for the PLUTO code: II – Hybrid Framework for Modeling Non-thermal emission from Relativistic Magnetized flows, Bhargav Vaidya, Andrea Mignone, Gianluigi Bodo, Paola Rossi, Silvano Massaglia, The Astrophysical Journal, vol. 865, Number 2, article 144, 2018.
3. A Particle Module for the PLUTO Code: I - an implementation of the MHD-PIC equations,Andrea Mignone, Gianluigi Bodo, Bhargav Vaidya, Giancarlo Mattia, 2018, The Astrophysical Journal, Volume 859, Issue 1.

**Research Highlights:**

1. Developed a state-of-the-art hybrid module for the PLUTO code for application to study particle acceleration mechanisms at shocks and non-thermal emission from relativistic jets.
2. Developed three-dimensional model to study impact of Coronal Mass Ejection (CME) shocks from Sun on Earth's magnetosphere to study the impact of Space Weather as part of the Science Team of ISRO's Aditya L1 mission.

**Events/Seminars Organized:**

1. Part of the Organization team for Astronomy Outreach Activity and Night Sky Observation event: Bapu Khagol Mela in collaboration with Nehru Planetarium, Delhi.
2. Astronomy Visitor Seminar - Dr. Tulasi Parashar (University of Delaware).

**Research Project:**

Synthetic Observatory for X-shaped Radio Galaxies (Funded by CSIR).

**Suman Majumdar**
Assistant Professor
suman.majumdar@iiti.ac.in

**Dr. S. Majumdar** has done his PhD. from Indian Institute of Technology Kharagpur in 2013. He was a Postdoctoral Research Associate at Imperial College London, UK from 2015 to 2018 and at Department of Astronomy, Stockholm University, Sweden from December, 2012 to November, 2015. His thrust areas are Cosmology, Large Scale Structure, Cosmic Dawn and Epoch of Reionization, Statistical Inference, Large Scale Simulations of the Early Universe.

### Selected Publications:

1. Suman Majumdar, Jonathan R. Pritchard, Rajesh Mondal, Catherine A. Watkinson, Somnath Bharadwaj, Garrelt Mellema, Quantifying the non-Gaussianity in the EoR 21-cm signal through bispectrum, Monthly Notices of the Royal Astronomical Society, 476, 3, 4007-4024 (2018).
2. Cathryn M. Trott, Catherine A. Watkinson, Christopher H. Jordan, Shintaro Yoshiura, Suman Majumdar, N. Barry, R. Byrne, B.J. Hazelton, K. Hasegawa, R. Joseph, T. Kaneuji, K. Kubota, W. Li, J. Line, C. Lynch, B. McKinley, D.A. Mitchell, M.F. Morales, S. Murray, B. Pindor, J.C. Pober, M. Rahimi, J. Riding, K. Takahashi, S.J. Tingay, R.B. Wayth, R.L. Webster, M. Wilensky, J.S.B. Wyithe, Q. Zheng, David Emrich, A.P. Beardsley, T. Booler, B. Crosse, T.M.O. Franzen, L. Horsley, M. Johnston-Hollitt, D.L. Kaplan, D. Kenney, D. Pallot, G. Sleap, K. Steele, M. Walker, A. Williams, C. Wu, Gridded and direct Epoch of Reionisation bispectrum estimates using the Murchison Widefield Array, Publications of the Astronomical Society of Australia, 36, 023 (2019).
3. Suman Majumdar, Kanan K. Datta, Raghunath Ghara, Rajesh Mondal, T. Roy Choudhury, Somnath Bharadwaj, Sk. Saiyad Ali, Abhirup Datta, Line-of-Sight Anisotropies in the Cosmic Dawn and Epoch of Reionization 21-cm Power Spectrum, "Science with the SKA: an Indian perspective" special issue of Journal of Astrophysics and Astronomy, 37, 4, 32, (2016).

### Research Highlights:

We have developed a novel image analysis technique with which one will be able to constrain the role of galaxies and quasars in reionization by combining the future 21-cm observations with the SKA and infrared observations with Euclid, JWST, ELT etc. This will be a major step towards solving one of the fundamental problems related to this era of first dawn.

The topological distribution of neutral hydrogen during the Cosmic Dawn is non-Gaussian in nature, however this non-Gaussianity cannot be captured through the traditional statistic of 21-cm data e.g. power spectrum. We have proposed and showed that a higher order statistic can quantify this non-Gaussianity in the signal and thus can provide a more comprehensive picture of this early stage of the Universe.

We have provided an upper limit on the 21-cm bispectrum from the epoch of reionization using the actual observational data from the Murchison Widefield Array in Australia.

In a separate project we have shown that the bispectrum of 21-cm signal from the post-reionization era can help us to put independent constraints on the linear bias parameter and can provide us a measure of the primordial non-Gaussianity.

We have compared different methods to simulate the 21-cm signal from the epoch of reionization and have shown that the one dimensional radiative radiative transfer methods are optimal in terms of accuracy and computational time.

We have also shown that the Multi-frequency Angular Power Spectrum can optimally extract the reionization history from a radio interferometric observation of the early universe.

### Events/Seminars Organized:

International Conference and School on Observing the First Billion Years of the Universe Using Next Generation Telescopes (20-31 January 2020)

### Research Project:

Imaging the first billion years of the universe with next-generation telescopes (Funded by: MHRD).

**Dr. Hari Hablani**
Visiting faculty
hbhablani@iiti.ac.in

**Dr. Hablani** has done his PhD. from the Indian Institute of Science, Bangalore. He has been associated with Integrated Space and Defence, The Boeing Company, NASA Johnson Space Center, Houston, TX, USA, School of Aeronautics and Astronautics, Purdue University, West Lafayette, IN, USA, IIT Kanpur, IIT Bombay, IIT Gandhinagar. His research interests are concerned with spacecraft guidance, navigation and control; space-based payload pointing and tracking for surveillance, reconnaissance and remote sensing; airborne and spaceborne multi-sensor multi-target detection and tracking in clutter; all this with industrial applications in mind.

**Research Highlights:**

Our recent research has been focussed on (a) characterizing the errors in navigation signals of Indian constellation (NavIC) comprised of seven satellites; (b) developing algorithms for high-accuracy estimation of position, velocity and time of stationary and mobile receiver platforms using single- and dual-frequency NavIC signals with ambiguity resolution; (c) agile spacecraft manoeuvring, pointing and tracking of landmarks with variable speed control moment gyros avoiding singularities; (d) spacecraft offset spinning antenna pointing control for remote sensing and attitude estimation with GPS signals; (e) using airborne and space borne multiple radars and infrared sensors for detection and tracking of multiple manoeuvring targets with interacting multiple model probabilistic data association filters, unscented Kalman filters, and particle filters.

**Selected Publications:**

1. Althaf, A., and Hablani, H. B., "Assessment of Errors in NavIC Observables for Stationary Receivers," ION Navigation Journal (under review).
2. Panda, B., and Hablani, H. B., "Attitude Estimation and Control of Spacecraft with Global Positioning System," Recent Advances in Space Technologies RAST – 2019, Hezarfen Aeronautics and Space Technologies Institute, Istanbul, Turkey, IEEE Xplore Digital Library, https://ieeexplore.ieee.org/xpl/conhome/8760338/proceeding.
3. Althaf, A., and Hablani, H. B., "High-Accuracy Baseline Estimation using Differential NavIC and GPS", International Technical Meeting, Institute of Navigation, 2020 (abstract submitted).

**Events organized:**

One-day presentation at ISRO U. R. Rao Satellite Center concerning "Design and Analysis of Multiple Platform Tracking Systems with Infrared and Radar Sensors", May 11, 2018.

**Research Projects:**

Differential NavIC and GAGAN-Aided Inertial Navigation with Applications to Land, Air and Space Vehicles (Funded by ISRO Space Application Centre).

**Dr. Siddharth Savyasachi Malu**
Associate Professor
siddharth@iiti.ac.in

**Dr. Siddharth Savyasachi Malu** has done is PhD. in Physics (Astrophysics) from University of Wisconsin-Madison in 2007. Later he joined as postdoctoral fellow at IUCAA from 2007 to 2009 and at Raman Research institute from 2010 to 2011. He was a Chief Research Officer at Redwood Associates from 2011 to 2012. He joined IIT Indore in 2012 as an assistant professor.

**Selected Publications:**

1. Radio Astronomy Instrumentation, Galaxy clusters and Cluster Mergers Pritpal Sandhu, Siddharth Malu, Ramij Raja and Abhirup Datta, The peculiar cluster MACS J0417.5-1154 in the C and X-bands, Astrophysics and Space Science, vol. 361, article 8, 2018.
2. Paul, Surajit; Datta, Abhirup; Malu, Siddharth; Gupta, Prateek; John, Reju Sam; Colafrancesco, Sergio, Rings of diffuse radio emission surrounding the Bullet cluster, Cornell University Preprint Server, vol. arXiv:1804.02588, pp. 10, 2018.

**Research Project:** C and L-Band Interferometer as Galaxy Cluster Observatory Pathfinderm (Funded by: DST, SERB).

# International Cell Update

**2018-2019**

**Dr. Kapil Ahuja, Dean of International Affairs**

IIT Indore faculty members and students have been collaborating with universities globally since its inception. This includes analyzing challenging problems and researching solutions for them, leading to improvement of lives of people. In the past one year, we have expanded our efforts to all geographical regions of the world. Most notable among these is our joint work with European nations.

## European Collaboration

The German initiative at IIT Indore is now about four years old. In the past one year, we strengthened our links with six of the nine TU9 universities, with which we have an existing MoU. Namely, LU Hannover, RWTH Aachen, TU Berlin, TU Braunschweig, TU Dresden, and University of Stuttgart. The biggest output among these is our recently approved four-year DAAD project with LU Hannover under the scheme "New Passage to India". This project involves six faculty members from India and ten from the German end. We also established deeper links with the other three TU9 universities too. That is, KIT, TU Darmstadt, and TU Munich.

The French initiative at IIT Indore although being ten years old, got the most momentum in the past one year. We were identified as the nodal institute for France under the SPARC scheme of MHRD. Thus, we played (and are still playing) a major role in increasing collaboration between the Indian and the French institutes. In the recently concluded Knowledge Summit 2 between India and France in Lyon, we were asked to lead all Indian institutes in collaboration with France. In-terms of collaboration with other European nations, in this past one-year, multiple research projects were started between IIT Indore and different universities in UK, Sweden, Finland and Russia.

## SAARC, ASEAN, West Asia, and African Collaboration

Although we have international students present on our campus during substantial time of the year under exchange programs, this past year we specifically made efforts to enroll more foreign students in our degree programs from developing regions (as in the title above). We aligned our efforts with "Study in India" program of MHRD, where Dr. Kapil Ahuja led the initiative of signing of an MoU between 1st and 2nd generation IITs and EdCIL, a public sector undertaking of MHRD. Currently, we have three international students enrolled in our degree programs.

## Other Regions

As above, this year we increased our collaborative efforts with other geographical regions of the world as well. The biggest among these is collaboration with USA, where we are now collaborating with more than ten universities and five national labs. Canada, Japan, Singapore, Taiwan, and Australia are other five countries with which we have had increased interaction in this past one year (in the form of faculty-student exchanges, signing of MoU, and joint-publications).

Second-IITI-TU9-Workshop

# Student Enrolments and Graduation

Courses Offered : 828
Undergraduate Courses : 400
Postgraduate Courses : 322
Cross Listed Courses : 106

| Enrolments | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Academic Year** | **2013-14** | **2014-15** | **2015-16** | **2016-17** | **2017-18** | **2018-19** | **2019-20** |
| **Doctoral Students Admitted** | | | | | | | |
| PhD (Including Dual Degree) | 87 | 93 | 118 | 83 | 117 | 89 | 107 |
| **Post Graduate Students Admitted** | | | | | | | |
| MTech | 5 | 24 | 30 | 31 | 34 | 62 | 41 |
| MSc | 15 | 20 | 24 | 47 | 56 | 69 | 80 |
| MS (Research) | - | - | - | - | - | 7 | 21 |
| **Under Graduate Students Admitted** | | | | | | | |
| BTech | 119 | 117 | 111 | 258 | 249 | 265 | 283 |
| Preparatory Course | - | - | - | - | - | - | 4 |

| Graduation | | | | | | | |
|---|---|---|---|---|---|---|---|
| Convocation Year | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
| **Doctoral Students Graduated** | | | | | | | |
| PhD | - | 6 | 23 | 24 | 38 | 67 | 80 |
| **Post Graduate Students Graduated** | | | | | | | |
| MTech | - | - | 5 | 22 | 25 | 26 | 29 |
| MSc | - | - | 14 | 20 | 22 | 41 | 55 |
| **Under Graduate Students Graduated** | | | | | | | |
| BTech | 101 | 117 | 114 | 108 | 118 | 112 | 108 |

## List of PhD. students graduating in 2019 - Convocation

| Sl. | Roll No. | Discipline | Name | Date of PhD Viva | PhD Thesis Title [Thesis supervisor(s)] |
|---|---|---|---|---|---|
| **Discipline of Bio-sciences and Bio-medical Engineering** | | | | | |
| 1 | 1301171007 | BSBE | Subodh K. Mishra | 27-Nov-18 | G-Quadruplex Nucleic Acids and Small Molecule Modulators as a Potential Target and Tool in Human Diseases **(Dr. Amit Kumar)** |
| 2 | 1301271003 | BSBE | Vinay Sharma | 07-Jan-19 | Multifunctional Nanomaterials for Biosensing and Bioimaging: Insights from Metal Oxides and Carbon-dots **(Dr. Shaikh M. Mobin)** |
| 3 | 1301171004 | BSBE | Mansi Srivastava | 29-Apr-19 | Identification of Molecular Mechanisms of Chronic Inflammatory Responses **(Dr. Mirza S. Baig)** |
| 4 | 1401171001 | BSBE | Eshan Khan | 02-Aug-19 | Small molecule based therapeutics development via targeting (CAG)n repeats RNA that causes Huntingtonas Disease (HD) and spinocerebellar ataxia (SCAs) **(Dr. Amit Kumar)** |
| **Discipline of Computer Science and Engineering** | | | | | |
| 1 | 1401101002 | CSE | Nikhil Tripathi | 04-Jan-19 | Novel Application Layer Denial of Service Attacks and Detection **(Dr. Neminath Hubbali)** |
| 2 | 1501201007 | CSE | Dipanjan Roy | 31-Jan-19 | Hardware Security and IP Core Protection of CE Systems **(Dr. Anirban Sengupta)** |
| 3 | 1301201006 | CSE | Rudresh Dwivedi | 12-Feb-19 | Unimodal and Multimodal Biometric Verification using Cancelable Iris and Fingerprint Templates **(Dr. Somnath Dey)** |
| 4 | 11120103 | CSE | Rakesh Kumar Sahu | 19-Feb-19 | Efficient Energy Aware Routing Protocol for Mobile Ad Hoc Network **(Prof. Narendra S. Chaudhari)** |

| | | | | | |
|---|---|---|---|---|---|
| 5 | 1301101004 | CSE | Piyush Joshi | 23-Feb-19 | No-reference and No-training based Image Quality Assessment and Enhancement **(Dr. Surya Prakash)** |
| 6 | 1501101009 | CSE | Deepak Kachave | 16-Apr-19 | Transient Fault Reliability and Security of IP Cores **(Dr. Anirban Sengupta)** |
| 7 | 12110103 | CSE | Shruti Bhilare | 11-May-19 | Presentation Attack Detection and Matching Techniques for Hand-based Biometric Systems **(Dr. Vivek Kanhangad and Prof. N.S. Chaudhari)** |
| 8 | 1301101006 | CSE | Syed Sadaf Ali | 23-Jul-19 | A Few Techniques for Fingerprint Template Protection **(Dr. Surya Prakash)** |
| 9 | 11120104 | CSE | Rajat Saxena | 09-Sep-19 | Collaborative Approach for Efficient Authentication, Data Auditing, and Data Availability in Cloud Computing **(Dr. Somnath Dey)** |
| 10 | 1401101001 | CSE | Mayank Swarnkar | 30-Sep-19 | Deep Packet Inspection Applications for Traffic Classification and Security Monitoring **(Dr. Neminath Hubballi)** |
| 11 | 1301201004 | CSE | Rajendra Choudhary | 25-Oct-19 | Stability Analysis of Inexact Linear Solves in Model Order Reduction **(Dr. Kapil Ahuja)** |
| **Discipline of Electrical Engineering** | | | | | |
| 1 | 1501102018 | EE | Rishi Raj Sharma | 15-Nov-18 | Non-Stationary Signal Processing Techniques Based on Eigenvalue Decomposition of Hankel Matrix **(Prof. R.B. Pachori)** |
| 2 | 1501102011 | EE | Sanjeev Sharma | 17-Nov-18 | Signal Processing for Ultra-Wideband Wireless Communications **(Prof. Vimal Bhatia)** |
| 3 | 1401102013 | EE | Rohit Singh | 27-Dec-18 | Fabrication and Modelling of MgZnO/ZnO based Heterostructures to realize 2D Confinement of Electron Gas for HEMT Application **(Dr. Shaibal Mukherjee, Prof. Abhinav Kranti and Dr. Ajay Agarwal [CEERI Pilani])** |

