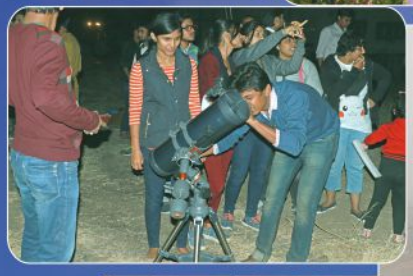
# Annual Report

2017-18



भारतीय प्रौद्योगिकी संस्थान इन्दौर

Indian Institute of Technology Indore

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# Director's Message

As IIT Indore enters the tenth year of its existence, I am happy to report that the Institute is on schedule, as per its vision, to become a top 200 internationally ranked institution. In its debut in the Times Higher Education ranking, released a few weeks ago, IIT Indore is ranked in the 350-400 slot, as the best performing IIT, amongst all, new and old, and second amongst all Indian institutions, behind IISc Bangalore. As the top ranking IIT, the Institute eagerly looks forward now to be identified by the Government of India as an institution of eminence. Needless to say, the impressive performance of IIT Indore has resulted from the hard work and ground breaking research work carried out by several research groups, as evidenced by the best citation per faculty member amongst all Indian institutions, and visually seen by the large number of top-rated journal publications.

At IIT Indore we believe that within our global society, internationalization has to permeate all aspects of the Institute's activities from teaching and learning, to research, knowledge transfer and the way we organize our activities. Working with over 50 international partners and committed to providing an international experience for our research students, and others, IIT Indore has, this year, been identified by the Government of India to be the nodal institute for promoting new and strengthening already existing, collaborations between all IITs and universities and research laboratories in France. With the nine technical universities in Germany, (the TU9's), IIT Indore is the leading Indian collaborating institution. The Institute has promoted widening its global reach by hosting 58 foreign faculty members, under the Government of India scheme, Global Initiative of Academic Networks, once again, one of the highest per faculty members amongst all institutions.

This year the Institute witnesses 112 B. Tech., 26 M. Tech., 41 M.Sc., and 67 Ph.D. degrees being awarded.

On behalf of the Institute, I wish our graduates all success, each one of whom has made the Institute proud.

**Professor Pradeep Mathur**
**IIT Indore**

# Board of Governors, IIT Indore

## Chairman

**Professor Pradeep Mathur**
Director, 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. Ashok Varnwal**
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 [AI & 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. I. A. Palani (Senate Nominee)**
Associate Professor
Discipline of Metallurgy Engineering and Material Science, IIT Indore

**Dr. Pritee Sharma (Senate Nominee)**
Associate Professor, School of HSS
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 Neelesh. K. Jain

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

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

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

**Dean, Planning**
Dr. Rajesh Kumar

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

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

**Dean, Faculty Affairs**
Professor Subhendu Rakshit

## Associate Deans

| | | |
|---|---|---|
| Academics I | : | Dr. Amod C. Umarikar |
| Academics II | : | Dr. Mohan Santhakumar |
| Research and Development | : | Dr. Vimal Bhatia |
| Administration | : | Dr. Somnath Dey |
| Planning I | : | Dr. Shaikh M. Mobin |
| Planning II | : | Dr. Mirza S. Baig |
| Planning III | : | Dr. Sandeep Chaudhary |

## Heads of School

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

## Heads of Departments

| | | |
|---|---|---|
| Computer Science & Engineering | : | Dr. Surya Prakash |
| Electrical Engineering | : | Dr. Trapti Jain |
| Mechanical Engineering | : | Dr. I. A. Palani |
| Chemistry | : | Dr. Amrendra K. Singh |
| Mathematics | : | Dr. Md. Aquil Khan |
| Physics | : | Prof. Krushna Mavani |
| Astronomy | : | Dr. Abhirup Datta |
| Biosciences and Biomedical Engineering | : | Dr. Hem Chandra Jha |
| Metallurgy Engineering and Materials Science (MEMS) | : | Dr. Parasharam M. Shirage |
| Civil Engineering | : | Dr. Sandeep Chaudhary |

## Constitution of Senate

**Prof. Pradeep Mathur**
Director, IIT Indore and Chairman, Senate

### External Experts

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

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

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

**Prof. Sudhir Chella Rajan**
Department of HSS,
Indian Institute of Technology Madras, Chennai

### Deans

**Prof. Neelesh Kumar Jain**
Dean, Academic Affairs, Professor,
Mechanical Engineering

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

**Prof. Subhendu Rakshit**
Dean, Faculty Affairs, Professor,
Physics, IIT Indore

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

## Deans

**Dr. Rajesh Kumar**
Dean, Planning, Associate Professor, Physics

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

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

## Heads

**Dr. Sandeep Chaudhary**
HOD, Civil Engineering,
Associate Professor, Civil Engineering

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

**Dr. Trapti Jain**
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,
Associate Professor, Mechanical Engineering

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

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

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

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

**Dr. Abhirup Datta**
Head, Centre of Astronomy,
Associate Professor, Centre of Astronomy

**Dr. Sanjram Premjit K.**
Head, School of Humanities and Social Science,
Associate Professor, Psychology, School of HSS

## Professors

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

**Prof. Neelesh Kumar Jain**
Mechanical Engineering

**Prof. Anand Parey**
Mechanical Engineering

**Prof. Ram Bilas Pachori**
Electrical Engineering

**Prof. Abhinav Kranti**
Electrical Engineering

**Prof. Vimal Bhatia**
Electrical Engineering

**Prof. Rajneesh Misra**
Chemistry

**Prof. Suman Mukhopadhyay**
Chemistry

**Prof. Subhendu Rakshit**
Physics

**Prof. Krushna R. Mavani**
Physics

**Prof. Sarika Jalan**
Physics

## Other Authorities

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

**Chief Warden**
**Dr. Parasharam M. Shirage**
Associate Professor, Metallurgy Engineering
and Materials Science

**Faculty-In-Charge,**
**Training and Placement Office**
**Dr. Prabhat Kumar Upadhyay**
(Associate Professor, Electrical Engineering)

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

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

## Disciplines & Faculty Members: Profiles

# Discipline of Computer Science and Engineering

### From the HoD's Desk

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

**Dr. Kapil Ahuja** (B.Tech.: IIT (BHU), India; M.S. and Ph.D.: Virginia Tech, USA; Postdoctoral Research Fellow: Max Planck Institute, Germany) 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. He has also held many visiting positions at prestigious universities around the world. During the summer of 2017, he was a Visiting Professor at TU Dresden (Germany).

Since joining IIT Indore in 2013, Dr. Ahuja has received external funding for 6 projects (4 completed and 2 active) from CSIR (India), DAAD (Germany), MHRD (India), DAAD-DIES (Germany), and DST-SERB (India).

During the past five years, he has published his work in prestigious journals (SIAM, Academic Press, Elsevier, etc.). A recent research breakthrough has been achieved in proving stability of classes of model reduction algorithms with respect to the error introduced by inexact linear solves. A critical and unique contribution has been in developing new linear solvers that satisfy these stability conditions at almost no extra cost. For the period of this report, he has been invited to present his latest work at TU Dresden (Germany), Householder Symposium XX (USA), Sandia National Labs (USA), Lawrence Berkeley National Lab (USA), IMT Atlantique (France), UC Louvain (Belgium), and IIT Ropar (India).

As a teacher, Dr. Kapil Ahuja has received the 'best teacher award' at IIT Indore four times in the past five years (2013, 2014, 2016 and 2017). Dr. Ahuja has also held many administrative positions at IIT Indore. He is currently the Dean of International Affairs at IIT Indore and heads the Indo-German and Indo-French initiatives as well.

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

**Dr. Gourinath Banda** is an Associate Professor with a Ph.D. in Computer Science from Roskilde University, Denmark. His thesis was on formal verification of embedded systems. His MS Engg is in Mechatronics where he developed a Real time kernel. 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.

**Major thrust area:** Dr. Gourinath Banda researches in the areas of embedded systems including their recent reincarnations such as the Internet of Things (IoT), Cyber-Physical Systems (CPS) and Autonomous CPS (ACPS). The focus is on algorithms development for (A)CPS and IoT and formal verification of such systems. He is also interested in embedded systems employed in health diagnostics.

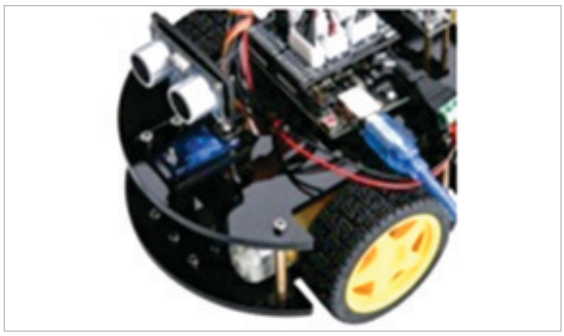


Fig 1. Arduino-based low-cost Elegoo platform for toy autonomous car implementation

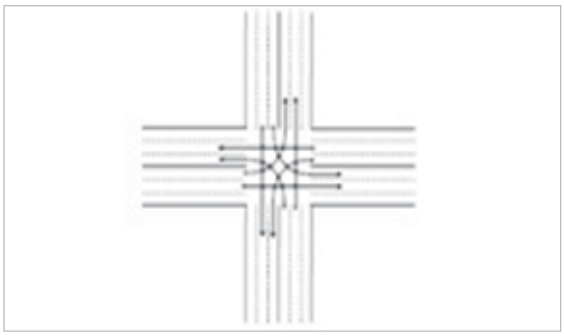


Fig 2. Intersection of a multi-lane road depicting conflicting points

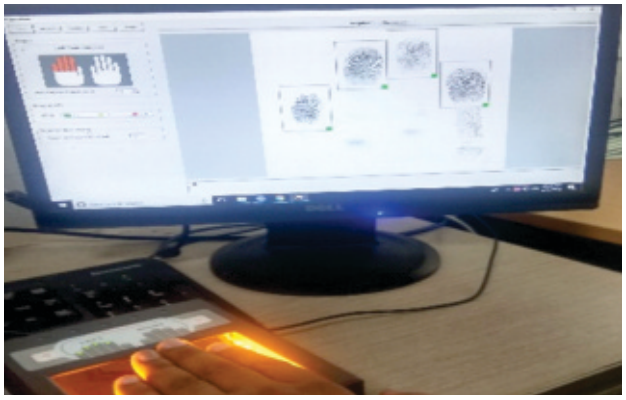
**Dr. Narendra S. Chaudhari**
Professor (HAG)
nsc@iiti.ac.in

**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). During the time he was also the Director of Maulana Azad National Institute of Technology (MANIT), Bhopal from March 2016 to May 2017. From Sept 2010 to June 2013, 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. From 1990 to 2001, he was Professor of Computer Science in M.Sc. DRDO Program, Ministry of Defense (Govt. of India) at Devi Ahilya University, Indore and from 1988 to 1990, he was a Reader in M.Sc. DRDO Program, Ministry of Defense (Govt. of India) at Devi Ahilya University, Indore. Before 1988, he was with the Department of Computer Science and Engineering, IIT, Mumbai, as a Senior Software Engineer.

Dr. Chaudhari was part of a six-member academic delegation of the Honorable President of India's State Visit to Sweden and Belarus for the duration of 31 May to 04 June 2015. He was also part of an academic delegation during the State Visit of Honorable President of India to the People's Republic of China for the duration of 24 May to 27 May 2016. He was part of FICCI's higher education delegation to Germany, France, and Netherlands for the duration of 22-27 June 2015. He represented VNIT, Nagpur in the first BRICS-Network University (NU) Conference at Yekaterinburg, Russia held on 06- 09 April 2016, where he signed the Protocol Agreement on behalf of VNIT, Nagpur for being part of BRICS-NU. In 2017, at St. Petersburg Mining University in St. Petersburg, Russia, he was instrumental in making VNIT Nagpur a part of the International Competence Centre in Mining Engineering. He initiated the foundation of the International Centre of Excellence in Excavation Engineering at VNIT Nagpur(to be funded by UNESCO).