| | | | | | |
|---|---|---|---|---|---|
| 4 | 1301202007 | EE | Mayoorika Shukla | 07-Jan-19 | Investigations on the In uence of Aspect Ratio and Morphology of Hydrothermally Grown ZnO Based Nanostructures Towards Biosensing Applications **(Dr. Vipul Singh and Dr. I.A. Palani)** |
| 5 | 1401102014 | EE | Satish Kumar Tiwari | 07-Jan-19 | Estimation and Optimization of Design Parameters in Diffusive Molecular Nanonetworks **(Dr. P.K. Upadhyay)** |
| 6 | 1401202002 | EE | Ankur Beohar | 25-Jan-19 | Performance Enhancement of 3D Cylindrical Gate-all-around Tunnel FET and Its Applications for Ultra Low Power Cross Coupled Voltage Doubler Circuit Design **(Dr. S.K. Vishvakarma)** |
| 7 | 1401202005 | EE | Mohit Kumar | 18-Feb-19 | Automated Diagnosis Methods for Heart Diseases Using Flexible Analytic Wavelet Transform **(Prof. R.B. Pachori)** |
| 8 | 1301202001 | EE | Ankita Jain | 08-Mar-19 | Human Behavior Analysis using Smartphone Sensor Data **(Dr. Vivek Kanhangad)** |
| 9 | 12120203 | EE | T. Venkatesh | 02-Apr-19 | Improved Monitoring and Security Assessment of Power Systems using Machine Learning Techniques and Phasor Measurements along-with their Optimal Placement **(Dr. Trapti Jain)** |
| 10 | 1401102012 | EE | Praveen Dwivedi | 05-Apr-19 | Influence of Transistor Architecture on the Performance of Dielectric Modulated Biosensor **(Prof. Abhinav Kranti)** |
| 11 | 1401102001 | EE | Aaryashree | 12-Apr-19 | ZnO Based Organic-Inorganic Hybrids: Properties and Device Applications **(Dr. Shaibal Mukherjee and Dr. Apurba K. Das)** |
| 12 | 1401102005 | EE | Brajendra S. Sengar | 22-Apr-19 | Investigation of heterojunction interface of CZTSSe/Cd-free buffer layers for photovoltaic applications **(Dr. Shaibal Mukherjee)** |
| 13 | 1601102013 | EE | Ambika Prasad Shah | 25-Apr-19 | Design Techniques for Bias Temperature Instability Aware and Soft-Error Resilient Nanoscale Circuits **(Dr. S.K. Vishvakarma)** |

| | | | | | |
|---|---|---|---|---|---|
| 14 | 1401102008 | EE | Maisagalla Gopal | 01-May-19 | Performance Enhancement of CMOS digital circuits using strain engineered asymmetric dual-k spacer finFETs **(Dr. S.K. Vishvakarma)** |
| 15 | 1401102003 | EE | Amitesh Kumar | 03-May-19 | Fabrication and modelling of ZnO based resistive switching devices for non-volatile memory applications **(Dr. Shaibal Mukherjee and Prof. Abhinav Kranti)** |
| 16 | 1401102015 | EE | Vivek Garg | 07-May-19 | Plasmons for Efficient Light Harvesting in Ultrathin Solar Cells **(Dr. Shaibal Mukherjee)** |
| 17 | 1301202005 | EE | Manish Gupta | 20-Jun-19 | Feasibility Assessment of Steep Switching in Silicon and Germanium Junctionless Transistors **(Prof. Abhinav Kranti)** |
| 18 | 1401202003 | EE | Anurag Nishad | 05-Jul-19 | Tunable-Q Wavelet Transform Based Filter Banks for Non-Stationary Signals Analysis and Classification **(Prof. R.B. Pachori)** |
| 19 | 1501102002 | EE | Abhishek Kumar Upadhyay | 08-Jul-19 | Compact Modeling of Graphene Field Effect Transistors for RF Circuit Applications **(Dr. S.K. Vishvakarma and Dr. Ajay K. Kushwaha)** |
| 20 | 1601102008 | EE | Md. Hasan R. Ansari | 08-Jul-19 | Transistor Architecture Evaluation for Standalone and Embedded 1T-DRAM **(Prof. Abhinav Kranti)** |
| 21 | 1501102022 | EE | Vishal Sharma | 10-Jul-19 | Highly Stable, Low-Power & Error Tolerant SRAM Memory Design For Wireless Sensor Node and FPGA **(Dr. S.K. Vishvakarma)** |
| 22 | 1501102020 | EE | Sourabh Solanki | 22-Jul-19 | Performance Analysis of Cognitive Relay Networks Using Spectral- and Energy-Efficient Schemes **(Dr. P.K. Upadhyay)** |
| 23 | 1401202009 | EE | Shalu | 29-Jul-19 | Investigations into Interfacial Effects in Blended Thin Films of DH6T and P3HT for Organic Optoelectronic Device Applications **(Dr. Vipul Singh & Dr. Mukesh P. Joshi (RRCAT))** |
| 24 | 1401202004 | EE | Bhuvaneshwari Y V | 08-Aug-19 | Extraction and Interpretation of Mobility in Heavily Doped Junctionless Transistors **(Prof. Abhinav Kranti)** |

| | | | | | |
|---|---|---|---|---|---|
| 25 | 1401202007 | EE | Pramila | 13-Aug-19 | Investigations on Factors Influencing Morphology of Polypyrrole Nanostructures for Enzymatic Biosensing Applications **(Dr. Vipul Singh)** |
| 26 | 1501102014 | EE | Abhijeet Bishnu | 25-Sep-19 | Algorithms for Channel Estimation and Spectrum Sensing with Implementation on Software Defined Radio **(Prof. Vimal Bhatia)** |
| 27 | 1501102023 | EE | Praveen Kumar Singya | 07-Oct-19 | Performance of Higher Order Modulation Schemes in Relay Networks **(Prof. Vimal Bhatia)** |
| **Discipline of Mechanical Engineering** | | | | | |
| 1 | 12110303 | ME | Balmukund Dhakar | 03-Dec-18 | Phase Stabilization and Characterization of Plasma Sprayed Alumina Based Coatings Prepared by Mechanically Blended Alumina-Chromia Powders **(Dr. Kazi Sabiruddin and Dr. Satyajit Chatterjee)** |
| 2 | 1301203012 | ME | Tameshwer Nath | 21-Feb-19 | Investigations on Contact and Non-Contact Based Actuation Studies of Shape Memory Alloy (SMA) Structures and their Life Cycle Behavior **(Dr. I.A. Palani)** |
| 3 | 1301103006 | ME | Kulkarni Aniket P. | 25-Feb-19 | Dense Spray Characterization in Airblast Atomization using Laser-based Techniques **(Dr. D.L. Deshmukh)** |
| 4 | 1301203002 | ME | Amandeep Singh Ahuja | | 07-Aug-19Artificial Neural Network Based Gearbox Fault Diagnosis **(Prof. Anand Parey)** |
| **Discipline of Metallurgy Engineering and Materials Science** | | | | | |
| 1 | 1401181007 | MEMS | Prateek Bhojane | 11-Feb-19 | Experimental Investigation of Transition Metal-Based Materials for Electrochemical Energy Storage Application **(Dr. P.M. Shirage and Dr. Somaditya Sen)** |
| 2 | 1401181004 | MEMS | Ashish Kumar Shukla | 19-Mar-19 | Investigations on Wet And Dry Laser Assisted Texturing on Flexible Polymeric Substrates and Their Suitability Towards Photovoltaic Applications **(Dr. I.A. Palani & Dr. M. Anbarasu)** |

| | | | | | |
|---|---|---|---|---|---|
| 3 | 1301103005 | MEMS | Gaurav Bajpai | 08-Apr-19 | Synthesis and structure correlated opto-electronic, mechanical and sensing properties of Fe/Si modified ZnO **(Dr. Somaditya Sen and Dr. P.M. Shirage)** |
| 4 | 1401181009 | MEMS | Yogendra Kumar | 23-Apr-19 | Size and Shape-Controlled Growth of CoFe2O4 Nanoparticles for Magnetic Properties and Humidity Sensing Applications **(Dr. P.M. Shirage and Dr. Somaditya Sen)** |
| 5 | 1401281002 | MEMS | Mohit Saraf | 29-Jun-19 | Architected Functional Materials with Emphasis on Sustainable Electrochemical Energy Storage and Sensing **(Dr. Shaikh M. Mobin)** |
| 6 | 1401181006 | MEMS | P. Rajagopalan | 08-Jul-19 | Design and Development of Zno based Flexible Piezoelectric nanogenerator for improved energy Harvesting and novel applications **(Dr. I.A. Palani and Dr. Vipul Singh)** |
| 7 | 1501181003 | MEMS | Saurabh Tiwari | 21-Aug-19 | Effect of transition elements substitution on structural, optoelectronic, magnetic and mechanical properties of CeO2 **(Dr. Somaditya Sen and Dr. Parashram M Shirage)** |
| 8 | 1401281003 | MEMS | Nandini Patra | 09-Sep-19 | Investigations on Laser Ablated NiTi and CuAl Alloyed Nanoparticles and Their Influence on the LSPR Effect at the Interface of ZnO Nanostructures **(Dr. I.A. Palani & Dr. Vipul Singh)** |
| 9 | 1401181005 | MEMS | Dipayan Pal | 27-Sep-19 | Surface and Interface Effect in ALD-Grown ZnO: Properties and Application in Rechargeable Batteries **(Dr. Sudeshna Chattopadhyay and Dr. Chelvam Venkatesh)** |
| 10 | 1501181010 | MEMS | Anita | 30-Sep-19 | Structure, dielectric, piezo/ ferroelectric, and energy storage properties of lead-free Na0.5Bi0.5TiO3-based ceramics **(Dr. Somaditya Sen and Dr. Parasharam Shirage)** |

| | | | | | |
|---|---|---|---|---|---|
| **Discipline of Chemisty** | | | | | |
| 1 | 1301131001 | Chemistry | Ajeet Singh | 14-Feb-19 | Investigation of Organometallic Complexes and their Applications in Catalysis, Biological Activities and Crystal Engineering **(Dr. Shaikh M. Mobin and Prof. Pradeep Mathur)** |
| 2 | 1401231004 | Chemistry | Kuber Singh Rawat | 27-Feb-19 | Computational Studies of Manganese Based Homogeneous Catalysts for CO2 Hydrogenation Reactions **(Dr. Biswarup Pathak)** |
| 3 | 1401131005 | Chemistry | Novina Malviya | 12-Jul-19 | Design, Fabrication and Applications of Soft and Crystalline Metal-Organic Materials **(Dr. Suman Mukhopadhyay)** |
| 4 | 1301231007 | Chemistry | Sagar Biswas | 16-Jul-19 | Bicomponent Co-assembled Molecular Gels: Design, Synthesis and Application in Biocatalysis **(Dr. Apurba K. Das)** |
| 5 | 1401231006 | Chemistry | Priyanka Garg | 29-Aug-19 | Theoretical Insights into Low Dimensional Materials for Water Splitting **(Dr. Biswarup Pathak)** |
| 6 | 1501131004 | Chemistry | Khursheed Ahmad | 06-Sep-19 | Design and Fabrication of Advanced Functional Materials for Electrochemical Sensor and Photovoltaic Applications **(Dr. Shaikh M. Mobin)** |
| 7 | 1501131007 | Chemistry | Bidyut Kumar Kundu | 27-Sep-19 | Studies on Metal Complexes if 'N, O-Donor' Ligands in Modelling Metalloenzymes, Sensing and Catalysis **(Prof. Suman Mukhopadhyay)** |
| 8 | 12123109 | Chemistry | Sagnik Sengupta | to be held on 30 Oct. 2019 | Design, Synthesis and Biological Evaluation of Novel Small Molecule Inhibitors for Early Diagnosis and Therapy of Diseased States **(Dr. Chelvam Venkatesh)** |
| **Discipline of Mathematics** | | | | | |
| 1 | 12124103 | Maths | Rupsha Roy | 26-Jul-19 | Some Aspects of Monotone Iterative Methods for Classical and Fractional Differential Equations **(Dr. Antony Vijesh)** |

| Discipline of Physics | | | | | |
|---|---|---|---|---|---|
| 1 | 12115105 | Physics | Pritpal Kaur Sandhu | 12-Nov-18 | Diffuse Radio Emission in a Galaxy Cluster Merger at Frequency Ranging from 150 MHz to 18 GHz **(Dr. Abhirup Datta)** |
| 2 | 1401151005 | Physics | Arvind Khuntia | 18-Mar-19 | Study of sub-atomic particle collisions with ALICE at the LHC and Application of Non-extensive Statistics in High Energy Physics **(Dr. Raghunath Sahoo)** |
| 3 | 1401151016 | Physics | Vikash Mishra | 26-Mar-19 | Investigation of Optical and Electronic Properties of Selected Transition Metal Oxides **(Dr. P.R. Sagdeo and Dr. Rajesh Kumar)** |
| 4 | 1301151001 | Physics | Ankita Goswami | 05-Apr-19 | Study of $\eta \rightarrow e^+e^-\gamma$ Dalitz Decay to Measure the Electromagnetic Transition Form Factor of the eta meson with WASA-at-COSY Facility **(Dr. Ankhi Roy)** |
| 5 | 1401151009 | Physics | Md. Kamal Warshi | 10-Apr-19 | Investigations of Structural, Optical, Electronic and Magnetic Properties of Rare-earth Orthoferrites **(Dr. P.R. Sagdeo and Dr. Rajesh Kumar)** |
| 6 | 1401251006 | Physics | Pragati Sahoo | 11-Apr-19 | Measurement of K*(892)± in Proton+Proton collisions with ALICE at the LHC and Study of Particle Production using Color String Percolation Model **(Dr. Raghunath Sahoo)** |
| 7 | 1401151011 | Physics | Nasima Khatun | 19-Jun-19 | Grain growth, phase transition and optical properties of modified TiO2 **(Dr. Somaditya Sen)** |
| 8 | 1401151010 | Physics | Md. Nasir | 14-Aug-19 | Understanding the Structure-Magnetic Properties Correlation in Transition Metal Oxides and Rare-earth-based Double Perovskites **(Dr. Somaditya Sen)** |
| 9 | 1401151006 | Physics | Dhananjaya Thakur | 27-Aug-19 | Multiplicity Dependence of Forward Rapidity J/ψ Production in proton+proton Collisions with ALICE at the LHC and Study of Particle Production in High-Energy Collisions **(Dr. Raghunath Sahoo)** |

| | | | | | |
|---|---|---|---|---|---|
| 10 | 12115113 | Physics | Sudeep Ghosh | 18-Sep-19 | Study of the Decay Matrix for η→ηπ+π- using CLAS Detector at Jlab **(Dr. Ankhi Roy and Prof. Moskov Amaryan)** |
| 11 | 1501151001 | Physics | Sushanta Tripathy | 18-Oct-19 | Event shape and Multiplicity dependence of meson production in Proton+Proton collisions with ALICE at the LHC and Characterization of Heavy-ion Collisions using Relativistic Kinetic Theory **(Dr. Raghunath Sahoo)** |
| **School of Humanities and Social Sciences** | | | | | |
| 1 | 12116106 | HSS (Economics) | Shanu Shukla | 30-Aug-19 | The Emotional Profile and Processing of Emotional Stimuli among Media Multitaskers **(Dr. Pritee Sharma and Prof. Sushanta Kumar Mishra)** |
| 2 | 1301161001 | HSS (Eng) | Ashna Mary Jacob | 27-Nov-18 | Mythopoeia In Popular Fiction: A Select Study of The Mythopoeic Deities Of J.R.R. Tolkien and **Amish Tripathi (Dr. Nirmala Menon)** |
| 3 | 1301161005 | HSS (Eng) | Reema Chowdhary | 06-Feb-19 | Study of Visual Narratives: Mapping Postcolonial Indian Biopics as Historical Palimpsest **(Dr. Nirmala Menon)** |
| 4 | 1301161002 | HSS (Philosophy) | Hareesh A. G. | 06-Feb-19 | Evolution And Ontological Realism: A Critical Interpretation **(Dr. C. Upendra)** |
| 5 | 12116104 | HSS (Philosophy) | S. Pattnaik | 20-Feb-19 | Utopia, Politics and Social Imagination **(Dr. C. Upendra)** |
| 6 | 1301161006 | HSS (Psychology) | Sajad Ahmad Najar | 19-Aug-19 | Visuospatial Working Memory and Distracted Driving: Deciphering Gaze Behavior, Cognitive Workload, and Driving Errors **(Dr. Sanjram Premjit Khanganba)** |
| 7 | 1301161004 | HSS (Sociology) | Neha Singh | 30-Apr-19 | From the backyards of the city, the river sings the blues." Governance of Rivers in India: A Technographic Analysis of Subaltern Rivers in Madhya Pradesh **(Dr. Neeraj Mishra)** |

## List of M.Tech Students Graduating in 2019 - Convocation

### Communication and Signal Processing

| Sl. | Roll Number | Name |
|---|---|---|
| 1 | 1702102002 | Anil Rathore |
| 2 | 1702102003 | Himanshu Chauhan |
| 3 | 1702102005 | Preeti Meena |
| 4 | 1702102006 | Rajat Katiyar |
| 5 | 1702102007 | Richa Singh |
| 6 | 1702102009 | Vishal Bhartiy |

### VLSI Design and Nanoelectronics

| Sl. | Roll Number | Name |
|---|---|---|
| 1 | 1702102013 | Abhishek Dalal |
| 2 | 1702102014 | Apoorv Srivastava |
| 3 | 1702102016 | Himanshu Soni |
| 4 | 1702102019 | Pallab Nath |
| 5 | 1702102020 | Pranshu Bisht |
| 6 | 1702102021 | Sanjay Sharma |
| 7 | 1702102022 | Sarika Athya |

### Production and Industrial Engineering

| Sl. | Roll Number | Name |
|---|---|---|
| 1 | 1702103001 | Ankit Kaithwas |
| 2 | 1702103002 | Gaurav Deshwal |
| 3 | 1702103003 | Mayank Sharma |
| 4 | 1702103004 | Shalini Singh |
| 5 | 1702103005 | Shivam Mishra |
| 6 | 1702103007 | Vinod Singh Thakur |

### Material Science and Engineering

| Sl. | Roll Number | Name |
|---|---|---|
| 1 | 1702105001 | Avi Jain |
| 2 | 1702105002 | Deepak Paliwal |
| 3 | 1702105003 | Hariom Sharma |
| 4 | 1702105004 | Harsh Vaid |

| | | |
|---|---|---|
| 5 | 1702105005 | Mohit Deshpande |
| 6 | 1702105006 | Narendra Anjana |
| 7 | 1702105007 | Parmar Kaushal Harishkumar |
| 8 | 1702105008 | Santosh Bimli |
| 9 | 1702105009 | Shubham Choudhary |
| 10 | 1702105010 | Vikesh Kumar |

## List of MSc Students Graduating In 2019 - Convocation

### Chemistry

| Sl. | Roll Number | Name |
|---|---|---|
| 1 | 1703131002 | Aniket Mandal |
| 2 | 1703131004 | Avijit Maity |
| 3 | 1703131005 | Barsha Deori |
| 4 | 1703131008 | Chetan Sharma |
| 5 | 1703131009 | Km. Sandhya Jaiswal |
| 6 | 1703131010 | Kusum Vinay Mohansingh |
| 7 | 1703131011 | Mahima |
| 8 | 1703131012 | Mithu Roy |
| 9 | 1703131013 | Nitish |
| 10 | 1703131014 | Pawan Kumar |
| 11 | 1703131015 | Puja Singhvi |
| 12 | 1703131016 | Punam Pawe |
| 13 | 1703131017 | Ram Kumar |
| 14 | 1703131018 | Shubham Rawat |
| 15 | 1703131020 | Subhankar Biswas |
| 16 | 1703131021 | Sumit Kumar |
| 17 | 1703131022 | Vanitha Reddy Naina |
| 18 | 1703131023 | Vivek |

### Mathematics

| Sl. | Roll Number | Name |
|---|---|---|
| 1 | 1603141007 | Nourhevinuo Victoria Angami |
| 2 | 1603141012 | Yashpal Yadav |
| 3 | 1703141001 | Akshita Aggarwal |
| 4 | 1703141002 | Baibhav Kumar Mishra |
| 5 | 1703141003 | Bshisht Moony |
| 6 | 1703141005 | Himanshu Mishra |

| | | |
|---|---|---|
| 7 | 1703141008 | Rishbha Jain |
| 8 | 1703141009 | Sapna |
| 9 | 1703141010 | Shilpa Sharma |
| 10 | 1703141011 | Swati Pal |
| 11 | 1703141012 | Vivek Yadav |

## Physics

| Sl. | Roll Number | Name |
|---|---|---|
| 1 | 1603151007 | Lalit Bharti |
| 2 | 1603151011 | Nima Tshering Bhutia |
| 3 | 1603151016 | Ramraj Meena |
| 4 | 1703151001 | Ashish Bisht |
| 5 | 1703151002 | Bajrang Lal Gupta |
| 6 | 1703151003 | Debasish Sahoo |
| 7 | 1703151004 | Deepak |
| 8 | 1703151005 | Hridey Chetri |
| 9 | 1703151006 | Manoj Kumar |
| 10 | 1703151007 | Megha |
| 11 | 1703151008 | Monika |
| 12 | 1703151009 | Naveen Kumar Mendola |
| 13 | 1703151010 | Pavish S |
| 14 | 1703151011 | Piyush Kalra |
| 15 | 1703151013 | Pramodini Mallik |
| 16 | 1703151014 | Prasoon Chakraborty |
| 17 | 1703151015 | Rahul |
| 18 | 1703151016 | Rahul Kumar |
| 19 | 1703151019 | Ravi Shankar Suman |
| 20 | 1703151022 | Swati Malhotra |

## Biotechnology

| Sl. | Roll Number | Name |
|---|---|---|
| 1 | 1703171001 | Abhipsa Panda |
| 2 | 1703171002 | Kalpana Kumari |
| 3 | 1703171004 | Neetu Rajak |
| 4 | 1703171005 | Priyanka Yadav |
| 5 | 1703171007 | Sai Kumari Vechalapu |
| 6 | 1703171009 | Suchi Agrawal |

## List of B Tech Students Graduating in 2019 - Convocation

## Computer Science and Engineering

| Sl. | Roll Number | Name |
|---|---|---|
| 1 | 140001030 | Shubham Burewar |
| 2 | 150001001 | Aditya Jain |
| 3 | 150001002 | Apoorva Joshi |
| 4 | 150001003 | Bandaru Harsha Vardhan |
| 5 | 150001005 | Bhor Bhaskar Verma |
| 6 | 150001006 | Bikash Kumar Tudu |
| 7 | 150001007 | Challapalli Chakradhar Reddy |
| 8 | 150001008 | Chavare Manish Sadashiv |
| 9 | 150001009 | Dhruv Chadha |
| 10 | 150001010 | Dip Kumar Das |
| 11 | 150001011 | E Ranjith Kumar |
| 12 | 150001012 | K Ganesh Raj |
| 13 | 150001013 | Kalkute Piyush Premchand |
| 14 | 150001014 | Keshav Goyal |
| 15 | 150001015 | Kunal Gupta |
| 16 | 150001016 | Kunal Sikri |
| 17 | 150001017 | Mainak Biswas |
| 18 | 150001018 | Mohit Mohta |
| 19 | 150001019 | Nalla Prajwal Chandra |
| 20 | 150001020 | Nitish Kumar Raj |
| 21 | 150001021 | Parshallu Prasad |
| 22 | 150001022 | Prakash Choudhary |
| 23 | 150001023 | Priyanka Meena |
| 24 | 150001025 | Punit Lakshwani |
| 25 | 150001026 | Radheshyam Gupta |
| 26 | 150001027 | Rahul Choudhary |
| 27 | 150001028 | Rohit Ranjan |
| 28 | 150001029 | Shah Vinit Haresh |
| 29 | 150001030 | Shashwat Raghuvanshi |
| 30 | 150001031 | Sheregar Kailas Nagaraj |
| 31 | 150001032 | Shivam Bhosale |
| 32 | 150001033 | Shivam Parashar |
| 33 | 150001034 | Shivam Tayal |
| 34 | 150001035 | Tapish Pratap Singh |

| | | |
|---|---|---|
| 35 | 150001036 | Thota Sri Ranga Vineel |
| 36 | 150001037 | Utkarsh Kumar Singh |
| 37 | 150001038 | Yadav Siddharth |
| 38 | 150002024 | Paridhi Yadav |
| 39 | 150002034 | Shrestha Kumar |

## Electrical Engineering

| Sl. | Roll Number | Name |
|---|---|---|
| 1 | 1100216 | Himanshu Soni |
| 2 | 140002011 | Chhatrola Parth Mukeshbhai |
| 3 | 150002001 | Achanta Vishnu Vardhan |
| 4 | 150002002 | Ajay Pippal |
| 5 | 150002003 | Amit Kumar Kabat |
| 6 | 150002005 | Anandita Rohi |
| 7 | 150002006 | Aniket Rajesh Tiwari |
| 8 | 150002007 | Ankit Gaur |
| 9 | 150002008 | Anmol Mansingh |
| 10 | 150002009 | Ayush Soni |
| 11 | 150002010 | Banka Nithin |
| 12 | 150002011 | Bhavesh Mahawar |
| 13 | 150002012 | Bhole Aashish Kiran |
| 14 | 150002013 | Chopda Mayur Dahyabhai |
| 15 | 150002014 | Deo Aditya Manoj |
| 16 | 150002015 | Dhairya Punjabi |
| 17 | 150002016 | Gargi Gupta |
| 18 | 150002017 | Harshit Jalan |
| 19 | 150002018 | J Venkatesh |
| 20 | 150002019 | Jashandeep Singh |
| 21 | 150002021 | Md Fayaz Ahmed |
| 22 | 150002022 | Narigara Kishan Vitthalbhai |
| 23 | 150002023 | Nelaturu Sreekanth Reddy |
| 24 | 150002025 | Pranjal Singh Tomar |
| 25 | 150002026 | Rakesh |
| 26 | 150002027 | Reena Meena |
| 27 | 150002028 | Rupank Pahuja |
| 28 | 150002029 | Sanchit Jalan |
| 29 | 150002030 | Sandeep Meena |
| 30 | 150002031 | Saurabh Kumar |
| 31 | 150002032 | Saurav Kumar Saini |

| | | |
|---|---|---|
| 32 | 150002035 | Shubham Gupta |
| 33 | 150002036 | Sonu Kishan |
| 34 | 150002037 | Suryaveer |
| 35 | 150002038 | Sushant Saxena |
| 36 | 150002039 | Vijay Sonone |
| 37 | 150003027 | Prateek Pradhan |

## Mechanical Engineering

| Sl. | Roll Number | Name |
|---|---|---|
| 1 | 1200317 | Kapil Gocher |
| 2 | 1200340 | Y Ashok Kumar |
| 3 | 140003030 | Ritesh Kumar Phogat |
| 4 | 150003001 | A G Sai Kiran |
| 5 | 150003002 | Aaditya Raj Sudarshan |
| 6 | 150003004 | Ashish Kishor |
| 7 | 150003005 | Badabagni Hitesh |
| 8 | 150003007 | Bollineni Uday Kumar |
| 9 | 150003008 | Brahmbhatt Jugal Hemenkumar |
| 10 | 150003009 | Challa Ajay Simha Reddy |
| 11 | 150003012 | Gagan Chawara |
| 12 | 150003013 | Gurram Sai Vilas |
| 13 | 150003014 | Harsh Nigam |
| 14 | 150003015 | K Dasarath Sankar Sai |
| 15 | 150003016 | Kasavaraju Venkata Pranay |
| 16 | 150003017 | Kirtiveer Singh |
| 17 | 150003019 | Mayank Bambal |
| 18 | 150003020 | Mohammad Taaib Uzair |
| 19 | 150003021 | Naveen Philipose George |
| 20 | 150003022 | Nihar Panchal |
| 21 | 150003023 | Nishant Anand |
| 22 | 150003025 | Prasenjeet Jain |
| 23 | 150003026 | Prateek Kumar Singh |
| 24 | 150003029 | Reshav Kumar |
| 25 | 150003030 | Rohit Srivastava |
| 26 | 150003032 | Shailesh Kumar |
| 27 | 150003033 | Shan Malviya |
| 28 | 150003034 | Sumit Kumar Singh |
| 29 | 150003035 | Sunil Gurjar |
| 30 | 150003036 | Vaidya Dattaraj Vilas |
| 31 | 150003037 | Vinay Shelke |
| 32 | 150003038 | Vinod Dawar |

## Indian Institute of Technology Indore

# 7th Convocation 2019: Recipients of Medals and Awards

## President of India Gold Medal

For the best academic performance among all the graduating UG students

**Mr. Rahul Choudhary**
B.Tech (CSE)
Roll No. 150001027

## Institute Silver Medal

For the best academic performance among all the graduating UG students of a particular Discipline

**Ms. Apoorva Joshi**
B.Tech (CSE)
Roll No. 150001002

**Mr. Bhole Aashish Kiran**
B.Tech (EE)
Roll No. 150002012

**Mr. Badabagni Hitesh**
B.Tech (ME)
Roll No. 150003005

## Institute Silver Medal

For the best overall performance among all the graduating PG of a particular program

**Ms. Vanitha Reddy Naina**
M.Sc (Chemistry)
Roll No. 1703131022

**Mr. Mayank Sharma**
M.Tech (ME)
Roll No. 1702103003

## Institute Silver Medal

For the Best All Round Performance among all the graduating UG students

**Mr. Shah Vinit Haresh**

B.Tech (CSE)
Roll No. 150001029

## Award For Best B.Tech Project (BTP)

Amongst all the graduating UG students

**Mr. E Ranjith Kumar**

B.Tech (CSE)
Roll No. 150001011

**Mr. Nalla Prajwal Chandra**

B.Tech (CSE)
Roll No. 150001019

Project Title: "Cryptosystem Based Digital Signature Embedding Approach for DSP Applications"

## Buti Foundation Gold Medal

For the best academic performance among all the graduating female PG students

**Ms. Vanitha Reddy Naina**

M.Sc (Chemistry)
Roll No. 1703131022

# Research & Development Report

IIT Indore envisages the convergence of traditional disciplines as the key to accomplish the previously unimaginable. With this foresight, IIT Indore has been promoting inter- disciplinary research programme focusing on basic and applied research, technology development and innovation. This vision has helped the institute to excel in all spheres of science, engineering, and humanities and social sciences.

A key competency of IIT Indore is research driven academic programme as it forms a core component of the undergraduate and postgraduate teaching. IIT Indore has consciously promulgated the idea of involving undergraduate students in forefront research projects. This led to the initiation of a formal undergraduate research scheme, Promotion of Research and Innovation for Undergraduate Students (PRIUS).

Research at IIT Indore has been recognized at both international and national level. Faculty members and scientists are actively involved in several key international projects and joint collaborations with research organizations in Japan, South Korea, Russian Federation, Portugal, France, Germany, UK, USA, and many other countries. The institute has been successful in securing 273 externally sponsored research projects with a sanctioned amount of INR 100.63 Crore. The interaction with industry has also progressed well with a total of 86 consultancy projects worth INR 2.47 Crore. IIT Indore has also filed 48 patent applications.

Centre for Innovation and Entrepreneurship (CIE) was established to encourage entrepreneurship for technology development, economic and social stability. The Sophisticated Instrumentation Centre is a unique facility of state-of-the-art research infrastructure. It continues to provide growth and characterization facilities to national and international users. Facilities include Single Crystal X-ray Diffraction, Nuclear Magnetic Resonance, Mass Spectrometry, Atomic Force Microscopy, Field Emission Scanning Electron Microscopy, Elemental Analysis, Single- Molecule Imaging, Dual Ion Beam Sputtering Deposition System, and other characterization facilities. IIT Indore community is actively working towards establishing their own start-ups and thereby applying innovation into practicality for the benefit of all. In the coming years, IIT Indore will develop into a world class centre for higher academic and industrial research, and innovation.