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

**Dr. Somnath Dey** is currently working as an Assistant 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.

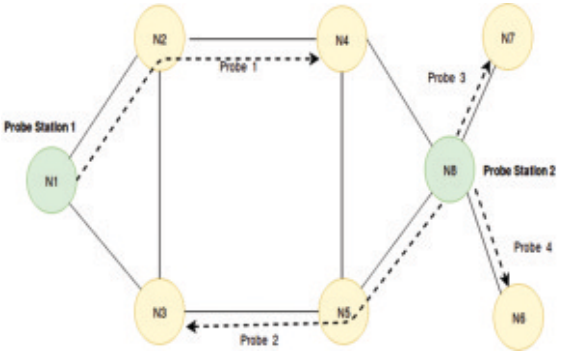


Ten print fingerprint and Iris Camera

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

**Dr. Neminath Hubballi** (Ph.D., IIT Guwahati) is an Assistant 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.

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 networks (which has applications in providing quality of service) and in security monitoring. His team also conducts research on Fault detection in networks to monitor networks and identify node and link failures quickly and localize them. Detecting and localizing failures/faults help in taking corrective measures and minimizing downtime. Specifically, his group is working on adaptive monitoring techniques where the fault monitoring techniques adapt to traffic dynamics experienced by the nodes and links in the Network to cause minimum disruption to normal traffic passing through the nodes and links. His group's recent research publications have appeared in reputed journals (IEEE Transactions on Information and Forensic Security, IEEE/ACM Transactions on Networking, Computers & Security) and conferences (IEEE Globecom and COMSNETS).



**Dr. Bodhisatwa Mazumdar**
Assistant Professor
bodhisatwa@iiti.ac.in

**Dr. Bodhisatwa Mazumdar** (Ph.D: IIT Kharagpur) is an Assistant Professor at CSE. The Cryptography and Hardware Security research group is presently involved in determining side-channel vulnerabilities of lightweight cryptographic implementations and logic locking techniques for ICs. They have successfully mounted a power analysis attack on KASUMI block cipher, determined the probable vulnerabilities in the implementation, and have proposed a lightweight countermeasure to thwart such attacks. This work has been presented at the International conference on Security, Privacy, and Applied Cryptography Engineering at IIT Kanpur. At present they have mounted linear approximation and differential attacks on standard logic locking techniques such as random logic locking, fault analysis based logic locking, and strong logic locking technique. The group has discovered that key gate locations in the logic circuit contribute to such vulnerabilities. This work has been presented at the prestigious Embedded VLSI Design Conference. Currently, they are in the process of extending this work and submitting it to an IEEE Transaction in Computer-Aided Design of Integrated Circuits. The group has also presented guest lectures related to this work in the discipline of CSE at IIT Kharagpur. They are also conducting research on establishing secured fingerprint authentication techniques to thwart Masterprint attacks on enrolled fingerprint databases. In this context, the research group is in the process of setting up a cryptographic security laboratory for lightweight cryptographic implementations that will be geared towards data confidentiality and integrity in IoT system components. In this respect, theory courses and lab projects are being undertaken to raise awareness on cryptographic security amongst undergraduate students.

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

**Dr. Surya Prakash** (PhD: IIT Kanpur) is an Assistant 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.

3-D Biometrics for High Security Applications (Pattern Analysis and Machine Intelligence Lab headed by Dr. Surya Prakash)

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

**Dr. Anirban Sengupta** directs the research lab on CAD for Consumer Electronics Hardware Device Security & Reliability in CSE at IIT Indore. He has been an active researcher with strong publications in the emerging areas of Hardware Security, IP Core Protection, Privacy and Digital Rights Management for Electronics Devices, Forensic Engineering for Security. He has been awarded prestigious IEEE Distinguished Lecturer (Renowned DL of IEEE CE Society) by IEEE Consumer Electronics Society in 2017. His research achievements have received wide media coverage as IET International News, United Kingdom in December 2017 issue of IET Member News (Vol.9, Issue 46, pp.5). He has been awarded "Outstanding Associate Editor" Award from IEEE TCVLSI Letter Editorial Board, IEEE Computer Society in Sep 2017.

He has been inducted into the Executive Committee of IEEE Computer Society Technical Committee on VLSI in Oct 2017. He is the recipient of Visvesvaraya Faculty Research Fellow by Digital India Corporation, Ministry of Electronics & IT. His work has been awarded "IEEE Computer Society Technical Committee on VLSI - Best Paper Award" in IEEE International Symposium on Nanoelectronic and Information Systems (iNIS 2017).

He has 181 Publications (that includes around 100 Journals/Patents/ Books/Chapters). He is the co-author of a Book from IET on ''IP Core Protection and Hardware-Assisted Security for Consumer Electronics'' releasing in 2019. He is currently Editor-in-Chief of IEEE VLSI Circuits & Systems Letter of IEEE Computer Society Technical Committee on VLSI. He also currently serves on several Editorial positions as Senior Editor, Associate Editor, Editor and Guest Editor of several IEEE Transactions/ Journals, IET and Elsevier journals including IEEE Transactions on Aerospace and Electronic Systems (TAES), IEEE Transactions on VLSI Systems, IEEE Transactions on Consumer Electronics (to join from Jan 2019), IEEE Access Journal, IET Journal on Computer & Digital Techniques, IEEE Consumer Electronics, IEEE Canadian Journal of Electrical and Computer Engineering, IEEE VLSI Circuits & Systems Letter and Elsevier Microelectronics Journal. He is the General/Conference Chair of 37th IEEE International Symposium on Consumer Electronics (ICCE) 2019, Las Vegas and Technical Program Chair of 36th IEEE International Conference on Consumer Electronics (ICCE) 2018 in Las Vegas, 15th IEEE International Conference on Information Technology (ICIT) 2016, 3rd IEEE International Symposium on Nanoelectronic a n d Information Systems (iNIS) 2017 and 2019 IEEE International Symposium on VLSI (ISVLSI) in Florida. More than a dozen of his IEEE publications have appeared in 'Top 50 Most Popular Articles' with few in 'Top 5 Most Popular Articles' from IEEE Periodicals. His patents have been cited in various industry patents of IBM Corporation, Siemens Corporation, Qualcomm, Amazon Technologies, Siemens Aktiengesellschaft (Germany), Mathworks Inc, Ryerson University and STC University of Mexico multiple times. His professional work has received wide media coverage nationally and internationally such as in IET International News (UK), Times of India, Central Chronicle, DBPOST News, Free Press Journal, Dainik Bhaskar etc. He has supervised more than 15 candidates including several completed Ph.D. candidates all of whom are/were placed in academia and industry. He has successfully commissioned special issues on Hardware Security, Privacy, IP protection in IEEE TVLSI, IET CDT, IEEE Access as well as IEEE CEM which have received wonderful response from the scientific community. He is also the recipient of Best Research Paper Award 2017 by the Indian Institute of Technology Indore. He has been awarded highest rating 'Excellent' by the expert committee of Department of Science & Technology (DST) based on the performance (output) in the externally funded project in 2017. His research has been awarded competitive funding by various prestigious agencies such as Department of Science & Technology (DST), Council of Scientific and Industrial Research (CSIR) and Department of Electronics & IT (DEITY).

**Area of Work:**

Hardware Assisted Security, IP Core Protection and Reliability of Consumer Electronics Systems.

**Dr. Abhishek Srivastava**
Associate Professor
asrivastava@iiti.ac.in

**Dr. Abhishek Srivastava** (Ph.D.: University of Alberta, Canada; Formerly Assistant Professor, Rose-Hulman Institute of Technology, USA) is involved in research on machine to machine interactions in constrained environments. He is also interested in quantitatively assessing the behaviour of the 'human in the loop' in such environments.

Constrained environments include those of mobile devices and the infrastructure supporting the so-called Internet of Things. The thrust of his research group is towards developing robust security standards and sustainable models for seamless compositions in such constrained environments. His research group is also involved in exploring and comprehending the behaviour and thinking process of the 'human in the loop' in such environments. How 'interested' are humans in participating in crowd sourcing endeavours, how does one assess and predict the otherwise arbitrary behaviour of humans in such environments, how does one understand what drives human participation, and so on.

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

**Dr. Aruna Tiwari** (Ph.D.) 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 areas: artificial neural networks, fuzzy clustering, genetic programming and their applications to bioinformatics, medical diagnosis, etc.

**Teaching activities:** She has more than 21 years of teaching experience and has taught various courses at both UG and PG level. These include: database information systems, soft computing, database engineering, artificial intelligence, computer graphics, computational intelligence, data mining, compiler construction, etc. She has guided more than 20 minor projects in every semester during autumn and spring; and 5 B. Tech projects every year. She also guided more than 25 M.Tech projects and developed the artificial intelligence and database lab. She has conducted various expert talks in national and international workshops/conferences/FDPs.

**Ph.D. Supervision:** She has supervised 5 Ph.D. students (4 have been awarded doctorate and the open seminar of 1 student has been conducted). Out of 5 students, 2 are from SGSITS and 3 are from IIT Indore. She currently supervises 3 students.

**Research Facility:** The lab is equipped with a small Apache spark cluster setup. Number of nodes: 6, Number of processing cores: 18, Total memory: 240 GB, Total disk: 8TB.

Photographs from Various Events Organised

# Major Achievements / Awards / Milestones

| Sl. | Name of the Faculty |
|---|---|
| 01 | **Dr. Kapil Ahuja,** Associate Professor<br>1. Invited for participation in French Future Tour@CMI- Chennai and Knowledge Summit@ New Delhi, February- March 2018.<br>2. Funded and invited for research talk and collaboration at IMT Atlantique, France, and UC Louvain, Belgium, January 2018.<br>3. Successfully organized the second IIT Indore - TU9 research workshop at IIT Indore, India, October 2017.<br>4. Appointed as Dean of International Affairs at IIT Indore, August 2017.<br>5. Funded and invited for research talk and collaboration at Lawrence Berkeley National Laboratory, Berkeley, USA, July 2017.<br>6. Funded and invited for research talk and collaboration at Sandia National Laboratory, Albuquerque, USA, June 2017.<br>7. Awarded Council of Scientific & Industrial Research (CSIR) Foreign Travel Grant to present at Householder SymposiumXX, USA, June 2017.<br>8. Dr. Ahuja was a Visiting Professor at TU Dresden, Germany, May-June 2017.<br>9. Undergraduate student of Dr. Kapil Ahuja, Mr. Ruchir Garg, awarded Promotion of Research/Innovation for Undergraduate Students (PRIUS) grant at IIT Indore to visit Max Planck Institute in Magdeburg (Germany) for research collaboration, May-July 2017. |
| 02 | **Dr. Surya Prakash,** Assistant Professor<br>1. Nominated as Member of Board of Studies, Centre for Advance Studies, Dr. APJ Abdul Kalam Technical University (AKTU), Lucknow by the Academic Council of the University, 2017.<br>2. Certificate of Reviewing awarded by Pattern Recognition Letters Journal in May 2017.<br>3. Certificate of Outstanding Contribution in Reviewing awarded by Neurocomputing Journal in June 2017.<br>4. Awarded certificate of Outstanding Contribution in Reviewing awarded by Pattern Recognition Letters Journal in December 2017.<br>5. GIAN proposal with Prof. Gaurav Sharma of University of Rochester, USA approved by MHRD for a course on Media Security and Forensics. [Funding: INR 8,16,000].<br>6. GIAN proposal with Prof. Massimo Tistarelli of University of Sassari, Italy approved by MHRD for a course on Advanced Pattern Recognition Techniques for Biometrics. [Funding: INR 5,44,000].<br>7. Authored a book titled "Ear Biometrics in 2D and 3D: Localization and Recognition", published by Springer, Singapore. |
| 03 | **Dr. Anirban Sengupta,** Assistant Professor<br>1. Elected 'Chairman of IEEE Computer Society Technical Committee on VLSI (TC-VLSI)' for a term from Oct 2018 - 2020.<br>2. Awarded 'IEEE Consumer Electronics Society Best Paper Award 2019' in IEEE CE Society's Flagship Conference - 37th IEEE Int'l Conference on Consumer Electronics (ICCE), LV.<br>3. Awarded 'IETE Best Research Award 2018' by IETE Sub-Center, 2018. |