# GIAN Courses during April 2018 - March 2019

| | | |
|---|---|---|
| **Dr. Hem Jha (BSBE)** | | |
| 1. | Title of the Course<br>Brief Statement of the importance of the course<br>Academic Activities<br>The Approximate number of students and faculty who attended | How next generation sequencing untying the knot in viral pathogenesis<br>This course helps students to understand the modern biotechnology tools and interpretations which can be used in their future studies.<br>10 days<br>130 |
| **Dr. Surya Prakash (CS)** | | |
| 1. | Title of the Course<br>Brief Statement of the importance of the course<br><br><br><br>Academic Activities<br>The Approximate number of students and faculty who attended | Advanced Pattern Recognition Techniques for Biometrics<br>Methods and applications of pattern recognition in biometrics have seen tremendous advances in recent years. This course on Advanced Pattern Recognition Techniques for Biometrics provided an excellent opportunity to students, researchers and practitioners to learn advanced pattern recognition techniques for biometric recognition.<br>The course included lecture and practical sessions.<br>60 |
| 2. | Title of the Course<br>Brief Statement of the importance of the course<br>Academic Activities<br>The Approximate number of students and faculty who attended | Media Security and Forensics<br>This course provided an opportunity to know about the latest developments in the area of media security and forensics.<br>The course included lecture and practical sessions.<br>30 |
| **Dr. I A Palani (ME)** | | |
| 1. | Title of the Course<br>Brief Statement of the importance of the course<br><br><br><br><br><br>Academic Activities<br><br>The Approximate number of students and faculty who attended | Laser Assisted Surface Micro and Nano Fabrication<br>A few novel techniques have been developed to make functional nanostructures which includes process such as Laser Induced Backside wet etching (LIBWE), Laser micro-printing, Laser Induced forward transfer (LIFT), etc. However challenges still persist in fabricating nanostructure over a large area in a short time for mass production. Therefore, the course addressed the need to equip the participants in this cutting technology to compete with the international community towards efficient functional device development.<br>The course includes lectures sessions, tutorials and laboratory session (Hands-on experience with the Laser facility at IIT Indore)<br>30 |
| **Dr. Rupesh S. Devan (MEMS)** | | |
| 1. | Title of the Course | 1. One-dimensional metal-oxide nanostructures: Recent developments in synthesis, characteristics and applications<br>2. 'Basic Principles and Applications of Photovoltaic Device |

| | | |
|---|---|---|
| **Dr. Eswar P. Korimilli (MEMS)** | | |
| 1. | Title of the Course<br>Brief Statement of the importance of the course<br>Academic Activities<br><br>The Approximate number of students and faculty who attended | Integrated Computational Materials Engineering for metals<br>The emphasis of the course was on understanding the scale bridging techniques in engineering materials.<br>Besides co-organizing the course, delivered few lectures on dislocation dynamics<br>70 |
| **Dr. P. M. Shirage (MEMS)** | | |
| 1. | Title of the Course<br>Brief Statement of the importance of the course<br><br><br><br><br><br>The Approximate number of students and faculty who attended<br>Academic Activities | Basic Principles and Applications of Photovoltaic Device<br>Photovoltaics is a simple and elegant method of harnessing the sun energy. Photovoltaic devices (solar cells) are unique in that they directly convert the incident solar radiation into electricity, with no noise, pollution or moving parts, making them robust, reliable and long lasting. Solar cells are based on the same principles and materials behind the communications and computer revolutions, and this course covers the operation, use and applications of photovoltaic devices and systems.<br>20<br><br>Conducted Lectures and lab courses during the course work |
| 2. | Title of the Course<br><br>Brief Statement of the importance of the course<br><br><br><br>The Approximate number of students and faculty who attended<br>Academic Activities | One-dimensional metal-oxide nanostructures: Recent developments in synthesis, characteristics and applications<br>The objective of this course is to provide an introduction to, and overview of, the physics of the 1D metal-oxide nanostructures. The focus is on the basic semiconductor physics relevant to the 1D metal-oxide nanostructures, and how these relate to the design and function of practical devices.<br>15<br><br>Conducted Lectures and lab courses during the course work |
| **Dr. Sarika Jalan (Physics)** | | |
| 1. | Title of the Course<br>Brief Statement of the importance of the course<br><br><br><br><br>The Approximate number of students and faculty who attended | Network science – from structure to dynamics<br>The recent years have seen spectacular advances in our ability to accurately map complex social, biological and technological networks. Yet, to fully conquer these pertinent goals – understanding, predicting and controlling – we must progress network science to its next stage: developing tools to systematically translate our rich topological findings into dynamic predictions.<br>20 |
| **Dr. C. Venkatesh (Chemistry)** | | |
| 1. | Title of the Course | Advanced Concepts in The Synthesis of Pharmaceutical Drugs |

| | | |
|---|---|---|
| | Brief Statement of the importance of the course | The course worked towards understanding contemporary medicinal chemical principles and practices, and critical roles thereof in modern drug discovery program. The course may also spark an interest to pursue further educational training, research, and a professional career in medicinal chemistry. |
| | The Approximate number of students and faculty who attended | 35 students and teachers from several colleges and universities across India participated in the course |
| | Academic Activities | Twenty lectures and tutorials were delivered by the visiting faculty. |

# Sophisticated Instrumentation Centre (SIC), IIT Indore: A National Facility

Sophisticated Instrumentation Centre (SIC) was established in September 2011 with institute funding to expedite research programs at IIT Indore. The SIC mission is to support and foster research enterprises in Science and Engineering IIT Indore, as opportunities exist, by providing state-of-the-art instrumentation and ancillary equipment; and expertise in its use and application. The SIC is equipped with Single Crystal X- ray Diffraction, Nuclear Magnetic Resonance, Mass Spectrometry, Elemental Analysis, Single Molecule Imaging and Spectroscopy and other Spectroscopic facilities all together under one roof to provide the highest quality of data analysis to academics and students in both research and teaching. With our excellent facilities and high level of expertise, we can offer our analytical services to other schools within the Institute as well as external commercial organizations.

SIC has now emerged as one of the first such centers in the country providing extensive support to users across the country. It has become a self-sustained centre by generating funds from services provided to external users from academia and industry.

A major advantage of SIC is its accessibility to students within the Institute, a very healthy ratio of students to the time availability on instruments.

The SIC instruments strengthens the following research areas: Fundamental Research in Inorganic Chemistry, Organic Chemistry, Organometallic Chemistry, Various aspects of Material Science, Bio Science and Engineering including work on Biosensors, Materials Science and Engineering, and Condensed Matter Physics.

## Some Major Facilities

### X-Ray

- Single Crystal X-ray Diffraction Facility (SCXRD)
- Powder XRD (PXRD)
- X-ray Absoption Fine Structure (XAFS)
- Energy Dispersive X-ray Spectroscopy (EDS/EDX)
- Wavelength Dispersive Spectroscopy

### Spectroscopy

- Nuclear Magnetic Resonance (NMR)
- Fourier Transform Infrared Spectrometer (FT-IR)
- Time Corelated Single Photon Counting (TCSPC)
- Circular Dichrohism (CD)
- Photo Luminescence (PL)
- Raman Spectroscopy
- UV Visible Spectrometer
- UV VIS NIR
- Spectroflouro meter

### Microscopy

- Scanning Electron Microscopy
- Single Molecule Microscopy
- Confocal Microscope

### Chromatography

- Liquid Chromatography and Mass Spectroscopy (LC-MS)
- High Performance Liquid Chromatography (HPLC- Reversed phase)
- High Performance Liquid Chromatography (HPLC-Chiral)
- Gas Chromatography Mass Spectrometer (GC-MS)

### Electro-Analytical

- Cyclic Voltammetry
- Spectroelectro Chemical Cell (SEC)

### Elemental Analyzer Thermal

### Thermal Analysis

- Thermogravimetric Analyzer
- Differential Scanning Calorimetry

### BET Surface Area Analyzer

### DIBSD

### Other Equipment

- Polarimeter
- Lyophilizer
- Rheometer
- Langmuir-Blodgett film deposition system

## Apart from these the SIC has several other instruments enlisted at

http://www.iiti.ac.in/sic/index.php

**Academic Institutions:**

BARC, Mumbai
Banaras Hindu University
Delhi University
Guru Nanak DevUniversity, Punjab
IIT Bombay, IIT Madras, IIT Mandi
IIT Patna, IIT Gandhinagar
GITAM University, Visakhapatnam
Jammu University
MS University Baroda
NIPER Mohali
NIT Rourkela and others
Institute of Himalayan Bio-resource Technology (IHBT)
PuneUniversity
Pinnacle Biomedical Research Institute (PBRI), Bhopal
Devi Ahilya Vishwavidyalaya, Indore
Govindram Seksaria Institute of Technology and Science
NMU Jalgaon
RD University Jabalpur
CentralUniversity Sagar
Ghasidas Vishwavidyalaya Central University, Bilaspur
SRM University
University College Trivandrum
Tumkur University, Karnataka
Thapar University, Patiala
PunjabUniversity
Awadhesh Pratap Singh University, Rewa
University of Hyderabad, Telangana
Pondicherry University, Puducherry
Vikram University,Ujjain
Mewar University, Rajasthan
Centre for Advanced Technology (RRCAT), Indore

**Industries:**

Gharda Chemicals
Glenmark Pharmaceuticals
Piramal Healthcare Mumbai
Jubilant Biosys Ltd.
Lupin Pharmaceutical Pvt. Ltd.
Mimani Wires Pvt. Ltd.
Choksi Labs Ltd.
UV Resins Pvt. Ltd.
Impress Chemicals Pvt. Ltd.
Syntochem Pvt. Ltd.
Symbiotec Pharma Lab, Indore
Medilux Pharma, Indore
Emcure. Pune
Reliance Industries Ltd.
Navin Fluorine International Ltd., Dewas Shri
SRF Ltd., Indore
M.P. Dye Chem., Indore
Rupak Enterprises, Indore
Sprint Testing Solutions, Mumbai Guru
Rajveer Chemicals, Indore
Shree Pacetronix Ltd. Indore
Keva, Mumbai
IPCA, Ratlam
ATUL Ltd., Valsad
TIFR Hyderabad

**International Academic Institutes:**

Universität Stuttgart, Germany
Jehangirnagar University, Bangladesh
Dhaka University, Bangladesh Raja Ramanna

# Counseling Cell

The Counselling cell has been an integral part of IIT Indore since its inception in December, 2011. The function of this cell is to offer a supportive and conducive environment for students wherein he/she can discuss personal issues or academic challenges and seek help from a professional counsellor.

**Ms. Monika Gupta** presently heads the counselling cell of IIT Indore. After completing her Masters in Psychology from Delhi University, Ms. Gupta received her professional training as a Clinical Psychologist from NIMHANS, Bangalore.

**Ms. Monika Gupta**

(M.Phil, Clinical Psychology)
Counselor IIT Indore

**Dr. Ashutosh Singh**

(MBBS, DNB Psychiatry)
Visiting Psychiatrist,
IIT Indore

In addition, the Counselling cell comprises of a visiting consultant psychiatrist **Dr. Ashutosh Singh** (MBBS, DNB Psychiatry). The Counselling cell works in close association with the office of Dean, Students Affairs, IIT Indore, student mentors and volunteers.

With a vision to enhance positive well-being and facilitate an overall development of IIT Indore's student community, the cell's services are equally accessible to all the students (B.Tech, M.Tech/ M.Sc, PhD. and any other course). Having a focus on prevention of mental health issues- prevention of suicide and chronic mental health problems, the counselling cell works for early identification and early intervention for various mental health issues in students.

The Counselling cell undertakes various activities-

- Individual counselling sessions- Individual counselling assists students in dealing with a wide range of concerns -be it academic, personal, emotional, family or peer related; as well as wide range of psychological concerns, including clinical depression, anxiety spectrum difficulties, suicidal tendencies, difficult personality traits.
- Small group interactions with students having common concerns are also organised.
- Creating a good liaison with various departments and services at the institute to facilitate the implementation of the intervention plan is an important activity.
- Working towards creating a strong referral system as a basis for enhancing mental health services, where students are being referred by academic office, medical unit, faculty advisors, sports and security officers, wardens and hostel office, parents and friends, apart from walk-in students who approach the counsellor on their own; is a priority.
- Facilitation of meetings during the orientation program involving fresher students and their parents, faculty advisors, student mentors is a core task.
- Peer tutoring and peer-mentoring program is organised by the cell.
- Greater support is provided for students coming from underprivileged background- PwD.
- Facilitation of various policies for students having academic concerns by the cell.
- The cell organises expert talk and activities to create awareness for mental health issues and enhancing positive well-being.
- De-stigmatising counselling services to a considerable extent and enhancing the positive perception of the cell.

### Programme organised by Counselling Cell-

- A meeting was organised during orientation program involving new B.Tech students (and their parents) along with assigned faculty advisors and student mentors.
- An expert talk titled "Building resilience-encouraging positive mental health" on October 27th, 2018 was organised with the purpose of creating awareness and sensitisation of mental health issues in the IIT Indore community.

# Central Library

## Library at a Glance: Collection (As on 31.03.2019)

| Books | E-Journals | E-Books | Print Journals | Magazines | Newspapers |
|---|---|---|---|---|---|
| 35284 | 7685+ | 7600approx. | 01 | 26 | 12 |

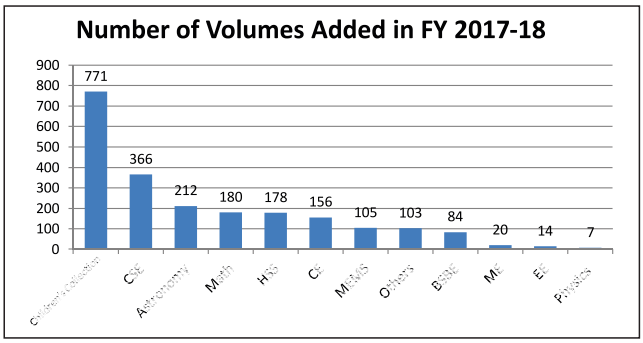



Figure 1. Number of volumes added in FY 2017-18

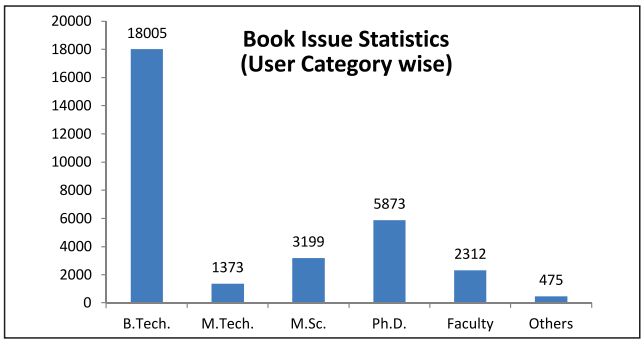



Figure 2. Book Issue Statistics (Apr.2017 to Mar.2018)

## Library Usage: (April 2018 to March 2019)

| Books Issued | Reading Room Usage per month |
|---|---|
| (Average) 30195 | 4000 users p.m. approx |

### Department wise book issue:

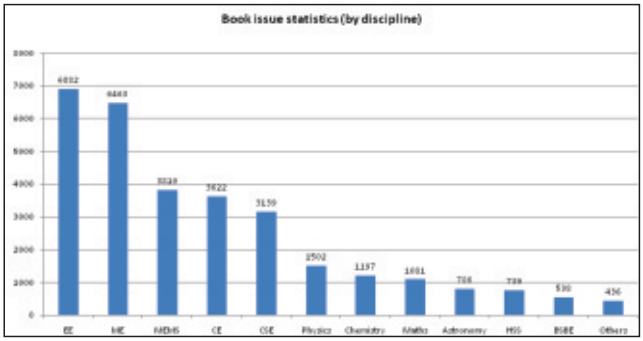


Figure 3. Book Issue Statistics (Apr. 2017-Mar. 2018)

**Periodicals and Newspapers (in print):** At present, the Library subscribes to 1 Journal,26 Magazines, and 12 newspapers in print format.

**Electronic Resources:** Access to electronic information resources is critical for research. The Library has developed a collection of electronic resources which include journal articles, databases, research papers, books, and other resources. E-journals in various disciplines published by reputed societies such as American Mathematical Society, American Chemical Society, American Institute of Physics, American Physical Society, Optical Society, Electrochemical Society, Royal Society of Chemistry and IEEE are subscribed by the Library. Journals published by Elsevier, Springer and Taylor & Francis are also available. The e-resource collection includes 7600+e-books from various publishers.The complete list of e-resources with hyper links is available on the Library website.

**Library Services:**

At present, the Library offers the following services:

- **Lending Facility:** Undergraduate students can borrow 8 books for 15 days, where as PhD. students can borrow upto 8 books for one month. Faculty members can borrow upto 40 books for a semester.
- **Overnight Lending:** Overnight lending facility is provided to students who wish to borrow a book from there served section, or have crossed their entitlement limit. Books on over night issue have to be returned by 9.30 a.m. the next day.
- **Claims/Reservations:** Users can claim/ reserve books which are issued out. Claimed/ reserved books are kept in the Library for the user for 3 days from the date of return by the previous borrower before they can be issued to the next claimant.
- **Renewals:** Books can be renewed only if there are no claims.
- **Reading Room:** The Library provides an air-conditioned and wi-fi enabled reading room with a seating capacity of 50 students. 40 PCs are available for research scholars and faculty members.
- **Inter-Library Loan & Document Delivery Services:** The Library has informal Inter-Library Loan arrangements and Document Delivery Services with IIM Indore, RRCAT Indore, IIT Bombay, GSITS Indore, etc. Under this facility, access is provided to books or electronic materials which are not available in our Library.
- **Book Bank:** Under the Book Bank scheme, text books are provided for a semester to students belonging to the under privileged category.
- **Library Portal:** Detailed information about the Library can be accessed through the Library portal. It can be accessed at: http://library.iiti.ac.in/
- **Reprography Services:** Users are provided photocopies or printouts of select portions of library resources as required by them, subject to the provisions of the Copyright Act.
- **Orientation Programs:** The Library conducts orientation programs for new students to make them aware of the Library facilities and services and to help the utilize the Library resources optimally.
- **Originality Check:** The Library provides originality reports to students on their assignments and papers, using Turnitin.
- **Remote access to Library Resources:** The Library provides 24x7 access to its resources for the users of the library, using Remote Xs.

**Library Automation:**

**ILMS:** The Library has successfully migrated from Libsys 7 to Koha (an Open Source ILMS software) which provides new features and functions for the automation of all its activities and services. Users can also browse the collection by using the Web OPAC (Online Public Access Catalog).

**CCTV Surveillance:** The Library has installed high tech cameras to ensure the safety and security of its users and resources.

**Bar Coding:** Bar Code Technology is being used for issue/return of books at the Circulation Counter. RFID implementation: RFID implementation is under consideration in the Library.

**QR Codes:** The Library uses QR codes to provide quick access to users to the Library website, Library OPAC, and recommendation forms for books and journals.

**Trial Access:** The Library requests trial access to various e- resources from publishers so that users can get an opportunity to use and evaluate there source. After the trial is over, the Library Committee discusses the possibility of subscription based on there commendations/feed back received from users.

**Other Activities:** The Library organizes various Author Workshops/ Training Programs/ Informative Sessions for E-Resources and also for Print Resources. The most recent Author Work shops were conducted on August 27th, 2019 in collaboration with Elsevier and on September 19th, 2019 in collaboration with Springer.

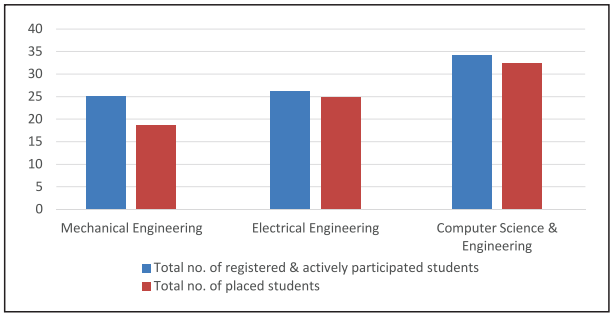
# Annual Placement Report

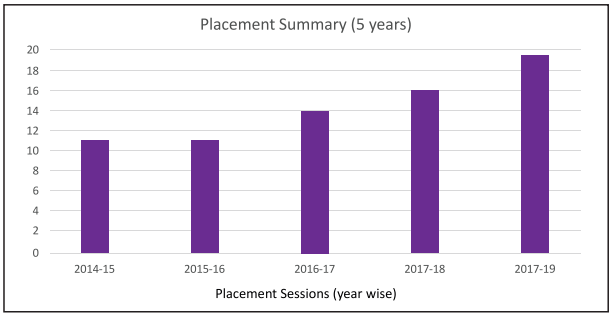
The final placements at the IIT Indore have been successfully completed for the 2018-2019 session. The placement office has always strived to build a strong mutual association with the recruiters and create better opportunities for the students. This has reflected in our results as IIT Indore has achieved 91% placements in the 2018-19 session.

Students were offered various job roles in areas such as: (i) Automobiles, (ii) Software Engineering (iii) Technology Consulting, (iv) Analytics, Research & Development, (v) Graduate Engineering Trainee,(vi) Data Scientist, (vii) Associate Engineering and others.

Companies from various sectors visited IIT Indore. These include: (i) DE- Shaw, (ii) Goldman Sachs, (iii) Mastercard, (iv) FICO, (v) Sales force, (vi) MAQ Software, (vii) Deloitte, (viii) Arcesium, (ix) Barclays, (x) AQR Capital, (xi) Code Nation, (xii) Razorpay, (xiii) United Health Group, (xiv) Go-Jek, (xv) HSBC, (xvi) GE India, (xvii) Strand Life Sciences, (xviii) Microsoft, (xix) MathWorks, (xx) Wipro, (xxi) Capgemini, (xxii) L&T Construction, (xxiii) ISRO, (xxiv) Addverb Technologies, (xxv) Quantile Analytics, (xxvi) Bosch, (xxvii) Futures First, (xxviii) Techture Structures, (xxix) Maruti Suzuki, (xxx) NXP Semiconductors, (xxxi) Mentor Graphics, (xxxii) Marvell Semiconductor, (xxxiii) Seagate, (xxxiv) Tata Steel, (xxxv) Jindal Steel, and many more.

The average salary package was INR 18.87 lakh p.a. and the highest package received was INR 47 lakh p.a. (domestic). Many companies offered internship opportunities. The highest stipend offered was 1.5 lakh per month. Approximately 10% of students opted for higher education at IIMs, IITs, and universities a broad; while others were more inclined to prepare for competitive exams. A few showed enthusiasm to start their own ventures.




## Placement Statistics & Key Highlights for Session 2018-19 (UG)

| **Particulars** | **No. of students in (CSE+EE+ME)** | **No. of students registered & actively participated for placement** | **No. of students placed** | **Placement percentage** | ***No. of companies*** | **Average package (INR, LPA)** | **Highest Package Received/ Offered* (In INR)** |
|---|---|---|---|---|---|---|---|
| Placement Session 2018-19 | 108 | 85 | 77 | 91% | 70 | 18.87 | 47 LPA, INR (Domestic) |

# Administration

## 1. General Administration:

### 1.1 About the Organization:

IIT Indore is one of the second generation IITs. It was established in 2009 as an autonomous statutory organization functioning within the Institutes of Technology Act, 1961, as amended by The Institute of Technology Act, 2012. The IITs are administered centrally by the Council of IITs, the apex body established by the Government of India (GoI) to coordinate the activities of these Institutes. The Minister of Human Resource Development, GoI is the Chairperson of the Council. Each IIT has a Board of Governors responsible for overall governance, superintendence and control.

The Senate is the apex body which decides on academic policies and matters of the Institute and approves and administers curricula, courses, examinations and declaration of results. It also appoints other 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 standards. The Director of the Institute is also the Chairman of the Senate.

The BoG is assisted by the Finance Committee on financial matters and by Building and Works Committee for Campus Development matters. The composition of these committees is given separately in Appendix.

### 1.2 Staff position:

As on 31st March, 2019, **129** faculty members and **99** non-teaching staff have been appointed, as per the details given in the table below;

Faculty members - 127

Visiting Faculty - 02

Group A Officers - 19

Technical staff - 32

Other Administrative Staff - 48

Number of faculty / staff members appointed during the year is as under:

Professors - **01**, Associate Professor - **12,** Assistant Professor (Grade I) - **08,** Assistant Professor (Grade II) - **05,** Visiting Faculty - NIL, Non-teaching staff - **16**

No of faculty members were relieved due to resignation or other reasons of separation - **05**

No of staff were relieved due to resignation / other reasons - **08**

### 1.3. The list of faculty/staff appointed between 1st April, 2018 and 31st March 2019 are as under:

| SN | Name of Employee | School / Discipline / Centre | Position / Designation | Date of Joining |
|---|---|---|---|---|
| 1. | Dr. Avinash Sonavane | Biosciences & Biomedical Engineering | Associate Professor | 4-Jul-18 |
| 2. | Dr. Sandeep Chaudhary | Civil Engineering | Professor | 23-Oct-18 |
| 3. | Dr. Pavan Kumar Kankar | Mechanical Engineering | Associate Professor | 4-Dec-18 |
| 4. | Dr. Abhinav Raghuvanshi | Chemistry | Assistant Professor (Grade I) | 10-Dec-18 |
| 5. | Dr. Sunil Kumar | Metallurgy Engineering and Materials Science | Assistant Professor (Grade I) | 11-Dec-18 |
| 6. | Dr. Abhijeet B. Joshi | Biosciences and Biomedical Engineering | Assistant Professor (Grade I) | 11-Dec-18 |
| 7. | Dr. Niraj Kumar Shukla | Mathematics | Associate Professor | 11-Dec-18 |
| 8 | Dr. Satyajit Chatterjee | Mechanical Engineering | Associate Professor | 11-Dec-18 |
| 9. | Dr. Satya Silendra Bulusu | Chemistry | Associate Professor | 11-Dec-18 |
| 10. | Dr. Neminath Hubballi | Computer Science and Engineering | Associate Professor | 11-Dec-18 |

| | | | | |
|---|---|---|---|---|
| 11 | Dr. Kiran Bala | Biosciences and Biomedical Engineering | Associate Professor | 11-Dec-18 |
| 12 | Dr. Mirza Saqib Baig | Biosciences and Biomedical Engineering | Associate Professor | 11-Dec-18 |
| 13 | Dr. Rupesh Shivaji Devan | Metallurgy Engineering and Materials Science | Associate Professor | 11-Dec-18 |
| 14 | Dr. Santosh S. Hosmani | Metallurgy Engineering and Materials Science | Associate Professor | 11-Dec-18 |
| 15 | Dr. Saikat Sarkar | Civil Engineering | Assistant Professor (Grade I) | 14-Dec-18 |
| 16 | Dr. Abhishek Rajput | Civil Engineering | Assistant Professor (Grade II) | 17-Dec-18 |
| 17 | Dr. Chelvam Venkatesh | Chemistry | Associate Professor | 17-Dec-18 |
| 18 | Dr. Anirban Sengupta | Computer Science and Engineering | Associate Professor | 17-Dec-18 |
| 19 | Dr. Kaustav Bakshi | Civil Engineering | Assistant Professor (Grade II) | 24-Dec-18 |
| 20 | Dr. Saptarshi Ghosh | Electrical Engineering | Assistant Professor (Grade II) | 24-Dec-18 |
| 21 | Dr. Anupampal Choudhury | Mathematics | Assistant Professor (Grade I) | 28-Dec-18 |
| 22. | Dr. Guru Prakash | Civil Engineering | Assistant Professor (Grade II) | 4-Jan-19 |
| 23. | Dr. Dipak Kumar Roy | Chemistry | Assistant Professor (Grade I) | 19-Feb-19 |
| 24. | Dr. Swaminathan R | Electrical Engineering | Assistant Professor (Grade II) | 22-Feb-19 |
| 25 | Dr. Puneet Gupta | Computer Science and Engineering | Assistant Professor (Grade I) | 1-Mar-19 |
| 26. | Dr. Saurabh Das | Astronomy, Astrophysics and Space Engineering | Assistant Professor (Grade I) | 5-Mar-19 |
| 27. | Nitin Bhate | Academics | Technical Manager (Academic Infrastructure) | 01-Aug-18 |
| 28. | Pranay Chopra | Estate | Deputy Executive Engineer (Electrical) | 24-Aug-18 |
| 29. | Avantika Awasthi | Estate | Deputy Executive Engineer (Civil) | 10-Oct-18 |
| 30. | Neeraj Kumar Soni | Administration | Manager | 23-Oct-18 |
| 31. | Sunil Sawle | Office of Dean, Student Affairs | Manager | 23-Oct-18 |
| 32. | Ekta Vishwakarma | Office of Dean, Administration | Manager | 24-Oct-18 |
| 33. | Sunit Kumar Singh | MMS | Manager | 25-Oct-18 |
| 34. | Yogendra Singh | Computer Centre | Deputy IT Officer | 14-Nov-18 |
| 35. | Shilpa Chouhan | Academic Office | Manager | 19-Nov-18 |
| 36. | Dr. Radhe Shyam Ji | SIC | Scientific Officer | 27-Nov-18 |
| 37. | Namdev Sheshrao Dinde | Health Centre | Medical Officer | 07-Dec-18 |
| 38. | Pooja Laddha | R & D | Manager | 17-Dec-18 |
| 39. | Harshraj Singh Chouhan | Purchase | Deputy Manager | 10-Jan-19 |
| 40. | Pankaj Vaskala | Administration | Deputy Manager | 15-Jan-19 |
| 41. | Amit Kumar | R & D | Deputy Manager | 01-Feb-19 |
| 42. | Indrajeet Vishwakarma | Administration | Deputy Manager | 01-Feb-19 |

**1.4 Faculty members on sabbatical leave/Deputation are as under:**

1. Dr. N.S. Chaudhari (on Deputation to Uttarakhand Technical University, Dehradun)
2. Dr. Neeraj Mishra (on Deputation to National Institute of Rural Development & Panchayati Raj, Hyderabad)

**1.5 Staff Welfare**

The IIT Indore Cooperative Society Limited is a registered society tasked with adding value to the Institute residents and members as per the approval of the Board of Governors (BoG) of the Institute vide its 24th meeting started its operation. The Cooperative society aims at adding valuable services to IITI community.

The Society is oversees the Convenience Store (La Fresco) and its members are entitled to avail a discount on the purchase of items from the store.

The installation of one additional State Bank of India ATM in workshop building inside the campus has proved to be a time saving endeavor for employees and students alike. Further, Canara Bank also begun functioning from its own building constructed on a BLOT basis. An e-lobby has also been set up by HDFC Bank in the School Building for facilitating students and staff.

Residential accommodation facility at Faculty Housing inside the campus have become fully functional and approximately 56 plus families have shifted, including faculty members and staff falling under essential category.

Additionally, several food kiosks have also begun operations within the campus for facilitating the IITI community as a whole.