| Sl. | Name of the Faculty |
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| | 4. Awarded prestigious IEEE Distinguished Lecturer by IEEE Consumer Electronics Society.<br>5. "Outstanding Associate Editor" Award from IEEE TCVLSI Editorial Board, IEEE Computer Society.<br>6. Founder Chairman, IEEE Consumer Electronics Society - Bombay Section.<br>7. IEEE CESoc Education and Distinguished Lecturer Nominations Committee.<br>8. General Chair, 37th IEEE Int'l Conference on Consumer Electronics (ICCE) 2019, Las Vegas.<br>9. Author of IET Book on "IP Core Protection and Hardware-Assisted Security for Consumer Electronics" releasing in Jan 2019.<br>10. Associate Editor, IEEE Transactions on VLSI Systems.<br>11. Associate Editor, IEEE Transactions on Aerospace and Electronic Systems.<br>12. Associate Editor, IEEE Transactions on Consumer Electronics.<br>13. Technical Chair, 16th IEEE Computer Society Annual Symposium on VLSI (ISVLSI), Florida.<br>14. Recipient of IEEE Computer Society TC-VLSI Best Paper Award 2017 in IEEE iNIS. |
| 04 | **Dr. Aruna Tiwari,** Associate Professor<br>1. Best paper award for two conference papers.<br>2. Elected as Secretary for Computer Society of India, Indore Chapter and Treasurer for three times.<br>3. Appointed as an external examiner from various institutes including IITs/NITs. |
| 05 | **Dr. Somnath Dey,** Assistant Professor<br>1. Early Career Research Award from Department of Science & Technology (DST), Govt. of India in June, 2017.<br>2. Appointed as Associate Dean of Administration at IIT Indore, October, 2017.<br>3. Awarded grant for GIAN course with Prof. Anwitaman Datta of Nanyang Technological University (NTU), Singapore by Funding agency MHRD, India. December, 2018 [Funding: INR 5,44,000]. |

| Sl. | Patent / Publications / Events |
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| 01 | **Dr. Kapil Ahuja,** Associate Professor<br>**Publications:**<br>1. N. Singh and K. Ahuja. Stability Analysis of Inexact Solves in Moment Matching based Model Reduction. Cornell University Preprint arXiv:1803.09283, Mar 2018.<br>2. R. Agrawal, C. Hao Hoo, K. Ahuja, and A. Kumar. Parallel FPGA Router using Sub-Gradient method and Steiner tree. Cornell University Preprint arXiv:1803.03885, Mar 2018.<br>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, Feb 2018.<br>4. A. A. Shastri, D. Tamrakar and K. Ahuja. Density-Wise Two Stage Mammogram Classification using Texture Exploiting Descriptors. Expert Systems with Applications, Elsevier, vol. 99, pp. 71-82, 2018 (online in Jan 2018).<br>5. H. Jain, G. Sai Teja, P. Mane, K. Ahuja and N. Krishnamurthy. Data Backup Network Formation with Heterogeneous Agents. In COMSNETS'18: Proc. of the 10th International Conference on COMmunication Systems & NETworkS, IEEE, Bangalore (India), pp. 418- 420, Jan 2018 (extended abstract). |

| Sl. | Patent / Publications / Events |
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| | **Projects:**<br>1. Title: 'Biorthogonal Krylov Subspace Bases and Short Recurrences' Sponsoring Agency: MATRICS Scheme of Department of Science and Technology (DST-SERB), India<br>Period: 2018 - 2021 (Approved on 18th December 2017) Funding Amount: 6.5 Lakhs INR; 10000 USD<br>2. Title: 'Management of Internationalization' Sponsoring Agency: DAAD-DIES, Germany<br>Period: 2017-2018 for Setting up of International Cell (Approved on 23rd June 2017)<br>Funding Amount: 10 Lakhs INR; 14000 Euros |
| 02 | **Dr. Gourinath Banda,** Associate Professor<br>**Patents:**<br>1. An invention in the area of assisted living for severely disabled has been submitted for patent. Title of patent: "Wheel chair equipped with Brain Computer Interface". This is jointly with undergrad students. (Filled: March 2018).<br>**Publications:**<br>1. Gourinath Banda, Krishna Chaitanya Bommakanti, Harsh Mohan, Manish Singh Saini, Abhay Chandra, "A forward compatible IoT protocol and framework addressing concerns due to internet-outage", International Journal of Internet Technology and Secured Transactions, Volume 7, Issue 3, Pages193-217. (Dec2017).<br>**Projects:**<br>1. As Co-PI, received a project grant towards "Embedded system development for diagnosing female dogs" from DBT. (Grant amount: Rs. 35 Lakh). |
| 03 | **Dr. Somnath Dey,** Assistant Professor<br>**Publications:**<br>**Journal:**<br>1. R. Saxena and S. Dey, Light Weight Access Control Mechanism for Mobile-based Cloud Data Storage, International Journal of Next-Generation Computing (Accepted) (Emerging SCI).<br>2. R. Saxena and S. Dey, On-Demand Integrity Verification Technique for Cloud Data Storage, International Journal of Next-Generation Computing, vol. 9, Issue 1, pp. 33-50, March 2018. [ISSN: 2229-4678 (Print) and ISSN: 0976-5034 (Online)] (Emerging SCI).<br>3. R. Saxena and S. Dey, A Curious Collaborative Approach for Data Integrity Verification in Cloud Computing, CSI Transactions on ICT, Springer, vol. 5, Issue 4, pp. 407-418, December, 2017. [ ISSN: 2277-9078 (print version) and ISSN: 2277-9086 (electronic version)]<br>**Conference:**<br>1. R. Dwivedi and S. Dey, Coprime Mapping Transformation for Protected and Revocable Fingerprint Template Generation, Proceedings of the 5th International Conference on Mining Intelligence and Knowledge Exploration (MIKE-2017), Hyderabad, India, December, 2017, pp. 111-122. (Springer LNCS, volume 10682)<br>2. R. P. Sharma and S. Dey, Fingerprint Image Quality Assessment and Scoring, Proceedings of the 5th International Conference on Mining Intelligence and Knowledge Exploration (MIKE-2017), Hyderabad, India, December, 2017, pp. 156-167. (Springer LNCS, vol. 10682).<br>**Projects:**<br>1. Design and Development of Efficient Cancelable Template Generation Methods for Fingerprint and Iris Biometrics, DST SERB, Duration: 2017-2020<br>2. GIAN Course on Data protection - from Principles to Practice, MHRD, 18$^{th}$-22$^{nd}$ December, 2017. |

| Sl. | Patent / Publications / Events |
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| 04 | **Dr. Surya Prakash,** Assistant Professor<br>**Publications (2017-18):**<br>1. Iyyakutti Iyappan G and Surya Prakash, 3D Ear Recognition using Global and Local Features, IET Biometrics, IET, 2018 (Accepted).<br>2. Piyush Joshi, Surya Prakash and Sonika Rawat, Continuous Wavelet Transform based No-reference Quality Assessment of Deblocked Images, The Visual Computer Journal, Springer, 2017 (Accepted).<br>3. Piyush Joshi and Surya Prakash, Retina Inspired No- reference Image Quality Assessment for Blur and Noise, Multimedia Tools and Applications, 76(18), pp. 18871- 18890, Springer, September 2017.<br>**Project:**<br>Title: 'Development of an Efficient Ear Biometric System and Investigation of Age Invariant Nature of Human Ear Sponsoring' Agency: Department of Science & Technology (DST), Government of India, Period: 2015 - 2018, Funding Amount: Rs. 31.53 lakhs |
| 05 | **Dr. Aruna Tiwari,** Associate Professor<br>**Patent:**<br>1. Application No.:1988/MUM/2015 Inventors: Aruna Tiwari, Ashok Pencily, Kunal Chaudhary Title: 'System And Method For Sign Language Gesture Recognition'. Filing Date: 20th of May, 2015<br>Status: Pending<br>**Publications:**<br>Published in 10 peer reviewed journals (like IEEE Transaction, Elsevier etc.), 23 international conferences (including A and A* rated conference as per CORE ranking), and 7 book chapters.<br>**Projects:**<br>1. Sponsoring agency: Council of Scientific and Industrial Research (CSIR), Govt. of India Collaborator: ICAR-Indian Institute of Soyabean Research (ICAR-IISR) Indore, Funding amount: 30 Lakhs INR<br>2. Sponsoring agency: Joint sponsors CSIR - Central Electronics Engineering Research Institute (CSIR- CEERI)Pilani& Indian Institute of Technology Indore. Collaborator: CSIR-CEERI Pilani Funding amount: 30 Lakhs INR<br>**Events Coordinated:**<br>1. Conducted GIAN Short Term Course Scheme of Ministry of Human Resources and Development (MHRD).<br>2. Conducted first NTU-India Connect Program of our country under the name of symposium "International Symposium on Computational Mathematics, Optimization, and Computational Intelligence" (CMOCI 2017). Also received the grant from various sponsoring agencies: SERB, NBHM, CSIR, INSA, and SBI.<br>3. One Day Research Workshop enabled to sign MOU with CSIR-Central Electronics Engineering Research Institute (CSIR-CEERI), Pilani.<br>4. Workshop on ''Nature Inspired Optimization Techniques & their Applications" jointly organized with Soft Computing Research Society (SCRS), India.<br>5. Expert Talk by Dr. Srinivas Padmanabhuni (ACM India President and Associate Vice President at Infosys) and Professor David M Howard (Head of the Department of Electronics, University of York, UK).<br>6. Chaired various sessions in various international conferences. |

| Sl. | Patent / Publications / Events |
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| 06 | **Dr. Neminath Hubballi,** Assistant Professor<br>**Projects:**<br>1. Title: Public Forum Data Collection and Analysis for Actionable Intelligence-With MCTE Mhow.<br>2. Network simulator - With CTE Mhow.<br>3. Title: Design and Development of a Trusted and Accountable Cloud Computing Platform-Sponsoring Agency: Science & Engineering Research Board, Government of India.<br>4. Title: Big Data Aware High Capacity Wireless Network Architecture Using Caching and Machine Learning - Sponsoring Agency: DST-UKIERI.<br>**Publications:**<br>**Journals**<br>1. Neminath Hubballi and Mayank Swarnkar, "BitCoding : Network Traffic Classification through Encoded Bit Level Signatures", IEEE/ACM Transactions on Networking (To Appear).<br>2. Mayank Swarnkar and Neminath Hubballi, "Spam Detector: Detecting Spam Callers in VoIP with Graph Anomalies,'' Security and Privacy (To Appear).<br>3. Neminath Hubballi and Jonathan Santini, "Detecting TCP ACK Storm Attack: A State Transition Modeling Approach", IET Networks (To Appear).<br>4. Mayank Swarnkar and Neminath Hubballi, "RDClass: On Using Relative Distance of Keywords for Accurate Network Traffic Classification", IET Networks, Vol 7(4), PP 273-279, IET(IEEE), 2018.<br>5. Nikhil Tripathi and Neminath Hubballi, "Detecting Stealth DHCP Starvation Attack Using Machine Learning Approach", Journal of Computer Virology and Hacking Techniques, Vol 14(3), PP 233-244, Springer, 2018.<br>6. Nikhil Tripathi and Neminath Hubballi, "Slow Rate Denial of Service Attacks Against HTTP/2 and Detection", Computers & Security, Vol 72(C), PP 255-272, Elsevier, 2018.<br>7. Neminath Hubballi and Nikhil Tripathi, "An Event based Technique for Detecting Spoofed IP Packets", Journal of Information Security and Applications, Vol 35(C), PP 32-43, Elsevier, 2017<br>**Conference**<br>1. Mayank Swarnkar, Neminath Hubballi, Nikhil Tripathi and Mauro Conti, "AppHunter: Mobile Application Traffic Classification", Advanced Networks and Telecommunications System (ANTS 2018)<br>2. Anuja Tayal, Neminath Hubballi, Maitreya Natu and Vaishali Sadaphal, "Congestion-Aware Probe Selection for Fault Detection in Networks" 10th International Conference on Communications Systems and Networks (COMSNETS 2018), Bangalore, India (To Appear)<br>3. Anuja Tayal, Neminath Hubballi and Nikhil Tripathi, "Communication Recurrence and Similarity Detection in Network Flows", Advanced Networks and Telecommunications System (ANTS 2017)<br>4. Himsnshu Dogra, Sudhakar Verma, Neminath Hubballi and Mayank Swarnkar, "Security Service Level Agreements in Cloud: A Proof of Concept Implementation", Advanced Networks and Telecommunications Systems (ANTS 2017)<br>5. Nikhil Tripathi, Mayank Swarnkar and Neminath Hubballi, "DNS Spoofing in Local Networks Made Easy", Advanced Networks and Telecommunications System (ANTS 2017)<br>6. Neminath Hubballi and Mayank Swarnkar, "BitCoding : Protocol Type Agnostic Robust Bit Level Signatures for Traffic Classification", IEEE Global Communications Conference (GLOBECOM 2017) |

# Discipline of Electrical Engineering

## From the HoD's Desk

**Dr. Trapti Jain**
Associate Professor
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 Ph.D. Two M.Tech programs are 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 13 faculty members with expertise in diverse areas including Power Electronics and Power Systems, Micro and Nano-electronics, Communications, Signal Processing, Image Processing, and Bio-photonics.

**It has the following research laboratories:**

- Advanced Memory Technology Laboratory
- 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 25 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 strives 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.

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**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. One doctoral student has submitted her thesis under his supervision during the year 2017-18.

Currently, he is engaged in international collaborative work with the National Sun Yat-Sen University, Taiwan R.O.C. under the India-Taiwan bilateral research project. Contributions from the group have been recognized through (i) German Academic Exchange Service (DAAD) scholarship to visit RWTH Aachen, June 2017, (ii) An outstanding reviewer for IOP Nanotechnology, 2017; and, (iii) Ph.D. scholar, Mr. Manish Gupta's award of 'best oral presentation' in the CMOS Technology Extended – Novel Systems and Approaches session at the 6th International Symposium on Integrated Functionalities (ISIF), New Delhi, 2017.

Other contributions are (i) Conducting Continuing Education Programme (CEP) on Information Communication Technologies (ICT): Concepts, Implementations and Prospects, March 08-10, 2018; and, (ii) Being invited to talk and co-chair a session at the 6th International Symposium on Integrated Functionalities (ISIF), New Delhi, 2017.

## Publications:

Prof. Kranti has contributed to 12 peer reviewed journals publications in 2017-18.

1. Md. H.R. Ansari, N. Navlakha, J.-T. Lin, and A. Kranti, Doping dependent assessment of accumulation mode and junctionless FET for 1T DRAM, IEEE Trans. Electron Devices, vol. 65, pp. 1205-1210, 2018.
2. N. Jaiswal, and A. Kranti, A model for gate-underlap dependent short channel effects in junctionless MOSFET, IEEE Trans. Electron Devices, vol. 65, pp. 881-887, 2018.
3. J.-T. Lin, H.-H. Lin, Y.-J. Chen, C.-Y. Yu, A. Kranti, C.-C. Lin and W.-H. Lee, Vertical transistor with n-bridge and body on gate for low power 1T-DRAM application, IEEE Trans. Electron Devices, vol. 64, pp. 4937-4945, 2017.
4. Y.V. Bhuvaneshwari, and A. Kranti, Extraction of mobility and degradation coefficients in double gate junctionless transistors, Semiconductor Science and Technology, vol. 32, 125011, 2017.
5. N. Navlakha, and A. Kranti, Insights into operation of planar tri-gate tunnel field effect transistor for dynamic memory application, Journal of Applied Physics, vol. 122, 044502, 2017.
6. M. Gupta, and A. Kranti, Steep switching Germanium junctionless MOSFET with reduced off-state tunneling, IEEE Trans. Electron Devices, vol. 64, no. 9, pp. 3582-3587, 2017.
7. M. Gupta, and A. Kranti, Hysteresis free negative total gate capacitance in junctionless transistors, Semiconductor Science and Technology, vol. 32, 095014, 2017.
8. N. Navlakha, and A. Kranti, Overcoming the drawback of lower sense margin in tunnel FET based dynamic memory along with enhanced charge retention and scalability, Nanotechnology, vol. 28, 445203, 2017.
9. R. Singh, Md. A. Khan, S. Mukherjee and A. Kranti, Analytical model for 2DEG density in graded MgZnO/ZnO heterostructures with cap layer, IEEE Trans. Electron Devices, vol. 64, no. 9, pp. 3661-3667, 2017.
10. A. Kumar, M. Das, V. Garg, B.S. Sengar, M.T. Htay, S. Kumar, A. Kranti, and S. Mukherjee, Forming-free high-endurance Al/ZnO/Al memristor fabricated by dual ion beam sputtering, Applied Physics Letters, vol. 110, 253509, 2017.
11. M. Gupta and A. Kranti, Variation of threshold voltage with temperature in impact ionization induced steep switching Si and Ge junctionless MOSFETs, IEEE Trans. Electron Devices, vol. 64, no. 5, pp. 2061-2066, 2017.
12. N. Navlakha, J.-T. Lin and A. Kranti, Retention and scalability perspective of sub-100 nm double gate tunnel FET DRAM, IEEE Trans. Electron Devices, vol. 64, pp. 1561-1567, 2017.

**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.

During the year 2017-18, two doctoral students have graduated under his supervision, and one doctoral candidate has further enrolled under his supervision.

Dr. Karthik Thirumala (completed his doctoral research as a part of his research group) has been awarded with the POSOCO Power System Award. POSOCO Power System Award (PPSA) is an initiative to recognize and reward innovative technical research excellence in power system by discovering and encouraging fresh doctoral/masters research accomplishments in power system and related field.

## Publication:

During the year, he has published one paper in IEEE Transactions on Instrumentation and Measurement.

1. V. K. Tiwari, A. C. Umarikar and T. Jain, "Fast Amplitude Estimation of Harmonics Using Undecimated Wavelet Packet Transform and Its Hardware Implementation," in IEEE Transactions on Instrumentation and Measurement, vol. 67, no. 1, pp. 65-77, Jan. 2018. doi: 10.1109/TIM.2017.2759358.

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**Dr. M. Anbarasu**
Associate Professor
anbarasu@iiti.ac.in

**Dr. M. Anbarasu** graduated in Electrical and Electronics Engineering from Bharathiar University Coimbatore . He received his Ph.D. from the Indian Institute of Science, Bangalore in 2008. He worked as Alexander von Humboldt Post-Doctoral research fellow at The I. Institute of Physics, RWTH Aachen University Germany. Since 2012, he has been a faculty at Indian Institute of Technology Indore.

His research goals are: (i) Nanoscale phase change electronic memory devices, (ii) Multi-bit data storage, stackable cross-point memory devices, (iii) Ovonic threshold switch selector devices, (iv) Neuromorphic computing.

During the year 2017-18, three doctoral students graduated under his supervision. He organized and conducted a GIAN course on 'Fundamentals of Solid State Physics: From Theoretical and Computational Concepts to Recent Applications in Information Technology', February 5-16, 2018. Prof. Dr. Riccardo Mazzarello, RWTH Aachen University, Germany was the guest faculty for the course. The course benefitted 35 students and professionals from across the country. He has been engaged in international collaborative research work with RWTH Aachen University since 2014.

## Publications:

Dr. Anbarasu had published 11 journal papers during the year 2017-18.

1. S.K. Pandey and M. Anbarasu, 'A fully automated temperature-dependent resistance measurement setup using van der Pauw method', Rev. Sci. Instrum., 89 033906 (2018).
2. A.K Shukla, V.M Yadav, Akash Kumar, I A Palani and M. Anbarasu, 'Investigations on effect of laser-induced self-assembled patterning on optical properties of flexible polyimide substrates for solar cell applications', J. Phys. D: Appl. Phys., 51, 045502, (2018).

3. K.D. Shukla, N. Saxena, and M. Anbarasu, 'An ultrafast programmable electrical tester for enabling time-resolved, sub-nanosecond switching dynamics and programming of nanoscale memory devices' Rev. Sci. Instrum., 88 123906 (2017).
4. S. Sahu, R. Sharma K.V. Adarsh and M. Anbarasu, 'Ultrafast and low-power crystallization in Ge1Sb2Te4 and Ge1Sb4Te7 thin films using femtosecond laser pulses', Appl. Opt., 57, 178 (2017).
5. K.D. Shukla, S. Sahu M. Anbarasu and U.P. Deshpande, 'Direct Evidence for a Systematic Evolution of Optical Band Gap and Local Disorder in Ag, In Doped Sb2Te Phase Change Material', Phys. Status Solidi RRL, 11, 1700273 (2017).
6. Ashish K. Shukla, K. Akash, I. A. Palani, M. Anbarasu, 'Laser assisted wet texturing of flexible Polyethylene terephthalate (PET) substrate using Nd3+:YAG Laser for photovoltaics devices', Mater. Sci. & Engg. B, 226, 78 (2017).
7. S.K. Pandey and M. Anbarasu, 'Extremely high contrast multi-level resistance states of In3SbTe2 device for high density non-volatile memory applications', Phys. Status Solidi, RRL, 11, 1700227 (2017).
8. S. Sahu, M. Anbarasu, H. Shaik, G. Mohan Rao, 'Local structure of amorphous Ag5In5Sb60Te30 and In3SbTe2 phase change materials revealed by X-ray photoelectron and Raman spectroscopic studies', J. Appl. Phys., 122, 015305 (2017).
9. S.K. Pandey and M. Anbarasu, 'A weak electric field assisted ultrafast electrical switching dynamics in In3SbTe2 phase change memory devices', AIP Advances, 7, 075206 (2017).
10. Smriti Sahu, Rituraj Sharma, K. V. Adarsh, and M. Anbarasu, 'Femtosecond laser-induced ultrafast transient snapshots and crystallization dynamics in phase change material', Optics Letters, 42, 2503 (2017).
11. S. S. Mani Prabu, H.C. Madhu, Chandra S. Perugu, K. Akash, P. Ajay Kumar, Satish V. Kailas, M. Anbarasu, I.A. Palani, 'Microstructure, mechanical properties and shape memory behaviour of friction stir welded nitinol', Mater. Sci. & Engg. A, 693, 233 (2017).

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

**Dr. Mukesh Kumar** received his M.Tech (2004) from the Indian Institute of Technology Kharagpur; and Ph.D. (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:

- Silicon Photonics: Micro Nano Devices based on Silicon/SOI
- Nanophotonics: Nano Devices for Multidisciplinary Applications
- Nanoelectronic Fabrication
- Devices based on engineered and hybrid materials
- Engineered On-chip Biosensors

One doctoral student has graduated under his supervision. His group's research collaboration has been proposed with Institute of Semiconductor Physics, Novosibirsk, Russia. A joint bilateral proposal has been submitted in this regard. This joint venture will enable the fabrication of nanophotonic resistive memory. The group also has an ongoing collaboration with the Raja Ramanna Center for Advanced Technology (RRCAT) Indore on Device Fabrication.

## Publications:

He has published 1 Journal publication and 3 Conference papers during the year 2017-18.

1. 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.
2. Sulabh, L. Singh, S. Tidke and M. Kumar, "Metal assisted slot waveguide biochemical sensor," 2018 3rd International Conference on Microwave and Photonics (ICMAP), Dhanbad, 2018, pp. 1-2.
3. Swati Rajput, Vishal Kaushik, Sourabh Jain and Mukesh Kumar, "Ultra-low loss slow light in Si-ITO Hollow waveguide" International Symposium on Integrated Functionalities (ISIF), New Delhi, 10-13 Dec.2017.
4. Sourabh Jain, Swati Rajput, Vishal Kaushik and Mukesh Kumar "Silicon based Broadband Reflector for On-chip Photonic Devices",International Symposium on Integrated Functionalities (ISIF) New Delhi, 10-13 Dec.2017.