**1.5.1 Human resource development**

As part of its human resource development activities, the Institute plans and implements programs for providing opportunities to the technical and administrative staff to update and upgrade their knowledge and skills so that they may perform their duties effectively. During this financial year staff members have been sent for training, workshop, seminars etc. in their respective areas. In addition, the institute encourages all its employees to upgrade their educational qualifications and professional skills through voluntary participation in part-time training/degree/diploma courses. The Institute also enables employees to seek these opportunities through in-house facilities including Library facilities, English language courses and computational facilities. A few staff members have been permitted to pursue higher studies as well without affecting their office duties.

| Name | Post Held | Organization | Department | Training/Course | From | To |
|---|---|---|---|---|---|---|
| Mr. Siba Prasad Hota | Deputy Registrar (Registrar I/C) | Institute of Secretariat Training & Management | Department of Personnel & Training Department of | OSP for M/o Human Resource Development on Establishment Rules & Purchase Procedures OSP for M/o Human Resource | 11.03.2019 | 13.03.2019 |
| Mr. Tentu Satyanarayana | Deputy Registrar | Institute of Secretariat Training & Management | Personnel & Training | Development on Establishment Rules & Purchase Procedures | 11.03.2019 | 13.03.2019 |
| Mr. Tanmay Harsh Vaishnav | Senior Manager | Institute of Secretariat Training & Management | Department of Personnel & Training | Training Programme on Organizational Behavior in Government | 29.04.2019 | 03.05.2019 |
| Mr. Lala Ram Ahirwar | Senior Manager (Library) | Institute of Secretariat Training & Management | Department of Personnel & Training | Training Programme on Organizational Behavior in Government | 29.04.2019 | 03.05.2019 |
| Mr. Roshan Bhatia | Senior Manager | Institute of Secretariat Training & Management | Department of Personnel & Training | Training Programme on Organizational Behavior in Government | 29.04.2019 | 03.05.2019 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Mr. Rajan Thomas | Administrative Officer | Institute of Secretariat Training & Management | Department of Personnel & Training | Training Programme on Organizational Behavior in Government | 29.04.2019 | 03.05.2019 |
| Mr. Kapil Kumar Gupta | Manager (Library) | Biju Patnaik Central Library Nit Rourkela | Raja Rammohun Roy Library Foundation, Kolkata | National Conference on Advanced Automation Technologies for Next-Gen Libraries (ATNL) | 20.05.2019 | 24.05.2019 |

## Details of Training Programme (In house)

| SN | Topics of Training | Trainer/Instructor | Designation | Date | Officials participated in training |
|---|---|---|---|---|---|
| 1 | Training session on Finance, Accounts & works related issues | Mr. Ajay Prasad | Deputy Registrar, IIT Bombay | 16.08.2019 | Estate and F&A section |
| 2 | Induction training session for newly joined staff | Mr. Siba Prasad Hota | Registrar I/c, IIT Indore | 23.08.2019 | 40 Staff Participated |
| 3 | Office procedure for lab In-charge and office | Mr. Santosh Kumar Khare | APO, RRCAT | 04.09.2019 | 4 Staff Participated |
| 4 | Training session to clarify doubts on issues related to Finance and Estate Section | Mr. Dnyaneswar K. Sawalkar | Deputy Registrar (Estate Section), IIT Bombay | 12.09.2019 | Estate and F&A section |
| 5 | Lecture on compliance of labour laws and welfare measures | Mr. P. K. Bidua | Regional Labour Commissioner, Central | 20.08.2019 | Contractors, Service Providers & Administrative Staff Members |
| 6 | Training on Office Procedure | Mr.Santosh Khare<br>Mr. Siba Prasad Hota | APO, RRCAT<br>Registrar I/c, IIT Indore | 05.10.2019 | Group 'B' & 'C' employees |
| 7 | A. Training on Office Procedure employees<br>B. Record Management | Mr.Santosh Khare<br><br>Mr. Siba Prasad Hota | APO, RRCAT<br><br>Registrar I/c, IIT Indore | 05.10.2019 | Group 'B' & 'C' |
| 8 | Training session on Employee Provident Fund (EPF). | Shri Amardip Mishra | Regional P.F. Commissioner, Indore | 04.11.2019 | Group 'B' & 'C' employees |

## Details of Training Programme (Outside)

| SN | Topics of Training | Trainer/Instructor | Designation | Date | Officials participated in training |
|---|---|---|---|---|---|
| 1 | Training on Communication Skills | Mr. Rajan Thomas | Administrative Officer | October 3 to 4, 2019 | Group-A |
| 2. | Training on Communication Skills | Mr. Rajan Thomas | Administrative Officer | October 3 to 4, 2019 | Group-A |
| 3 | Management Development Programme on Public Procurement, NIFM Training in New Delhi | Mr. Dushyant Pratap | Deputry Manager | 16.09.2019 to 21.09.2019 | |
| 4 | Workshop on Goods & Services Tax (GST) at NAHRD, Goa | Mr. Pradeep Agarwal | Joint Registrar | 23.09.2019 to 25.09.2019 | |
| 5 | Training on Communication Skills, ISTM, New Delhi | Mr. Rajan Thomas | Administrative Officer | 03.10.2019 to 04.10.2019 | |

**1.6. Reforms measures undertaken during the year inter-alia include:**

- Based on approved RPN, 34 officials have been promoted to higher grades.
- The Board has accorded blanket approval for the creation of additional position of faculty and non-teaching staff in accordance with the MHRD Govt. of India guidelines as applicable to IITs
- MoU with Bombay Hospital, Choithram, Rajshree Apollo, CHL has been renewed and medical facilities can now be availed by producing Smart Card and a referral letter is not required for faculty members and staff and for dependent family members. Apart from these, one new hospital has been empanelled i.e. Medanta Hospital.
- Administration section has taken up the initiative of developing HRMS Software
- To speed up the procedure of recruitment dynamic steps have been adopted and a separate recruitment cell has been formed.
- To increase the transparency in recruitment, the Institute has started publishing all recruitment results for non-teaching positions on its official website.
- Measures have been initiated to increase transparency in working procedures as per the instructions of Central Information Commission (CIC). All Grievances/RTI have been closed in a timely and hassle-free manner.
- On the occasion of completion of 10 years of its foundation in February 2019 the Institute has launched its 10th Anniversary Logo and decided to organize various events to celebrate it.
- All the buildings of the institute have been named formally during this tenure. The Institute has adopted various names from Periodic Table.
- Institute has also taken positive measures to reduce plastic pollution inside the campus. Separate bins have been placed with separate marking to identify waste which can be recycled.
- Appointment of a Liaison Officer for Other Backward Classes (OBCs) to take care of compliance of various orders and instructions pertaining to reservation and welfare measures for OBCs and other concessions admissible to the community has been done by the Institute.
- A Contract has been awarded for providing facility management services inside the campus thus resulting in reduction of Housekeeping staff deputed by Manpower agency.

**1.7 Meetings of the Authorities: -**

| | |
|---|---|
| Board of Governors: | Six Meetings held on 25.04.2018<br>11.07.2018, 25.10.2018, 10.12.2018, 15.02.2019, 18.03.2019 |
| Finance Committee: | Six Meetings held on 08.05.2018<br>12.06.2018, 25.10.2018, 03.12.2019, 15.02.2019, 18.03.2019 |
| Building and Works Committee: | Six Meetings held on 26.04.2018<br>01.06.2018, 06.07.2018, 22.10.2018, 27.12.2018, 08.02.2019 |
| Senate: | Three Meeting held on 19.06.2018<br>02.11.2018, 16.03.2019. |

**1.8 Activities held as per MHRD instructions:**

1. Celebration of International Yoga Day 2018
2. Celebration of 150$^{th}$ Birth Anniversary of Mahatma Gandhi
3. Observing the Birth Anniversary of Sardar Vallabh Bhai Patel on 31$^{st}$ October 2018 "Rashtriya Ekta Diwas"
   - Unity Run
   - Pledge taking by Institute community members
4. Observance of Vigilance Awareness Week 2018
5. Celebration of "Constitution Day"
6. Celebration of Matribhasha Diwas (Mother Tongue Day) on 21$^{st}$ February 2019

# Material Management Section (MMS) Financial Year 2018-2019

## 2. Statement of activities of Material Management Section

| SN | Details | 2017-18 | Amount in Rs. | 2018-19 | Value |
|---|---|---|---|---|---|
| 1. | Total Indent Issued | 1047 | - | 1196 | Project Indent- 301<br>Non-Project= 810<br>GeM Indent- 86 |
| 2. | Total Purchase Order Issued | 945<br>P. O.: 928<br>GeM Order: 10<br>Service Order: 07 | Rs. 29,70,13,458.00<br>PO Rs. 29,26,04,370.00<br>GeM Rs. 44,09,088.00 | 990<br>PO- 887<br>GeM Order- 85<br>Service Order- 07 | Rs. 28,96,60,802.00<br>PO- Rs. 26,98,26,277.00<br>GeM- Rs. 1,74,52,687.00<br>SO- Rs. 23,81,838.00 |
| 3. | Total Import Order issued | 73 | Rs. 9,92,67,949.00 | 41 | Rs. 5,23,73,260.00 |
| 4. | Total Indigenous Order | 865 | Rs. 19,77,45,510.00 | 844 | Rs. 21,74,53,017.00 |
| 5. | Total Advertisement | 28 | Rs. 17,89,203.00 | 29 | Rs. 24,63,227.00 |
| 6. | Total CDEC | 176 | | 83 nos. Rs. 1,54,03,363.00 | |
| 7. | Total GST Certificate Issued | 298 nos.<br>Rs. 4,29,05,971.00 | | 1574 nos. Rs. 15,02,57,897.00 | |
| 8. | Stock Entries | 6572 | | Total Stock Entry: 9982<br>Direct Purchase: 7075 Nos.-<br>Rs. 4,47,25,558.00<br>Purchase Order: 2907 Nos.-<br>Rs. 40,32,38,981.00<br>CON- 1625 Nos. Rs. 5,22,99,412.00<br>NON-CON 1282 Nos. Rs. 35,09,39,569.00 | |
| 9. | Prebid | 47 | | 70 Prebid Meeting held at IITI and the Prebid report was uploaded on website & CPPP | |

**2.1 Digitization of Procurement process i.e. e-Tendering/e-Publishing through Central Public Procurement Portal:**

2.1.1 Total e-tender floated in FY 18-19: 198 nos. (Total e-tender floated in FY 17-18:16 Nos.)

2.1.2 Total e-publishing floated in FY 18-19: 09 Nos.

2.1.3. Total Tenders/RFP's/RFQ processed through CPPP e-procure + e-publish = 207 Nos.

2.1.4. Total No-dues issued- 255

2.1.5. Buy Back Details- 11 Nos. Rs. 3,98,704.00

2.1.6. Total LD deducted- 125 Nos. Rs. 15,42,890.00

2.1.7. Total Letter of Credit Established: 25 Nos. LC value: Rs. 11,37,91,804.00

2.1.8. Total Export/Re-import/Repair Cases- 27 Nos. Preparation of documents for export/import and rigorous follow up for clearance.

2.1.9. Total Demonstration of Products: 05 cases (Hostel Furniture, Dual Desk, Housekeeping Equipment, Flap Barrier, Biometric Access Control

2.1.10 Total e-Way Bill issued: 50 +

2.1.11 Total reverse auction on GeM- 02

| Item | GeM L1 price | Final Order Value after reverse auction |
|---|---|---|
| UPS 60 KVA | Rs. 19,89,600.00 | Rs. 6,39,999.00<br>(Difference Amount= Rs. 13,49,601.00) |
| Workstation | Rs. 4,50,000.00 | 3,97,995.00<br>(Difference Amount= Rs. 52,005.00) |

## 2.2 SERVICE CONTRACTS

2.2.1 Comprehensive Security Services at IIT Indore- Advertised tender enquiry floated along with pre-bid option for an estimated cost of Rs. 5 Crore.

2.2.2 Medicine – Rate contract finalized with 2 firms to meet the day to day requirements of the Health Center.

2.2.3 End to End Cleaning & Sanitation Solutions- Advertised tender enquiry has been floated along with pre-bid and Demo options. The Proposal to do so was approved by the BoG and the order placed on 4 firms, building-wise for Rs. 3,00,28,697.00

2.2.4 End to End Solution for Clearing & Forwarding, Consolidation Service provider- A Proposal on the matter was finalized and approved. An Order has been placed from 3 firms for smooth export/import/clearance of consignment.

2.2.5 Engagement of Travel Agency for Ticket Booking: A Service Order has been issued for ticket booking on a No Service Charge basis.

2.2.6 Manpower Outsourcing: Advertised tender enquiry has been floated along with pre-bid option for an estimated cost of Rs. 5 Crore.

## 2.3 Value Added Services

2.3.1 Set up of Lafresco at New Building (Cooperative society center)- La-fresco was set up with a wide range of grocery, dairy and stationery products to meet the day to day requirements of residents at IITI Campus.

2.3.2 Coordination with AICTSL: A follow-up with AICTSL has been initiated and conducted for increasing the frequency of the City Buses and the fixing the time of city bus as-per office timings (specifically for 8.00 AM to 9.00 AM & 6.00 PM to 7.00 PM time periods)

2.3.3 Comprehensive Group Insurance Policy for the regular faculty and staff of IITI.

2.3.4 Disposal - Total Amount received from Disposal : Rs. 32,03,300.00

a) Packing and Wooden Scrap- Rs. 21,300.00

b) Vehicles/Buses- Rs. 31,82,000.00

2.3.5 Registration have been done/recorded /E-way bill, DSIR, GST, Ex-import, AERB, DAVP

2.3.6 Storage Shed at Balda Farm: A Storage shed has been constructed for the storage of receipts of items and for segregation of unserviceable/serviceable/obsolete and scrap items.

## 2.4 POLICY MATTERS:

2.4.1 Revision in MM & Stores: Forms have been revised in accordance with GFR and GeM Order.

2.4.2 Set up of Store for Stocking of Stationery Items: A store has been set up to facilitate the daily requirement of the institute pertaining to the stationery items. Other items will be stocked later on after pattern study of the local item requirement. Total stock in-hand as on 31/03/2019 was Rs. 1,12,706.00

2.4.3 GST Certificate: Initiated a form for issuance of GST Certificate against direct purchase for research purpose.

2.4.4 Bid Openers on CPPP: A Member of finance has been taken on board for online bid openings on CPPP.

2.4.5 Representation time to disqualified bidders: The disqualified bidders are given reasonable opportunity in each case to represent against their disqualification criteria.

**2.5 OTHERS:**

2.5.1 CAG Audit (June 13, 2018 to June 26, 2018 & January 02 to 11, 2019) - Facilitated the records, ledgers, files to CAG Auditor for the financial year 2017-18 for the audit period. All the queries raised by the CAG auditor were replied by MMS

2.5.2 MHRD Audit (First week of August 2018) - Facilitated the records, ledgers, files and audit replies against the queries.

2.5.3 Assistance in BOG, FC, and BWC meetings- assisted in preparation of agenda and minutes, ATR etc.

**2.6 Training:**

2.6.1 Organized an in-house training session on Recent changes on Public procurement procedure. The first session was on 27/04/2018 and the training was attended by almost 30 faculty/staff. The second session was held on 25/05/2018 and 13 staff members attended the training.

2.6.2 Mr. Nilesh Jadhav attended an Executive Program on Public Procurement on Creating Competitive Edge through Digital Supply Chain on April 29, 2018 at IIMM Alwar.

2.6.3 Mr. Siba Prasad Hota & Ms. Pooja Dutta attended the National Workshop on GeM on October 09, 2018 at AICTE, Nelson Mandela Marg, New Delhi

2.6.4 Organized a Talk on "Emerging Trends in Supply Chain Management" by Dr. L.R. Meena Chairman, IIMM Alwar and "Technological Challenges in supply chain Management & Logistics in Industry 4th Generation" by Dr. Sandeep Tare, Chairman, IIMM Indore on January 18, 2019 towards celebration of 10th Year of inception of IITI.

2.6.5 Ms. Pooja Dutta attended the National Workshop on CPPP on 21st Jan 2018 at Stein Hall, India Habitat Centre, Lodhi Road, New Delhi

**2.7 ACHIEVEMENTS:**

2.7.1 CPPP listed IITI as Major Entity.

2.7.2 IITI is on second position among 10 IITs registered for e-tendering on CPPP and is on first position among new IITs.

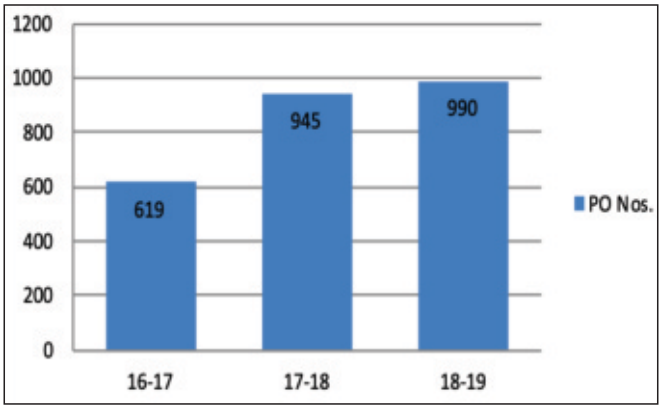
2.7.3 IITI has been marking an exponential increase of orders on GeM from 10 orders (17-18) to 85 orders (18-19).

2.7.6 IITI was appreciated at the National workshop for Uploading NITs of PAC Items.

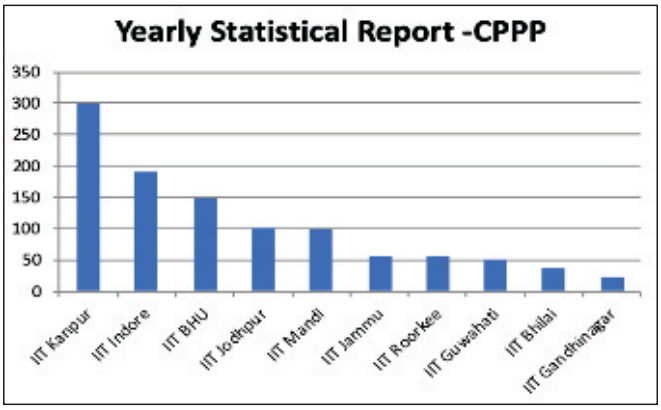
2.7.7 Green Initiatives- Initiated the adoption of green inventory such as letter head, files etc.