### His Latest Research:

Optical fiber communication provides the required high-speed and enormous bandwidth that is critical for the communication networks to be future flexible. Compact on-chip photonic devices carry the potential to enable future flexibility in terms of speed limitation and bandwidth usage. Reduction in the size of photonic devices is diffraction limited which hinders ultimate compactness required for future devices. In this work, the researchers are able to design and fabricate an ultra-compact photonic device with low-loss, nano-scale optical confinement, wide bandwidth and low dispersion. The proposed characteristics are crucial for future flexible optical fiber communication and optical interconnects.

The novel approach of guiding and controlling the light at real nano-scale together with fabrication process developed for such devices makes this device ideal for high-speed broadband communication. The coupling of light with collective oscillations of free electrons at a metal-dielectric interface is a potential candidate for nano-scale optical confinement beyond the diffraction limit. Such plasmonic devices with surface plasmonpolariton (SPP) modes suffer from large metallic losses which limit its use in practical devices. A promising approach for optical confinement at real nano-scales with low-loss is the hybridization of SPP and optical modes. Guided SPP mode in such hybrid plasmonic waveguide is dragged away from the metal-dielectric interface with a proper choice of dimensions which relaxes the effect of large metallic resistance on the guided (hybrid plasmonic, HP) mode resulting in a longer propagation length.

His research group has utilized a high-index semiconductor layer to offer a leaky mode confinement underneath the HP confinement layer for the further reduction in the losses and the tight control in propagation characteristics. The proposed hybrid plasmonic device has a dielectric layer sandwiched between high index silicon layer and gold. The dielectric layer is thermally grown 11-nm thick SiO2 on a silicon substrate which gives a defect-free interface. The electron beam (E-beam) lithography is used followed by reactive ion etching for getting the desired width of 300-nm of a proposed three-layer structure. Changing lateral and vertical leaky optical mode in the high index layer can control the hybrid mode. The introduction of a phase control layer in silicon should provide a filtering response to control the dispersion of guided mode. In modified device design, the grating is embedded in the hybrid plasmonic structure for high data rate applications.

The proposed innovative design of the device is an excellent example of the combination of novel device physics and semiconductor technology. The proposed mechanism and the adopted fabrication process may open up a new class of devices for high-speed and high data-rate broadband communication.

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

**Dr. Prabhat Kumar Upadhyay** received his Ph.D. 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. The aim is to conduct fundamental and applied research to cater to the emerging needs of the next generation of wireless communication systems. This seeks to address system performance, planning, and resource allocation problems by enabling cooperation amongst available network resources with renewable and/or RF energy sources for implementation of Large-Scale Ambient Energy Harvesting Wireless Networks.

One doctoral student has graduated under his supervision, and one doctoral student has enrolled during the year 2017-18. He has proposed a timely consultancy project with the King Fahd University of Petroleum and Minerals, "Design and Analysis of Cognitive Radio-Enabled Energy Harvesting based Wireless Body Area Networks for Smart Health Care".

He has also been coordinator for the CEP Short-Term Course; 'Information Communication Technologies (ICT): Concepts, Implementations, and Prospects' held at IIT Indore, in March, 2018.

He has also been actively involved in the organization of Industry-Academia Conclave (IAC), 2017. His multilateral research project proposal submitted under BRICS 2017 has been approved by the Department of Science & Technology, Government of India.

His research has gained international recognition: (i) Selected for IETE-Prof SVC Aiya Memorial Award-2018 by Institution of Electronics and Telecommunication Engineers, (ii) Best Paper Award in International Conference on Advanced Communication Technologies and Networking (CommNet), Marrakech, Morocco, April 2018, (iii) Awarded Sir Visvesvaraya Young Faculty Research Fellowship of MeitY, Government of India.

Dr. Upadhyay has been actively engaged with different engineering and research organizations in different capacities: (i) Guest Editor, IEEE Transactions on Cognitive Communications and Networking, Special Issue on "Energy-Harvesting Cognitive Radio Networks", 2018. (ii) Associate Editor, IEEE Access, January 2018 onwards, (iii) Publicity Co-Chair, International Conference on Advanced Communication Technologies and Networking (CommNet), Rabat, Morocco, April 2019, (iv) TPC Co-chair, IEEE International Conference on Advanced Networks and Telecommunication Systems (ANTS), Indore, India, Dec. 2018, (v) Co-organizer, Workshop on "Energy Harvesting Communication Networks", IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC), Bologna, Italy, Sep. 2018.

## Publications:

During the year 2017-18, he has published 11 Journal Papers, 9 conference papers, and two book chapters.

### Journal Papers:

1. S. Solanki and P. K. Upadhyay, "Performance Analysis of Cognitive Relay Sharing Systems with Bidirectional Primary Transmissions under Nakagami-m Fading," IET Communications, vol. 11, no. 8, pp. 1199-1206, June 2017.

2. A. Meshram, D. S. Gurjar and P. K. Upadhyay, "Joint Impact of Nodes-Mobility and Channel Estimation Error on the Performance of Two-Way Relay Systems," Physical Communication, Elsevier, vol. 27, pp. 103-113, June 2017.
3. D. S. Gurjar and P. K. Upadhyay, "Overlay Spectrum Sharing for Device-to-Device Communications in Two-Way Cellular Networks with Nodes-Mobility," Transactions on Emerging Telecommunications Technologies, vol. 28, no. 10, 10.1002/ett.3164,Oct. 2017.
4. Y. R. Ortega, P. K. Upadhyay, D. B. da Costa, P. S. Bithas, A. G. Kanatas, U. S. Dias, and R. T. de Sousa Jr., "Joint Effect of Jamming and Noise in Wiretap Channels with Feedback Delay and Multiple Antennas," Transactions on Emerging Telecommunications Technologies, vol. 28, no. 11, 10.1002/ett.3191, Nov. 2017.
5. D. S. Gurjar, P. K. Upadhyay, D. B. da Costa, and R. T. de Sousa Jr., "Beamforming in Traffic-Aware Two-Way Relay Systems with Channel Estimation Error and Feedback Delay," IEEE Transactions on Vehicular Technology, vol. 66, no. 10, pp. 8807-8820, Oct. 2017.
6. S. Solanki, P. K. Sharma, and P. K. Upadhyay, "An Adaptive Link Utilization Scheme for Two-Way Spectrum Sharing Relaying Systems under Average Interference-Constraints," IEEE Systems Journal, vol. PP, no. 99, June 2017. DOI:10.1109/JSYST.2017.2713887.
7. S. K. Tiwari and P. K. Upadhyay, "Estimate-and-Forward Relaying in Diffusion-Based Molecular Communication Networks: Performance Evaluation and Threshold Optimization," IEEE Transactions on Molecular, Biological, and Multiscale Communications, vol. 3, no. 3, pp. 183-193, Sept. 2017.
8. P. K. Sharma, P. K. Upadhyay, D. B. da Costa, P. S. Bithas, and A. G. Kanatas, "Overlay Spectrum Sharing in Hybrid Satellite-Terrestrial Systems with Secondary Network Selection," IEEE Transactions on Wireless Communications, vol. 16, no. 10, pp. 6586-6601, Oct. 2017.
9. 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. PP, no. 99, Dec. 2017. DOI: 10.1109/JSYST.2017.2783372.
10. P. S. Bithas, A. G. Kanatas, D. B. da Costa, P. K. Upadhyay, and U. S. Dias, "On the Double-Generalized Gamma Statistics and Their Application to the Performance Analysis of V2V Communications," IEEE Transactions on Communications, vol. 66, no. 1, pp. 448-460, Jan. 2018.
11. V. Bankey and P. K. Upadhyay, "Ergodic Capacity of Multiuser Hybrid Satellite-Terrestrial Fixed Gain AF Relay Networks with CCI and Outdated CSI," IEEE Transactions on Vehicular Technology, vol. 67, no. 5, pp. 4666-4671, Jan. 2018.

**Conference Papers:**

1. P. S. Bithas, A. G. Kanatas, D. B. da Costa, and P. K. Upadhyay, "Transmit Antenna Selection in Vehicle-to-Vehicle Time-Varying Fading Channels," IEEE International Conference on Communications (ICC), Paris, France, 21-25 May, 2017.
2. P. K. Sharma, P. K. Upadhyay, D. B. da Costa, P. S. Bithas, and A. G. Kanatas, "Hybrid Satellite-Terrestrial Spectrum Sharing System with Opportunistic Secondary Network Selection," IEEE International Conference on Communications (ICC), Paris, France, 21-25 May, 2017.
3. V. Bankey and P. K. Upadhyay, "Secrecy Outage Analysis of Hybrid Satellite-Terrestrial Relay Networks with Opportunistic Relaying Schemes," IEEE 85th Vehicular Technology Conference (VTC-2017 Spring), Sydney, Australia, 4-7 June, 2017.
4. S. Solanki and P. K. Upadhyay, "Secure Underlay Cognitive Relay Networks in Presence of Primary User's Interference," IEEE 85th Vehicular Technology Conference (VTC-2017 Spring), Sydney, Australia, 4-7 June, 2017.

5. Y. R. Ortega, P. K. Upadhyay, D. B. da Costa, P. S. Bithas, A. G. Kanatas, U. S. Dias, and R. T. de Sousa Jr., "Joint Effect of Jamming and Noise in Wiretap Channels with Multiple Antennas," 13th International Wireless Communications and Mobile Computing Conference (IWCMC), Valencia, Spain, 26-30 June, 2017.
6. P. S. Bithas, A. G. Kanatas, D. B. da Costa, P. K. Upadhyay, and U. S. Dias, "The Double-Generalized Gamma Distribution and its Application to V2V Communications", IEEE Globecom, Singapore, 4-8 Dec., 2017.
7. S. Solanki, P. K. Sharma, P. K. Upadhyay, D. B. da Costa, P. S. Bithas, and A. G. Kanatas, "Cognitive Multi-Relay Networks with RF Hardware Impairments and Channel Estimation Errors", IEEE Globecom, Singapore, 4-8 Dec., 2017.
8. V. Bankey, P. K. Upadhyay, and D. B. da Costa, "Physical Layer Security of Interference-Limited Land Mobile Satellite Communication Systems", International Conference on Advanced Communication Technologies and Networking (CommNet), Marrakech, Morocco, 2-4 April, 2018.
9. D. S. Gurjar, U. Singh, and P. K. Upadhyay, "Energy Harvesting in Hybrid Two-Way Relaying with Direct Link under Nakagami-m Fading", IEEE Wireless Communications and Networking Conference (WCNC), Barcelona, Spain, 15-18 April, 2018.

**Book Chapters:**

1. V. Singh, P. K. Upadhyay, K.-J. Lee, and D. B. da Costa, "Cooperative and Cognitive Hybrid Satellite-Terrestrial Networks," *Cognitive Radio, Mobile Communications and Wireless Networks,* M. H. Rehmani and R. Dhaou (Eds.), EAI/Springer Innovations in Communications and Computing Book Series, 2018.
2. D. S. Gurjar and P. K. Upadhyay, "Spectrum Sharing for D2D Communications in Fifth-Generation Wireless Networks," *Enabling Technologies and Architectures for Next-Generation Networking Capabilities,* M. Elkodr (Ed.), IGI Global, 2018.

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

**Dr. Ram Bilas Pachori** received his B.E. degree (with honours) in Electronics and Communication Engineering from Rajiv Gandhi Technological University, Bhopal (2001); and, M.Tech. (2003) and Ph.D. (2008) in Electrical Engineering from the Indian Institute of Technology (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.

He has more than 140 publications which include journal papers, conference papers, books, and book chapters. His publications have around 3000 citations, h index of 29, and i10 index of 68 (Google Scholar, October 2018).

He has served on review boards for more than 60 scientific journals and scientific committees of various national and international conferences.

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.

His research goals are: (i) Brain-Computer Interfacing, (ii) Computer-Aided Medical Diagnosis, (iii) Intelligent Signal Processing, (iv) Non-stationary and Non-linear Signal Processing

During the year, 2017-18, one doctoral candidate has graduated and one doctoral candidate has submitted a thesis under his supervision.

He is engaged in industry consultancy of analysis of coronary artery disease by signal processing through MATLAB, Professional Group of Conferences (PGC), Visakhapatnam, for a 20-month duration (began in August 2017).

He has authored a book during the year: M. Tanveer and R.B. Pachori, *Machine intelligence and signal analysis, Advances in Intelligent Systems and Computing* (Springer, 2018), ISBN: 978-981-13-0923-6.

He has participated in the following international workshops and seminars: (i) International conference on machine intelligence and signal processing, December 22-24, 2017, Indian Institute of Technology Indore. (jointly with Dr. M. Tanveer), (ii) Short-term course on advanced signal processing techniques for fault detection of mechanical and electrical systems, 10-11 March, 2018, School of Engineering, Indian Institute of Technology Indore (jointly with Prof. A. Parey). His research collaborations are across the globe. He has collaborated with Ulster University, UK; IIT Bombay. Kasturba Medical College, Manipal; Ngee Ann Polytechnic, Singapore; SUSS University, Singapore, University of Malaya, Kuala Lumpur, Malaysia, IIT Kanpur; SIM University, Singapore; IITRAM, Ahmedabad; RRCAT, Indore; Benett University, Greater Noida; IIT Delhi; University of Lorraine, France.

Dr. Pachori as well as his student's research have been recognized as Top social media article in 2017, and he is the Associate Editor of Biomedical Signal Processing and Control Journal. His Ph.D. student Mr. Abhijit Bhattacharyya has been awarded the Raman-Charpak Fellowship at University of Lorraine, CNRS, France.

## Publications:

During the year he has authored 32 journal papers and conference papers in highly reputed journals and conference proceedings.

### Journal Papers:

1. R.R. Sharma and R.B. Pachori, 'Time-frequency representation using IEVDHM-HT with application to classification of epileptic EEG signals', IET Science, Measurement & Technology, vol. 12, issue 01, pp. 72-82, January 2018.
2. M. Sharma and R.B. Pachori, 'A novel approach to detect epileptic seizures using a combination of tunable-Q wavelet transform and fractal dimension', Journal of Mechanics in Medicine and Biology, vol. 17, no. 07, 1740003, 20 pages, November 2017.
3. P. Singh and R.B. Pachori, 'Classification of focal and non-focal EEG signals using features derived from Fourier-based rhythms', Journal of Mechanics in Medicine and Biology, vol. 17, no. 07, 1740002, 16 pages, November 2017.
4. R. Sharma, R.B. Pachori, and A. Upadhyay, 'Automatic sleep stages classification based on iterative filtering of electroencephalogram signals', Neural Computing and Applications, vol. 28, issue 10, pp. 2959-2978, October 2017.
5. D. Bhati, R.B. Pachori, and V.M. Gadre, 'A novel approach for time-frequency localization of scaling functions and design of three-band biorthogonal linear phase wavelet filter banks', Digital Signal Processing, vol. 69, pp. 309-322, October 2017.
6. M. Kumar, R.B. Pachori, and U.R. Acharya, 'Automated diagnosis of myocardial infarction ECG signals using sample entropy in flexible analytic wavelet transform framework', Entropy, vol. 19 (9), 488, pages 14, September 2017.

7. A. Bhattacharyya and R.B. Pachori, 'A multivariate approach for patient specific EEG seizure detection using empirical wavelet transform, IEEE Transactions on Biomedical Engineering', vol. 64, no. 09, pp. 2003-2015, September 2017.
8. S. Maheshwari, R.B. Pachori, V. Kanhangad, S.V. Bhandary, and U.R. Acharya, 'Iterative variational mode decomposition based automated detection of glaucoma using fundus images', Computers in Biology and Medicine, vol. 88, pp. 142-147, September 2017.
9. M.K. Saxena, S.D.V.S. Jagannadha Raju, R. Arya, R.B. Pachori, and S. Kher, 'Instantaneous area based on-line detection of bend generated error in a Raman optical fiber distributed temperature sensor', IEEE Sensors Letters, vol. 01, no. 4, article sequence no. 7000204, August 2017.
10. A. Upadhyay, M. Sharma, and R.B. Pachori, 'Determination of instantaneous fundamental frequency of speech signals using variational mode decomposition', Computers and Electrical Engineering, vol. 62, pp. 630-647, August 2017.
11. A.K. Tiwari, R.B. Pachori, V. Kanhangad, and B.K. Panigrahi, 'Automated diagnosis of epilepsy using key-points based local binary pattern of EEG signals', IEEE Journal of Biomedical and Health Informatics, vol. 21, issue 4, pp. 888-896, July 2017.
12. V. Gupta, T. Priya, A.K. Yadav, R.B. Pachori, and U.R. Acharya, 'Automated detection of focal EEG signals using features extracted from flexible analytic wavelet transform', Pattern Recognition Letters, vol. 94, pp. 180-188, July 2017.
13. M. Sharma, R.B. Pachori, and U.R. Acharya, 'A new approach to characterize epileptic seizures using analytic time-frequency flexible wavelet transform and fractal dimension', Pattern Recognition Letters, vol. 94, pp. 172-179, July 2017.
14. M. Sharma, P.V. Achuth, R.B. Pachori, and V.M. Gadre, 'A parametrization technique to design joint time-frequency optimized discrete-time biorthogonal wavelet bases', Signal Processing, vol. 135, pp. 107-120, June 2017.
15. R. Sharma, M. Kumar, R.B. Pachori, and U.R. Acharya, 'Decision support system for focal EEG signals using tunable-Q wavelet transform', Journal of Computational Science, vol. 20, pp. 52-60, May 2017.
16. S. Maheshwari, R.B. Pachori, and U.R. Acharya, 'Automated classification of glaucoma using empirical wavelet transform and correntropy features extracted from fundus images', IEEE Journal of Biomedical and Health Informatics, vol. 21, no. 03, pp. 803-813, May 2017.
17. M. Sharma, A. Dhere, R.B. Pachori, and V. M. Gadre, 'Optimal duration-bandwidth localized antisymmetric biorthogonal wavelet filters', Signal Processing, vol. 134, pp. 87-99, May 2017.
18. A. Bhattacharyya, R.B. Pachori, A. Upadhyay, and U.R. Acharya, 'Tunable-Q wavelet transform based multiscale entropy measure for automated classification of epileptic EEG signals', Applied Sciences, vol. 7(4), 385, pages: 18, April 2017.
19. A.K. Tiwari, V. Kanhangad, and R.B. Pachori, 'Histogram refinement for texture descriptor based image retrieval', Signal Processing: Image Communication, vol. 53, pp. 73-85, April 2017.

**Conference Papers:**

1. A. Bhattacharyya, L. Singh, and R.B. Pachori, 'Identification of epileptic seizures from scalp EEG signals based on TQWT', International Conference on Machine Intelligence and Signal Processing, December 22-24, 2017, Indore, India.
2. S. Shah, M. Sharma, D. Deb, and R.B. Pachori, 'An automated alcoholism detection using orthogonal wavelet filter bank', International Conference on Machine Intelligence and Signal Processing, December 22-24, 2017, Indore, India.
3. M. Sharma, P. Sharma, R.B. Pachori, and V.M. Gadre, 'Double density dual-tree complex wavelet transform based features for automated screening of knee-joint vibroarthrographic signals', International Conference on Machine Intelligence and Signal Processing, December 22-24, 2017, Indore, India.

4. R.R. Sharma, M. Kumar, and R.B. Pachori, 'Automated CAD identification system using time-frequency representation based on eigenvalue decomposition of ECG signals', International Conference on Machine Intelligence and Signal Processing, December 22-24, 2017, Indore, India.
5. R.R. Sharma, P. Chandra, and R.B. Pachori, 'Electromyogram signal analysis using eigenvalue decomposition of the Hankel matrix', International Conference on Machine Intelligence and Signal Processing, December 22-24, 2017, Indore, India.
6. M. Dalal, M. Tanveer, and R.B. Pachori, 'Automated identification system for focal EEG signals using fractal dimension of FAWT based sub-bands signals', International Conference on Machine Intelligence and Signal Processing, December 22-24, 2017, Indore, India.
7. V. Gupta and R.B. Pachori, 'A new method for classification of focal and non-focal EEG signals', International Conference on Machine Intelligence and Signal Processing, December 22-24, 2017, Indore, India.
8. D. Bhati, R.B. Pachori, and V.M. Gadre, 'Optimal design of three-band orthogonal wavelet filter bank with stopband energy for identification of epileptic seizure EEG signals', International Conference on Machine Intelligence and Signal Processing, December 22-24, 2017, Indore, India.
9. P. Gaur, G. Kaushik, R.B. Pachori, H. Wang, and G. Prasad, 'Comparison analysis: single and multichannel EMD based filtering with application to BCI', International Conference on Machine Intelligence and Signal Processing, December 22-24, 2017, Indore, India.
10. A. Bhattacharyya, V. Gupta and R.B. Pachori, 'Automated identification of epileptic seizure EEG signals using empirical wavelet transform based Hilbert marginal spectrum', 22nd International Conference on Digital Signal Processing, August 23-25, London, United Kingdom.
11. V. Gupta, A. Bhattacharyya, and R.B. Pachori, 'Classification of seizure and non-seizure EEG signals based on EMD-TQWT method', 22nd International Conference on Digital Signal Processing, August 23-25, London, United Kingdom.
12. M. Sharma, R.B. Pachori, and V.M. Gadre, 'A novel class of optimal time-frequency localized biorthogonal wavelet filter banks for automated identification of epileptic seizures', International Symposium on Computational Mathematics, Optimization, and Computational Intelligence (CMOCI 2017), July 17 - 19, 2017, IIT Indore, Indore, India.(Abstract).
13. M. Tanveer, R.B. Pachori, and D. Mamta, 'Automated detection of EEG signal based on flexible analytic wavelet transform with an optimal signal length', International Symposium on Computational Mathematics, Optimization, and Computational Intelligence (CMOCI 2017), July 17 - 19, 2017, IIT Indore, Indore, India. (Abstract).

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**Dr. Shaibal Mukherjee**

Associate Professor

shaibal@iiti.ac.in

Ph.D.: University of Oklahoma, USA

Post-doctoral research: Northwestern University, USA

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.

In light of his acclaimed research at IIT Indore, Dr. Mukherjee has recently been awarded the prestigious 2018 Materials Research Society of India (MRSI) Medal and the Young Faculty Research Fellowship (YFRF) under Visvesvaraya Ph.D. Scheme for Electronics and Information Technology, Ministry of Electronics and Information Technology (MeitY). He has been awarded the prestigious 2017 Bhaskara Advanced Solar Energy (BASE) Fellowship of Indo-US Science and Technology Forum (IUSSTF) and DST.

Dr. Mukherjee's research group has published in 48 peer-reviewed journals, 55 proceedings in international conferences, and 5 book chapters. Moreover, Dr. Mukherjee's group has filed 3 Indian patent applications.