**2.8 CHART REPRESENTATION:**

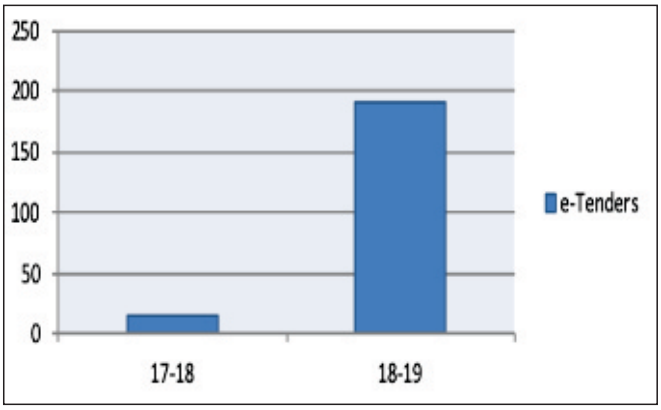
Purchase Order for
last three FY



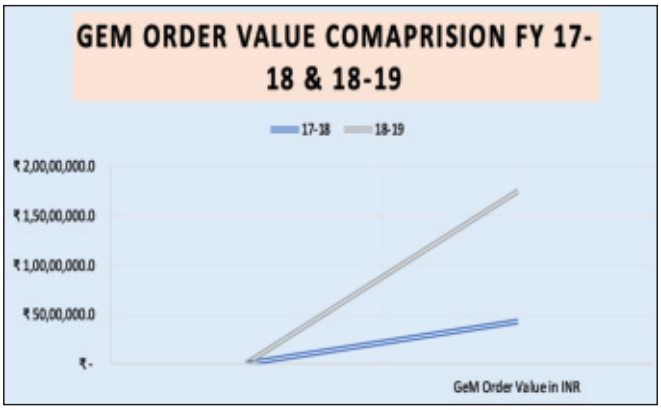
E-tendering of
IITI amoung other IITs on CPPP:




E-tendering of
IITI for Last two FY




GeM Order
Value for Last two FY




GeM Order
Numbers for Last two FY

# 3. Finance and Accounts

### 3.1 The year 2018 – 19 is characterized with the following Income and Expenditure:

(₹ in crores)

| S. No. | Particulars | | 2018-2019 |
|---|---|---|---|
| **1.** | **INCOME** | | |
| 1.1. | **Grants** | | |
| | Total Grant received | :155.33 | |
| | **Less –**Allocated for creation of Capital assets | : 60.00 | |
| | For Recurring Purpose | : 95.33 | 95.33 |
| 1.2. | Academic Receipts | | 13.77 |
| 1.3. | Interest Earned | | 08.16 |
| 1.4. | Other Income | | 01.64 |
| 1.5. | Total of 1 | | 118.89 |
| **2.** | **EXPENDITURE** | | |
| 2.1. | Staff Payments & Benefits | | 43.66 |
| 2.2. | Academic Expenses | | 17.45 |
| 2.3. | Administrative & General Expenses | | 17.00 |
| 2.4. | Transportation Expenses | | 00.49 |
| 2.5. | Repairs and Maintenance | | 03.47 |
| 2.6. | Depreciation | | 26.37 |
| 2.7. | Other Expenses | | 00.65 |
| 2.8. | Total of 2 | | 109.09 |
| **3.** | **Balance being excess of Income over Expenditure** | | **9.80** |

### 3.2 The position relating to creation of capital assets is as under:

(₹ in crores)

| S. No. | Particulars | | 2018-2019 |
|---|---|---|---|
| 2.1 | Opening Balance of Grant-in-Aid Plan | | 177.78 |
| 2.2 | Grant received during the year | | |
| | - For Creation of Capital Assets | 155.33 | |
| | - For Revenue Expenditure | 60.00 | 155.33 |
| | | 95.33 | |
| 2.3 | Transferred from Corpus Fund for Temporary Loan | | 48.91 |
| 2.4 | Total funds available at the disposal of the Institute | | 382.02 |
| 2.5 | Revenue Expenditure excluding Depreciation (109.09-26.36) | 82.73 | |
| 2.6 | Plan Grant after adjusting utilization for Income & Expenditure | | 299.30 |
| 2.7 | Utilized for developing infrastructure | | |
| | - Buildings & Works | 165.81 | |
| | - Utilized for Equipment's and other Assets | 31.45 | 197.26 |
| 2.8 | Unspent balance as on 31.03.2019 | | 102.03 |

**3.3 Funds availability and status of utilization thereof:**

During financial year 2018-19, against sanction of Revised Detailed Project Report (DPR) of ₹ 1,902 crores, a sum of ₹155.33 crores were released by Ministry of Human Resource Development. The Internal income of the Institute reckoned during the year was ₹23.57 crores, ₹48.91 crores were transferred from Corpus Fund as Temporary Loan and after considering the unspent balance as on 01.04.18 of ₹177.78 crores, the total funds available at the disposal of the Institute was of the order of ₹405.59 crores.

A sum of ₹197.26 crores has been utilized for the creation of Capital assets and a sum of ₹82.73 cores (which excludes Depreciation of ₹26.36 crores) was incurred on recurring expenditure out of the grant at the disposal with the Institute. Further Internal Revenue Generation for the year amounting to ₹23.57 crores transferred to Corpus Fund.

**3.4 Reforms, measures and initiatives undertaken during the year include:**

During the year under review the following reforms, measures Initiatives were initiated from Finance &Accounts :

3.4.1 Tuition fees for the undergraduate students joining from Academic Year 2018-19have been revised and subsequently MHRD has introduced Vidyalaxmi scheme vide MHRD letter No. 24-2/2016 TS 1 dated July 14, 2016for provision of interest free loans to students for first five years to be paid by IIT. 27 students applied for Education loan under Vidyalaxmi scheme through State Bank of India, Nodal Bank for the scheme. Interest implication for Financial Year 2018-19 is Rs. 10,30,320/-.

3.4.2 The Public Finance Management System (PFMS) is a platform for all DBT payments.

3.4.3 The Institute has developed payment gateway on IIT Indore website with State Bank of India and HDFC Bank Ltd as channel partner bank for the facility.

**3.5. Education assistance for children:**

During the financial year 2018-2019, the Institute reimbursed a sum of ₹44,51,154/- to 80 faculty and staff members against for education assistance according to Government of India norms.

**3.6. Transport facilities for staff members:**

Transport facilities to students/ faculty members/ staff members have been provided for the benefit of movement of staff from institute campus to Indore city at subsidized rates as the IITI Campus is located far away from Indore city.

**3.7. Advances:**

During the reporting year, a total sum of ₹14.93 lakhs was sanctioned as personal advances for the following.

(₹ in crores)

| SNo. | Nature of Advance | No. of Beneficiaries | Amount Sanctioned | Amount outstanding as on 31.03.2019 |
|---|---|---|---|---|
| | | | (in ₹) | (in ₹) |
| 1 | House Building Advance | - | - | 10,97,796 |
| 2 | Car Advance | - | - | 1,14,000 |
| 3 | Two-wheeler advance | - | - | 2,11,752 |
| 4 | Personal computer advance | - | - | - |
| 5 | Festival advance | 26 | 1,17,000 | 69,750 |
| | | **Total** | **1,17,000** | **14,93,298** |

**3.8 Insurance:**

Group Medical Insurance cover of ₹ 1.50 lakhs is provided to all students of the Institute for In-Patient treatment. Expenses towards insurance is ₹15,46,395/- during financial year 2018-19. Care of Out-patient treatment is taken care mainly by the Health Centre internally.

**3.9 Fellowships/scholarships:**

3.9.1. To Research Students:

During financial year 2018-19, Institute has disbursed Fellowships for following category of Students:

(₹ in crores)

| S.No. | Category of Students | Student | Fellowship (per month) |
|---|---|---|---|
| 01. | Institute Funded through MHRD grant-PHD | 321 | JRF- ₹31,000/- + HRA @ 16%<br>SRF- ₹35,000/- + HRA @ 16% |
| 02. | DST Funded (PHD) | 33 | |
| 03. | CSIR Funded (PHD) | 48 | |
| 04. | UGC Funded (PHD) | 50 | |
| 05. | Institute Funded through MHRD grant – M. Tech. | 89 | ₹12,400/- + HRA @ 16% |
| 06. | Institute Funded through MHRD grant – | 07 | ₹12,400/- + HRA @ 16% |
| | M. S. Research | | |

3.9.2. Merit cum Means Scholarship:

Institute has disbursed ₹3,75,02,401/- as Merit cum Means Scholarships to B. Tech & MSc. Students who are meeting the eligibility criteria set by Institute under various categories:

(₹ in crores)

| S. No. | Category | Course | Students | Amount of Scholarship |
|---|---|---|---|---|
| | | | | (in₹) |
| 01. | General | B.Tech. | 126 | 2,52,13,463 |
| | | MSc. | 16 | 2,92,022 |
| 02. | General (PD) | B.Tech. | 2 | 89,779 |
| | | MSc. | 1 | 38,452 |
| 03. | OBC | B.Tech. | 70 | 1,22,37,469 |
| | | MSc. | 10 | 1,75,675 |
| 04. | SC | B.Tech. | 25 | 11,54,082 |
| | | MSc. | 6 | 2,69,337 |
| 05. | ST | B.Tech. | 14 | 6,54,272 |
| | | MSc. | 1 | 39,216 |
| 06. | ST (PD) | B.Tech. | 1 | 38,542 |
| | | MSc. | 0 | - |
| | | **Total** | **272** | **3,75,02,401** |

3.9.3. Remission of Tuition Fees to Deprived Class of Students:

Institute has remitted/disbursed ₹1,20,03,537/- as Remission of Tuition fees of Under Graduate Students of Deprived Class admitted in Academic Session 2018-19 as per Ministry of HRD letter F. No. 24-2/2016 TS 1 dated April 04, 2016.

Summary of the Balance Sheet and Income &Expenditure isas under:

## A. BALANCE SHEET AS AT 31.03.2019

(Amount in ₹)

| SOURCES OF FUNDS | SCHEDULE | AS AT 31-03-2019 | AS AT 31-03-2018 |
|---|---|---|---|
| Corpus/Capital Fund | 1 | 7,04,79,42,889 | 5,03,82,13,629 |
| Designated/Earmarked/Endowment Funds | 2 | 9,00,88,385 | 6,47,28,918 |
| Current Liabilities & Provisions | 3 | 2,74,28,36,228 | 2,68,45,01,688 |
| **TOTAL** | | **9,88,08,67,502** | **7,78,74,44,235** |
| **APPLICATION OF FUNDS** | | | |
| **FIXED ASSETS** | 4 | | |
| A. Tangible Assets | | 4,15,57,94,799 | 3,18,70,71,686 |
| B. Intangible Assets | | 5,23,90,532 | 4,66,55,229 |
| C. Capital Work-In-Progress | | 2,15,99,09,274 | 92,66,81,862 |
| **INVESTMENTS FROM EARMARKED/ ENDOWMENT FUNDS** | 5 | | |
| Long Term | | | |
| Short Term | | 5,00,000 | - |
| **INVESTMENTS - OTHERS** | 6 | - | - |
| **CURRENT ASSETS** | 7 | 2,08,37,02,554 | 1,93,23,39,170 |
| **LOANS, ADVANCES & DEPOSITS** | 8 | 1,42,85,70,343 | 1,69,46,96,288 |
| **TOTAL** | | **9,88,08,67,502** | **7,78,74,44,235** |

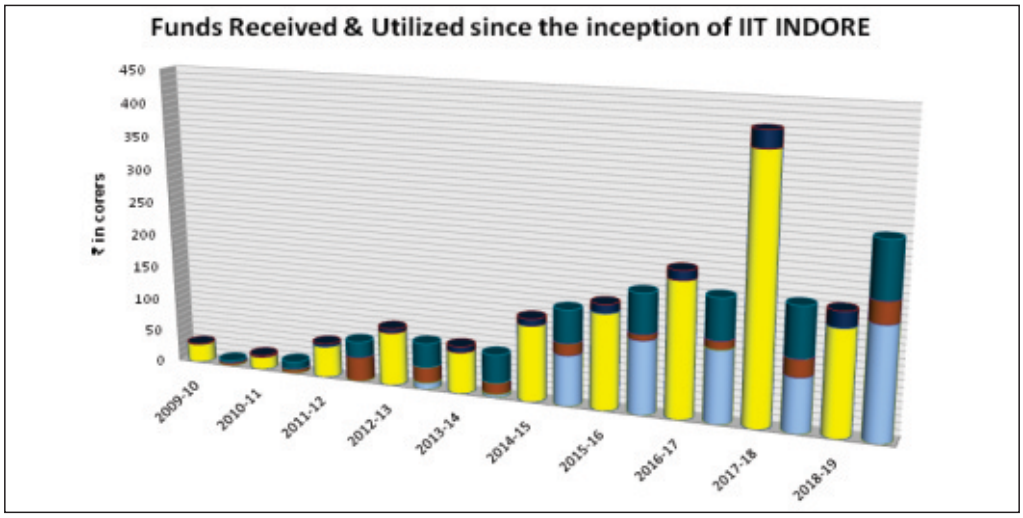
## B. INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH'2019

(Amount in ₹)

| PARTICULARS | | SCHEDULE | 31-03-2019 | 31-03-2018 |
|---|---|---|---|---|
| **(A) INCOME** | | | | |
| Academic Receipts | | 9 | 13,77,34,262 | 10,50,85,940 |
| Grants & Subsidies | 1,55,33,00,000 | 10 | 95,33,00,000 | 59,43,70,000 |
| Less: Capital Grants for Fixed Assets | 60,00,00,000 | | | |
| Income from Investments | | 11 | - | - |
| Interest Earned | | 12 | 8,15,93,753 | 13,69,92,051 |
| Other Income | | 13 | 1,51,85,044 | 81,63,126 |
| Prior Period Income | | 14 | 11,54,968 | 49,23,972 |
| **TOTAL (A)** | | | **1,18,89,68,027** | **84,95,35,089** |
| **(B) EXPENDITURE** | | | | |
| Staff Payments & Benefits (Establishment Exp) | | 15 | 43,65,93,404 | 40,23,79,828 |
| Academic Expenses | | 16 | 17,45,08,815 | 12,35,68,214 |
| Administrative and General Expenses | | 17 | 16,99,79,083 | 18,77,87,357 |
| Transportation Expenses | | 18 | 48,84,989 | 92,52,163 |
| Repairs and Maintenance | | 19 | 3,47,35,858 | 1,81,76,908 |
| Finance Costs | | 20 | 4,94,676 | 47,855 |
| Depreciation | | 4 | 26,36,82,026 | 59,53,55,228 |
| Other Expenses | | 21 | 19,27,758 | 7,71,091 |
| Prior Period Expenses | | 22 | 41,26,878 | 33,59,615 |
| **TOTAL (B)** | | | **1,09,09,33,487** | **1,34,06,98,259** |

| | | | |
|---|---|---|---|
| **Balance being excess of Income over Expenditure (A-B)** | | 9,80,34,541 | -49,11,63,170 |
| Less: Transfer to Corpus fund towards Internal Revenue Generation of 2018-2019 (2017-18) (See Notes to Account - no.6) | | -23,56,68,027 | -25,51,65,089 |
| **Total** | | **-13,76,33,487** | **-74,63,28,259** |
| Add: Amount transfer to Capital Fund | | 26,36,82,026 | 59,53,55,228 |
| Balance being Surplus (Deficit) Carried to Schedule 3C Unutilized Grant from Govt. of India | | 12,60,48,539 | -15,09,73,030 |

Funds Received & Utilized since the inception of IIT INDORE




| SN | Particulars | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 2018-19 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | **RECEIPT** | | | | | | | | | | |
| | GRANT | ₹27.78 | ₹19.15 | ₹47.47 | ₹80.00 | ₹62.00 | ₹113.45 | ₹142.80 | ₹200.00 | ₹386.44 | ₹155.33 |
| | IRG | ₹0.97 | ₹2.65 | ₹4.68 | ₹6.58 | ₹9.10 | ₹10.51 | ₹13.24 | ₹14.37 | ₹25.52 | ₹23.57 |
| **2** | **EXPENDITURE** | | | | | | | | | | |
| | BUILDING | ₹0.00 | ₹0.00 | ₹0.00 | ₹9.89 | ₹4.98 | ₹75.82 | ₹109.41 | ₹107.77 | ₹80.93 | ₹165.81 |
| | EQUIPMENT | ₹3.99 | ₹5.98 | ₹36.36 | ₹23.54 | ₹17.29 | ₹17.39 | ₹8.46 | ₹12.54 | ₹25.48 | ₹31.45 |
| | RECURRING | ₹3.50 | ₹11.47 | ₹24.06 | ₹36.14 | ₹42.15 | ₹49.32 | ₹59.51 | ₹60.79 | ₹74.54 | ₹82.73 |

## 4. Safety and Security Department

4.1.1 IIT Indore gives top priority to the safety and security of students, faculty members, scientists, staff members and visitors on its campus and in the laboratories.