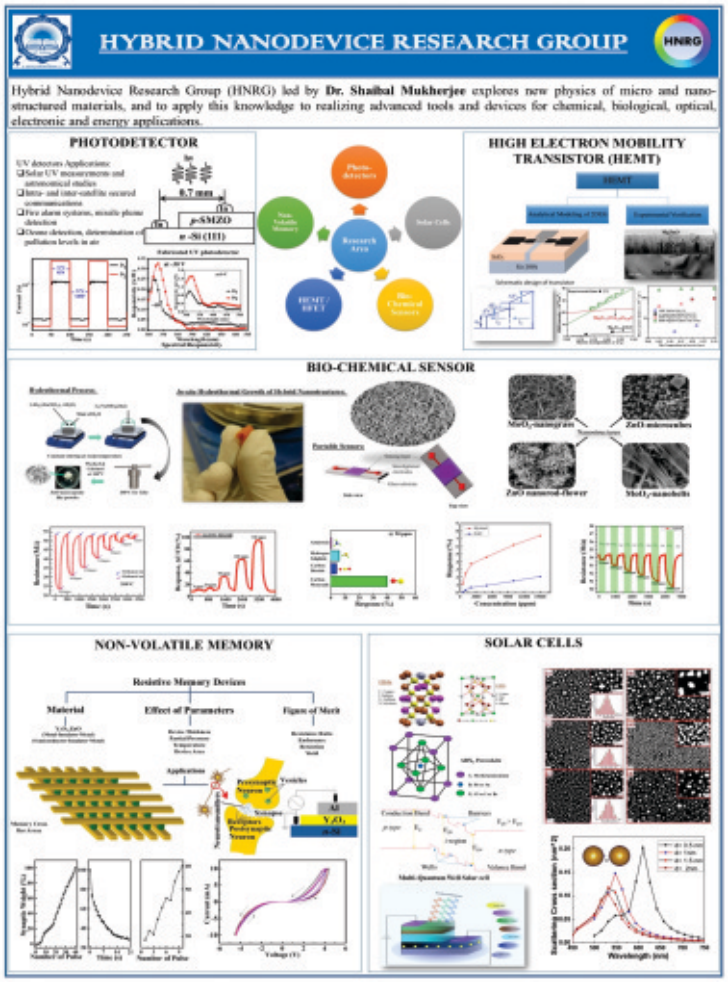
Till date, Dr. Mukherjee has successfully completed 6 externally funded research projects from DST and CSIR and is currently associated with 8 projects from DST, CSIR, DST Indo-Russia, DST Indo-USA, DST Indo-Taiwan, DAE-BRNS, and CEERI Pilani-IIT Indore. The total research grant from external funding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

6 Ph.D. students have graduated from HNRG group under his supervision. Successful Ph.D's from HNRG have been placed at IIT Patna, IIT Ropar, IIIT Pune, and IIIT Una. Currently, 13 students are completing their doctoral research work,and1 student is completing his B.Tech. Project work under his supervision.

Research group website: http://iiti.ac.in/people/~shaibal/

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

(a) Optoelectronic devices such as LED/ Photodetectors; (b) Next-generation Photovoltaic, (c) Bio-chemical Sensors for toxic gas and chemical sensing in water and atmosphere, (d) HFET/HEMT/RF devices for Space and Defence Applications, (e) RRAM/Synapse for Neural Network, Hardware Security, and Universal Memory Applications.




HNRG has been vigorously engaged in strong collaborative research activities with eminent researchers, scientists, and experts from industries and institutions in India (IISc Bangalore, IIT Bombay, CEERI Pilani, RRCAT, and M/s. Fourvac Technologies)and abroad-RMIT (Australia), Oak Ridge National Laboratory (USA), University of Oklahoma (USA), Novosibirsk State University (Russia), Shinshu University (Japan), Karlsruhe Institute of Technology (Germany), and M/s. Elettrorava spa (Italy).

Presently, Dr. Mukherjee has 13 students pursuing their doctoral research work under his supervision. One has graduated, and four have enrolled in the PhD. program during the year, 2017-18.

Dr. Mukherjee's contribution towards holding workshop and seminars during the year 2017-18 are:

1. Technical Program Committee Member of 21st Edition of VLSI Design and Test Conference (VDAT-2017), IIT Roorkee, June 29 – July 2, 2017.
2. Organizing Committee Member of Thematic Workshop and Call for CRS Research Proposals on Techniques and Instrumentation in Materials Research (TIMR), August 21-22, 2017.

**His contribution to research through international collaborations:**

- Mr. Brajendra S. Sengar (doctoral student under the supervision of Mukherjee) has been associated with University of Nevada, Las Vegas, USA for his research work during March-June, 2018 under the 2018 Bhaskara Advanced Solar Energy (BASE) Internship Award program supported by DST and the Indo-U.S. Science and Technology Forum (IUSSTF).
- Associated with Oak Ridge National Laboratory, USA for his research work during January-April, 2018 under 2017 Bhaskara Advanced Solar Energy (BASE) Fellowship Award program supported by DST and the Indo-U.S. Science and Technology Forum (IUSSTF).
- Collaborated with the Rzhanov Institute of Semiconductor Physics, Russia for his research work in 2017-2018 under the current DST-RFBR Project in the India-Russia Programme of Cooperation in Science and Technology.
- Collaborated with CSIR CEERI Pilani for his research work in 2017-18 under CEERI Pilani – IIT Indore joint research activity program.
- Associated with Shinshu University, Japan for collaborative research activities during 2017-18.
- Associated with RMIT University, Australia for collaborative research activities during 2017-18.

**Research work conducted by Dr. Mukherjee's group has been nationally and internationally recognised and awarded:**

- Recipient of the prestigious Materials Research Society of India (MRSI) Medal for 2018.
- 2018 Bhaskara Advanced Solar Energy (BASE) Internship Award received by Mr. Brajendra S. Sengar (Ph.D. student working under the supervision of Dr. Mukherjee) under the program supported by Department of Science and Technology, Government of India and the Indo-U.S. Science and Technology Forum (IUSSTF).
- Recipient of 2017 Bhaskara Advanced Solar Energy (BASE) Fellowship Award under the program supported by Department of Science and Technology, Govt. of India, and the Indo-U.S. Science and Technology Forum (IUSSTF)
- Recipient of Young Faculty Research Fellowship (YFRF) under Visvesvaraya Ph.D. Scheme for Electronics and Information Technology, Ministry of Electronics and Information Technology (MeitY)
- Best Presentation Award in 6th International Symposium on Integrated Functionalities, India on December 10-13, 2017 is awarded to Mr. Amitesh Kumar (Ph.D. student working under the supervision of Dr. Mukherjee)
- Young Researcher Award is given to Mr. Pankaj Sharma (Graduated Ph.D. student under the supervision of Dr. Mukherjee) for Outstanding Work presented in 3rd International Conference on Smart Materials and Structures, Florida, USA, 2017
- 2017 Recognition for Outstanding Work from The International Precious Metals Institute (IPMI), Inc., USA to Mr. Vivek Garg (Ph.D. student working under the supervision of Dr. Mukherjee)
- CSIR International Travel Support awarded to Mr. Brajendra S. Sengar (Ph.D. student working under the supervision of Dr. Mukherjee) to attend and present a paper in 33rd European PV Solar Energy Conference and Exhibition held in Amsterdam, Netherlands, September 25-29, 2017
- DST International Travel Support awarded to Mr. Vivek Garg (Ph.D. student working under the supervision of Dr. Mukherjee) to attend and present a paper in 33rd European PV Solar Energy Conference and Exhibition held in Amsterdam, Netherlands, September 25-29, 2017
- CSIR International Travel Support awarded to Mr. Vivek Garg (Ph.D. student working under the supervision of Dr. Mukherjee) to attend and present a paper in 44th IEEE Photovoltaic Specialists Conference held in Washington D.C., USA, June 25-30, 2017
- CSIR International Travel Support awarded to Mr. Pankaj Sharma (Ph.D. student under the supervision of Dr. Shaibal Mukherjee) to attend and present a paper in 3rd International Conference on Smart Materials and Structures held in Orlando, Florida, USA, March 20-22, 2017

Dr. Mukherjee has been engaged in the role of Reviewer, Editorial Board member, Technical Expert in 2017-18:

**Professional Activities:**

**Reviewer**

Microelectronics Journal, Elsevier
Applied Physics Letters, American Institute of Physics (AIP)
Journal of Applied Physics, AIP
Journal of Microelectronic Engineering, Elsevier
Journal of Alloys and Compounds, Elsevier
Journal of Crystal Growth, Elsevier
Materials Letters, Elsevier
Applied Surface Science, Elsevier
Journal of Surface and Coatings Technology, Elsevier
Journal of Electronic Materials, Springer
Journal of Materials Science: Materials in Electronics, Springer
Langmuir, American Chemical Society (ACS)
Applied Materials and Interfaces, ACS
Journal of Materials Chemistry C, Royal Society of Chemistry (RSC)
Nanotechnology, Institute of Physics (IoP)
Journal of Physics: Condensed Matter, IoP
Materials Research Express, IoP IEEE Photonics Technology Letters
Journal of Electronics Cooling and Thermal Control, Scientific Research

**Editorial Board Member**

Journal of Electronics Cooling and Thermal Control, Scientific Research

**Technical Expert**

Department of Scientific Programs, Shota Rustaveli National Science Foundation (SRNSF), Georgia, USA
Leading Research Program (LRP), National Research Foundation (NRF), Korea Central Power Research Institute (CPRI), Government of India
Science and Engineering Research Board (SERB), DST, Government of India
Recruitment and Assessment Centre (RAC), Defence Research and Development Organisation (DRDO) under the Department of Defence Research and Development of Ministry of Defence, Government of India
Institute Representative (IR) from IIT Indore for 2017 and 2018 JEE examinations

**Affiliation to Professional Organizations**

- Life Member, MRSI
- Life Member, OSI
- Member, OSA
- Member, IEEE

The research work of HNRG has been funded by several external government funding agencies and industries. The summary is mentioned below:

**Sponsored Research Grant from External Funding Agency**

- Completed projects: 5 as Principle Investigator and 1 as co-Principle Investigator
- Running projects: 4 as Principle Investigator and 3 as co-Principle Investigator
- Total grant from external research agency: >INR 5 Crores

The summary of manpower development under the supervision of Dr. Mukherjee in cutting-edge research activities in various aspects of VLSI and Nanoelectronics is mentioned below:

**Manpower Development (Ph.D., M.Tech., B.Tech. Supervision)**

- Number of Ph.D. students graduated under supervision: 6
- Number of current Ph.D. students under supervision: 13
- Number of completed M.Tech projects graduated under supervision: 2
- Number of completed B.Tech. projects under supervision: 3

**Publications:**

His research in 2017-18 has led to publications in 12 peer reviewed journals, 18 conference proceedings/invited talks and 4 book chapters. He has published in ACS Applied Materials and Interfaces; a journal with an impact factor of 8.097.

**Book Chapters:**

1. Pankaj Kumar and Shaibal Mukherjee, "Recent advances in ZnO based Ultraviolet Photodetectors" In: Saleem Hashmi (editor-in-chief), *Reference Module in Materials Science and Materials Engineering*. Oxford: Elsevier; 2018. pp. 1-12, ISBN: 978-0-12-803581-8, 2018.
2. Amitesh Kumar, Mangal Das, and Shaibal Mukherjee, "Oxide based memristors: fabrication, mechanism, and application" In: Saleem Hashmi (editor-in-chief), *Reference Module in Materials Science and Materials Engineering*. Oxford: Elsevier; 2018. pp. 1-17, ISBN: 978-0-12-803581-8, 2018.
3. Md Arif Khan, Rohit Singh, and Shaibal Mukherjee, "Review of II-VI Based Compounds for Transistor Applications" In: Saleem Hashmi (editor-in-chief), *Reference Module in Materials Science and Materials Engineering*. Oxford: Elsevier, accepted, March 2018.
4. Vivek Garg, Brajendra S. Sengar, and Shaibal Mukherjee, "A review on sputtered chalcopyrite and kesterite thin film solar cell" In: Saleem Hashmi (editor-in-chief), *Reference Module in Materials Science and Materials Engineering*. Oxford: Elsevier; 2018. pp. 1-15, ISBN: 978-0-12-803581-8, 2018.