4.1.1 Currently, comprehensive security services within the campus are being looked after by M/S Central Investigation and Security Services Limited. It is directly coordinated by our Chief Security Officer. Every discipline has their own safety committee to evolve, adopt and maintain best laboratory practices. To further strengthen our laboratory safety practices, the Institute is in the process of appointing a laboratory safety officer. An Institute level safety and security committee is in place to ensure a safety and security culture in the campus.

4.1.2 Periodic orientation programs are conducted for interns, faculty members, scientists and staff members of the Institute.

4.1.3 To spread awareness for fire safety, bio-safety and chemical safety, comprehensive safety guidelines for lab users in the Institute have been compiled and made available on the web page of the safety and security department.

4.1.4 A Round the clock patrolling unit and a 24x7 emergency control room, for responding to any on-campus/off campus emergency to any community member of IIT Indore, is operational.

4.1.1 Regular fire-fighting demonstrations and training is conducted for security personnel. On-the-job training by the security agency and training on emergency rescues from lifts have been conducted for security staff. Students, faculty members, scientists and staff members are also invited for fire-fighting training along with security personnel.

4.1.2 More usage of technology is being introduced in the security setup of the Institute. A few are listed below:

- Boom barriers have been equipped with an RFID detection system for automated entry of the cars of IIT Indore community members.
- A web-based visitors' pass system is in place for facilitating visitors' smooth entry to the campus.
- All critical areas in the campus are under 24x7 CCTV surveillance.
- Biometrics access control have been installed in all the laboratories and other facilities of the Institute.
- A centralized security control room has been developed at the Sodium Building.
- A portable fire pump is available to quickly respond to any fire incident in the campus.

## 5. Health Centre

The Health Centre provides dedicated health services to the Institute community. It includes outpatient, day care and inpatient services for minor ailments, trauma, and emergency medical care.

The medical team comprises of medical officers, specialist consultants and well trained paramedical and supporting staff.

**Facilities:**

- ✓ **OPD**
- ✓ **Day care**
- ✓ **Trauma and emergency care**
- ✓ **Inpatient services**
- ✓ **Physiotherapy**
- ✓ **Investigation facility**

This includes -

a) ECG Facility
b) Rapid Spot blood investigation
c) For further evaluation, sample collection facility

**Technical up-gradation**

a) Sterilization facility
b) Emergency set up

# 6. Hostel Facility

## Halls of Residence

The Halls of Residence provide students with a hygienic environment, overseen by a dedicated and professional housekeeping team.

Residence on campus:

1. Students currently reside at the permanent campus of IITI. The Halls provide a homely atmosphere with large spacious rooms with proper ventilation. A common hall and balcony are available in every unit.

A.P.J. Abdul Kalam Hall of Residence

J.C. Bose Hall of Residence

2. All students are provided 24×7 internet facilities
3. Basic facilities such as a Refrigerator, Sofa, RO water with chiller facility along with hot water in washrooms as well as intercom telephones, discussion tables, study tables, lights, fans, an almirah, and a cothave been installed in each unit.
4. Pest control services are also available at the premises.

Facilities available in the Halls of Residence

**Recreation:**

5. Televisions have been installed in common areas.
6. We have sports and gymnasium facilities.
7. We have football and table-tennis tables in the hall common areas.
8. A turf badminton court in the hall quadrangle has been made available for students.

9. We have a student facilities center (La'Fresco) for foods, vegetables, fruits and stationary and daily needs.

**Dining Hall:**

10. Students are served four healthy meals a day in the Carbondining hall. The Mess menu is decided by the dining committee and is updated regularly.

11. Other than regular dining services, we have food kiosks - Café Zippy, Shiru Café, Tea Post, Aladeen and Taste Buds.

12. Night-time canteen facilities are also available.

Café Zippy

Shiru Café

Tea Post

Taste Buds

Aladeens

**Transport:**

13. Green vehicles, available for movement within the campus, ply at regular intervals.
14. The Institute provides buses for the market every weekend.
15. Additional Transport facilities to a large group of students is made available, on written request to the authorities.

**Safety Securities:**

16. A dedicated security staff for security and emergency related issues.
17. A Biometric entry system in hall units for security.
18. The Halls of residence are completely secure due to CCTV surveillance.
19. Fire extinguishers are available on every floor to avoid any fire emergency.

**Laundry Facilities:**

20. A laundry facility is available for all students on campus.

**Banking Services:**

21. Canara Bank and HDFC Bank is situated inside the Institute campus for availing banking facilities.
22. Along with the bank, an ATM &cash deposit machine of Canara Bank and State Bank of India is also available.

**Hall Office:**

23. The Office of Hall of Residence is open 24x7 to deal with all the hall resident related issues.
24. The students can go with their concerns and suggestions to the hall office.
25. There is also a Counselling office for students inside the campus.

## Centre for Innovation and Entrepreneurship (CIE)

Centre for Innovation and Entrepreneurship (CIE) was established in 2016, CIE has always promoted free thinking and implementation of student ideas into real world products and services. The CIE at IIT Indore currently hosts and supports:

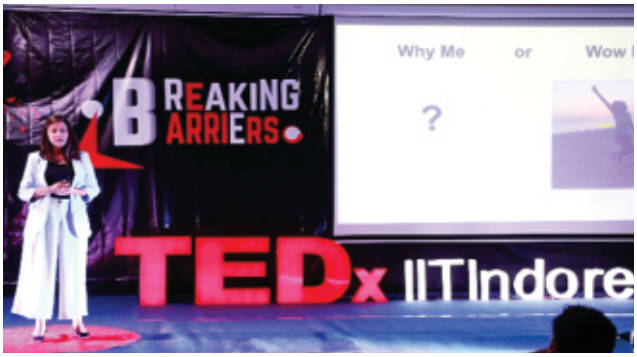
(i) SESC – Student Entrepreneurship Support Cell

(ii) Centre for Industry Relations – Industry relations cell

The aim of the Centre is to promote and encourage students to start up their ventures whilst in the campus and equip them with skills to start-up their own businesses and enterprises.

Department of Science and Technology funded Innovation and Entrepreneurship Development Centre (IEDC) has been setup at IIT Indore in 2014 with the aim of nurturing and fostering innovation and entrepreneurship culture. This year too IEDC funded 5 ideas where in students of IIT Indore explored the field of innovation.

The second edition of TEDx IIT Indore was conducted on October 20, 2018. The theme of the event was "Breaking Barriers". Eight speakers were invited for the talk from diverse backgrounds and spoke about their personal experiences which had a long-lasting impact on them as well as on the society. The speaker panel comprised of Lieutenant General Satish Dua, PVSM, UYSM, SM, VSM (Chief of Integrated Defence Staff to the Chairman Chiefs of Staff Committee of the Indian Armed Forces), Mr. Achanta Sharath Kamal (Professional Indian Table Tennis player), Mr. Divyanshu Damani (Entrepreneur, Social Media Influencer), Mr. Ashish Jaiswal (Author of international best sellers "Fluid", "True Dummy" and "How to reform a Business School"), Dr. Prasun Chatterjee (Specialist and Assistant Professor of Geriatrics Department, AIIMS, New Delhi), Ms Neeti Leekha Chhabra (Founder & President of NGO Yes to Life), Ms Rinku Sawhney (Success coach) and Mr. Swami Prem Parivartan, aka Peepal Baba (founder of "Give Me Trees" NGO).




**Incubation Center:** The Incubation center under the aegis of CIE has been promoting entrepreneurship ideas amongst the students and has been successful in setting the following start-ups:-

**1. Swaaha Resource Management Private Limited:** The name Swaaha is taken from initials of words Swachh (Clean) and Hara (Green), which are two fundamental tenets of proper waste management. Swaaha also means a pious sacrifice, which fosters our third and final aim of eradicating poverty by economically empowering the people involved in this sector. Presently operational in Indore City in the state of Madhya Pradesh, Swaaha has grown exponentially within 20 months of its incorporation. Swaaha specializes in designing solutions and products for composting (organic waste processing). With a current installed processing capacity of 6000 kg/day, Swaaha works with some of the best and prestigious institutions and organizations of Indore including Indian Institute of Technology Indore, Indian Institute of Management Indore, Indore Municipal Corporation, 56 Dukaan Trade Association, Sayaji Group of Hotels, Brilliant Convention Centre and Narsee Monji Institute of Management Studies Indore.

**2. Esmartify Private Limited:** on Internet-of-Things founded by Mr. Shikhar Bansal and Mr. Ravi Shankar Bharti. Esmartify provides location-based information to its users via a mobile app, both outdoor and indoor, using various proximity technologies including GPS and Beacons. Users can get local shopping offers when they visit a mall, menu cards and ratings when they are near a restaurant. They can also get information about animals when they are near them in a Zoo, about Paintings/Artefacts when they are near them in a Museum. Esmartify made Kamla Nehru Prani Sangrahalaya - Indore Zoo, the First Smart Zoo of India. They are currently testing their solutions in malls and retail.

**3. Chota Hospital:** on DocVita. Having the doctor connected virtually, and actively encouraging recovery can make a profound impact in making a patient's healthcare journey frictionless. DocVita is a smartphone app that facilitates this interaction. With DocVita, their aim is to enable care that transcends all boundaries and empowers people with more information and control over their health. It leverages on AI & Machine Learning to automate patient communications, inspiring & motivating them for better health outcomes.

**Interaction on Entrepreneurship & Innovation:** A series of leadership talks were conducted under the aegis of MHRD Innovation Cell. It included talks by Mr. Anand Mahindra (Chairman of Mahindra Group), Dr. Ruchi Sharma (Associate Professor, IIT Indore), Dr. Anand Deshpande (Founder, Chairman & Managing Director Persistent Systems Ltd), Mr. Ajit Doval (National Security Advisor) and Dr. Anil Sahasrabudhe (Chairman, All India Council for Technical Education).

## Student Activities

This is an attempt to capture the breadth and width of the vast multitude of student activities across technical, cultural and sports domains during the period from April 2018 to March 2019.

The Robotics Club held workshops on basic electronics - different components and Arduino. They also organized a "Robo Race" competition which was attended by 42 teams including many freshman students at IIT Indore. The Club also participated in ASME student design competition held at Vellore Institute of Technology, Vellore and secured enviable 5th position. They also participated in the coveted Boeing Aero challenge held at IIT Bombay. MATLAB webinar was also conducted by the club at IIT Indore.

Engine and Demons Cub, a group of enthusiastic students who design and innovate in the field of automobile engineering, participated in BAJA SAEINDIA competition held at Pithampur, Indore. The team demonstrated the in-house built ATV and demonstrated the technical excellence of the Institute. Presently the team is working on the design of electric powered vehicle, the need of the hour.

The Programming Club organized the summer of code (IITI SOC) to promote web and android development projects during the summer vacation. They also organized Treadbit Hackathon in association with NJACK IIT Patna. There were several competitive coding contests held and workshop for ACM ICPC was also organised. However, the highlight of the year was Euristica, annual codefest of the Programming Club which comprised of week-long coding competitions and attended globally by thousands of students.

The CAE club organised workshop on CATIA and Cadathon 2.0 in association with Fluxus with attractive prizes. The aero-modelling club also held a workshop on making gliders. Team IIT Indore also participated in the Inter-IIT Tech meet and secured an enviable rank with a bronze in BETiC Innovation Challenge (Biomedical). It also participated in the annual Robocon and Baja competitions. Metacryst also held a quiz on different types of materials. Concreate Club also conducted Bridge Design making competition which witnessed lot of innovative ideas. The strongest bridge, weighing 350 gm, sustained a load of 100 kgs.

The cultural sphere of IIT Indore witnessed a great deal of fervour and enthusiasm with a plethora of events that ensured active participation of the IITI community. The academic year kicked off to a splendid start with us being crowned winners in yet another IIT vs. IIM annual cultural competition. We participated in the inter-IIT cultural meet 2018 held at IIT Roorkee and clinched a

commendable overall 10th position. Our music club team secured the 1st spot in duet and 5th position in band performance. Cinephiles came 2nd in the screenplay writing contest and mystic hues emerged 5th in the photography contest.

Fluxus, IIT Indore's annual techno-cultural fest was held in 2019 as well. It lived up to its name of being Central India's Largest College fest and drew large crowds from outside IITI as well. Amit Trivedi, The Local Train, Miss Tara and Rahat Indori rocked the stage during the power-packed pro-nites as part of Fluxus '19.

The IBCC (Inter-Branch Cultural Competition) comprised art, dance, music, drama, photography, debate, graphic designing, literary events and quizzes. All the branches fought tooth and nail to emerge victorious. Electrical Engineering department emerged as winners. CSE department was adjudged the runners up with the mechanical department as the second runners up.

Another major event at IITI was our Model United Nations (MUN) which drew a large crowd from outside the IITI community as well. The student Gymkhana organised vibrant and colourful celebrations during festivals like Ganesh Chaturthi, Diwali, Makar Sankranti, Gudi Padwa, Lohri, Ugadi, Kesariya etc: There were many competitions and workshops organised by the various cultural clubs.

Akriti, an online photography contest as well as Alankrit, an online drawing competition was organised. The Lit club organised Ransense and many other creative writing competitions while the quiz club came up with several quizzes ranging from newbie quiz to Technophilia and other themed quizzes. The dramatics club performed many stage plays.

Magnum Opus, the annual alumni meet of IIT Indore saw the participation of alumni was a great success. A Plantation Drive was also conducted to promote awareness on Climate Change. A Cultural Program was also conducted which showcased the in-house talent of the students

On the sports front, IIT Indore took part in 53rd Inter IIT Sports meet held at IIT Guwahati and showed remarkable performance. Students stood fourth in Javelin throw and Long jump. A staff member also won a gold medal in Javelin throw. Apart from that, students of IIT Indore also showed great potential in various sports games held throughout the year like football, cricket,

badminton, table-tennis and chess. The Yoga and Fitness club of IIT Indore organised a mass Yoga event on the International Yoga Day with students and faculty members showing up in large numbers.

Students of IIT Indore in association with AVANA celebrated the festival of lights with the residents of Jagannath Narayan old age home. Fun games and activities were conducted which saw a huge participation with great enthusiasm. After that prize distribution was followed by healthy snacks and sweets. The whole old age home was filled with gleaming diyas, making the aura auspicious. Traffic Awareness Program was also conducted to educate the local population on traffic rules and ethics.

Heartfelt tribute was paid to CRPF martyrs of Pulwama who lost their lives in terror strike in Pulwama of Jammu and Kashmir on February 14, 2019. A candle-light march was organised to pay tribute to the martyrs from Gate No. 2A of IIT Indore via Khandwa Road to APJ Abdul Kalam Hall of Residence situated inside the campus. IITI community also observed two minutes silence for peace to the departed souls.

## Events in Campus

In order to ensure high level participation on June 21st 2019 in the IDY before the main event, Institute has organized a Pre-Event on 2nd May 2019 i.e. 50 Days to IDY-2019 wherein a 'Run for Yoga' a short marathon was organized in institute premises itself followed by a mass Yoga session in front of the Hall of residence of the Institute.

A session was conducted on 4th May 2019 by volunteers from "Heartfulness" which is an Educational and volunteer bases Non-Profit Organization active since 1945. The organization has its centers across 130+ countries. Heartfulness relaxation and meditation techniques are studied and proven to be effective in reducing stress and anxiety, improving sleep, enhancing emotional intelligence and exploring the heights and depths of human consciousness.

भारतीय प्रौद्योगिकी संस्थान इन्दौर
Indian Institute of Technology Indore
Khandwa Road, Simrol, Indore 453 552, India
Website: www.iiti.ac.in