**Peer-Reviewed Journals:**

1. Vivek Garg, Brajendra S. Sengar, Vishnu Awasthi, Amitesh Kumar, Rohit Singh, Shailendra Kumar, C. Mukherjee, V. V. Atuchin, and Shaibal Mukherjee, 'Investigation of dual-ion beam sputter-instigated plasmon generation in TCOs: A case study of GZO, ACS Applied Materials and Interfaces', vol. 10, pp. 5464−5474, January 22, 2018. (Impact factor: 8.097)
2. Rohit Singh, Md Arif Khan, Pankaj Sharma, Myo Than Htay, Abhinav Kranti, and Shaibal Mukherjee, 'Two dimensional electron gases in MgZnO/ZnO and ZnO/MgZnO/ ZnOheterostructures grown by dual ion beam sputtering', Journal of Physics D: Applied Physics, vol. 51, no. 13, pp. 1-7, February 22, 2018. (Impact factor: 2.373)
3. Ritesh Bhardwaj, Pankaj Sharma, Rohit Singh, Mukul Gupta, and Shaibal Mukherjee, 'High responsivity MgxZn1-xO based ultraviolet photodetector fabricated by dual ion beam sputtering', IEEE Sensors Journal, vol. 18, no. 7, pp. 2744-2750, March 2018. (Impact factor: 2.512)
4. Biswajit Mandal, Aaryashree, Rohit Singh, and Shaibal Mukherjee,' Highly selective and sensitive methanol sensor using rose-like ZnOmicrocube and MoO3 micrograss based composite', IEEE Sensors Journal, vol. 18, no. 7, pp. 2659-2666, March 2018. (Impact factor: 2.512)
5. Mangal Das, Amitesh Kumar, Rohit Singh, Myo Than Htay and Shaibal Mukherjee, 'Realization of synaptic learning and memory functions in Y2O3 based memristive device fabricated by dual ion beam sputtering', Nanotechnology, vol. 29, no. 055203, pp. 1-9, January 5, 2018. (Impact factor: 3.404)
6. Pankaj Sharma, Ritesh Bhardwaj, Amitesh Kumar, and Shaibal Mukherjee, 'Trap assisted charge multiplication enhanced photoresponse of Li-P codoped p-ZnO/n-Si heterojunction ultraviolet

photodetectors', Journal of Physics D: Applied Physics, vol. 51, no. 015103, December 1, 2017. (Impact factor: 2.373)

7. Pankaj Sharma, Ritesh Bhardwaj, Rohit Singh, Shailendra Kumar, and Shaibal Mukherjee, 'Investigation of formation mechanism of Li-P dual-acceptor doped p-type ZnO', Applied Physics Letters, vol. 111, no. 091604, pp. 1-4, August 30, 2017. (Impact factor: 3.495)
8. Ritesh Bhardwaj, Pankaj Sharma, Rohit Singh, and Shaibal Mukherjee,' Sb- doped p-MgZnO/n-Si heterojunction UV photodetector fabricated by dual ion beam sputtering', IEEE Photonics Technology Letters, vol. 19, no. 14, pp. 1215-1218, July 15, 2017. (Impact factor: 2.375)
9. Rohit Singh, Md Arif Khan, Shaibal Mukherjee, and Abhinav Kranti, 'Analytical model for 2DEG density in graded MgZnO/ ZnOheterostructures with cap layer, IEEE Transactions on Electron Devices', vol. 64, issue 9, pp. 3661-3667, July 11, 2017. (Impact factor: 2.605)
10. Aaryashree, Pankaj Sharma, Biswajit Mandal, Ankan Biswas, Manoj K Manna, Sayan Maiti, Apurba K Das, and Shaibal Mukherjee,' Synergetic accrual of lamellar nano-hybrids for band-selective photodetection', Journal of Physical Chemistry C, vol. 121, no. 26, pp 14037-14044, June 16, 2017. (Impact factor: 4.484)
11. Amitesh Kumar, Mangal Das, Vivek Garg, Brajendra S. Sengar, Myo Than Htay, Shailendra Kumar, Abhinav Kranti, and Shaibal Mukherjee, 'Forming-free high-endurance Al/ZnO/Al memristor fabricated by dual ion beam sputtering', Applied Physics Letters, vol. 110, no. 253509, pp. 1-5, June 22, 2017. (Impact factor: 3.495)
12. Pankaj Sharma, Aaryashree, Vivek Garg, and Shaibal Mukherjee, 'Optoelectronic properties of phosphorus doped p-type ZnO films grown by dual ion beam sputtering', Journal of Applied Physics, vol. 121, no. 225306, pp. 1-9, June 12, 2017. (Impact factor: 2.176)

**Conference Proceedings:**

1. Ritesh Bhardwaj, Pankaj Sharma, MdArif Khan, Rohit Singh, and Shaibal Mukherjee, Dual ion beam sputtering grown MgZnO based UV heterojunctionphotodetector, 6th International Symposium on Integrated Functionalities, Shangri-La's Eros Hotel, Delhi, India, December 10-13, 2017.
2. Aaryashree, Biswajit Mandal, Rohit K Jadhav, Mangal Das, Apurba K Das, and Shaibal Mukherjee, Study of ZnO-Oligophenylenevinylenenano-hybrid for Optoelectronic Applications, 6th International Symposium on Integrated Functionalities, Shangri-La's Eros Hotel, Delhi, India, December 10-13, 2017.
3. Biswajit Mandal, Aaryashree, Mangal Das, and Shaibal Mukherjee, Synthesis of micrograss like α-MoO3 and their enhance ethanol sensing performance, 6th International Symposium on Integrated Functionalities, Shangri-La's Eros Hotel, Delhi, India, December 10-13, 2017.
4. Mangal Das, Amitesh Kumar, Biswajit Mandal, and Shaibal Mukherjee, Influence of Deposition Temperature on Memristance in n-Si/Y2O3/Al Structure, 6thInternational Symposium on Integrated Functionalities, Shangri-La's Eros Hotel, Delhi, India, December 10-13, 2017.
5. Md Arif Khan, Rohit Singh, Ritesh Bhardwaj, Abhinav Kranti and Shaibal Mukherjee, Cadmium Alloyed Buffer Layer ZnO Enhances Sheet Charge Density in nO Based Heterostructure Grown by Dual Ion Beam Sputtering, 6th International Symposium on Integrated Functionalities, Shangri-La's Eros Hotel, Delhi, December 10-13, 2017.
6. Rohit Singh, Md Arif Khan, Ritesh Bhardwaj, Abhinav Kranti, and Shaibal Mukherjee, 2DEG Density in Dual Ion Beam Sputtering Grown ZnO Based Heterostructures,6th International Symposium on Integrated Functionalities, Shangri-La's Eros Hotel, Delhi, India, December 10-13, 2017.
7. Amitesh Kumar, Mangal Das, Rohit Singh, Md Arif Khan, Biswajit Mandal, Abhinav Kranti, and Shaibal Mukherjee, ZnO based resistive switching memory fabricated by Dual Ion Beam Sputtering with excellent endurance, 6th International Symposium on Integrated Functionalities, Shangri-La's Eros Hotel, December 10-13, 2017.

8. Vivek Garg, Brajendra S. Sengar, Nisheka Anadkat, Gaurav Siddharth, Shailendra Kumar, and Shaibal Mukherjee, Evaluation of Ga: MgZnO/CIGSeheterojunction for realization of all sputtered buffer-less solar cell, 19th International Workshop on The Physics of Semiconductor Devices (19th IWPSD), IIT Delhi, December 11-15, 2017.
9. Ritesh Bhardwaj, Pankaj Sharma, Md Arif Khan, Rohit Singh, and Shaibal Mukherjee, MgZnO based UV heterojunctionphotodetector fabricated using dual ion beam sputtering, 19th International Workshop on The Physics of Semiconductor Devices (19th IWPSD), IIT Delhi, India, December 11-15, 2017.
10. Rohit Singh, Md Arif Khan, Pankaj Sharma, Abhinav Kranti, and Shaibal Mukherjee, Variation of 2DEG density in DIBS-grown MgZnO/ZnO and ZnO/MgZnO/ZnOheterostructures, 19th International Workshop on The Physics of Semiconductor Devices (19th IWPSD), IIT Delhi, December 11-15, 2017.
11. Md Arif Khan, Rohit Singh, Ritesh Bhardwaj, Abhinav Kranti, and Shaibal Mukherjee, Enhanced sheet carrier density in ZnO based heterostructure by alloying cadmium in buffer layer ZnO, 19th International Workshop on The Physics of Semiconductor Devices (19th IWPSD), IIT Delhi, India, December 11-15, 2017.
12. Mangal Das, Amitesh Kumar, Biswajit Mandal, and Shaibal Mukherjee, Influence of crystallinity on memristance in n-Si/Y2O3/Al structure, 19th International Workshop on The Physics of Semiconductor Devices (19th IWPSD), IIT Delhi, December 11-15, 2017.
13. Biswajit Mandal, Aaryashree, Mangal Das, and Shaibal Mukherjee, Synthesis of high crystalline nanobelt like α-MoO3 and their alcohol sensing performance, 19th International Workshop on The Physics of Semiconductor Devices (19th IWPSD), IIT Delhi, December 11-15, 2017.
14. Aaryashree, Biswajit Mandal, Rohit G Jadhav, Apurba K Das, and Shaibal Mukherjee, Molar concentration variation in hydrothermal growth for highly porous Zn-BTC metal organic framework, 19th International Workshop on The Physics of Semiconductor Devices (19th IWPSD), IIT Delhi, December 11-15, 2017.
15. Amitesh Kumar, Mangal Das, Pankaj Sharma, Ritesh Bhardwaj, Abhinav Kranti, and Shaibal Mukherjee, Al/ZnO/Al memristor fabricated by Dual Ion Beam Sputtering with excellent endurance and retention, 19th International Workshop on The Physics of Semiconductor Devices (19th IWPSD), IIT Delhi, December 11-15, 2017.
16. Vivek Garg, Brajendra S. Sengar, Vishnu Awasthi, Shailendra Kumar, and Shaibal Mukherjee, Sputter-Instigated Plasmonic Features in TCO for Ultrathin Photovoltaics: a Case Study for Ga-Doped ZnO, 33rd European PV Solar Energy Conference and Exhibition, Amsterdam, Netherlands, September 25-29, 2017.
17. Brajendra S. Sengar, Vivek Garg, Vishnu Awasthi, Shailendra Kumar, and Shaibal Mukherjee, Effect of Cu Deficiency on the Optical Properties of Dual Ion Beam Sputtered CZTSSe Thin Film, 33rd European PV Solar Energy Conference and Exhibition, Amsterdam, Netherlands, September 25-29, 2017.
18. Vivek Garg, Brajendra S. Sengar, Vishnu Awasthi, Shailendra Kumar, and Shaibal Mukherjee, Dual ion beam sputtered TCO thin films: Sputter-instigated plasmonic features for ultrathin photovoltaics, 44th IEEE Photovoltaic Specialists Conference, Washington D.C., USA, June 25-30, 2017.

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

**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.

**Publications:**

During the year 2017-18, Dr. Vasudevan has published two journal papers in his research areas:

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. Abhijeet Gorey, Deblina Biswas, Anshu Kumari, Sharad Gupta, Norman Sharma, George C. K. Chen, Srivathsan Vasudevan, Application of continuous-wave photoacoustic sensing to red blood cell morphology, Lasers in Medical Science, Article in Press.

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**Dr. Santosh Kumar Vishvakarma**
Associate Professor
skvishvakarma@iiti.ac.in

**Dr. Santosh Kumar Vishvakarma** has been awarded his primary degrees in Electrical science: his Bachelor's (1999) from the University of Gorakhpur; Master's (2001) from Devi Ahilaya Vishvidayalaya, Indore; and, M.Tech. in Microelectronics from Panjab University Chandigarh (2003).

He has obtained his Ph.D. from the Indian Institute of Technology, Roorkee (IITR) 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. During his post-doc tenure, he developed the analytical compact model of Multigate MOSFET especially Square and Circular cross-section GAA MOSFET.

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 goals and research focuses include the design, simulation, and implementation of the Low Power, Secure and Highly reliable Circuits and System design for IoT Applications. Works in the following areas are:

- Microcontroller Design
- PLL Design for
- Secure IC Design
- Custom SoC Design

During the year 2017-18, 6 doctoral students have graduated under his supervision. 1 has submitted his thesis and 13 are involved in ongoing research.

He has been engaged in the following collaborative works during the year 2017-18:

| | | |
|---|---|---|
| Funding Agency | : | IIT Indore and CEERI Pilani, Rajasthan, India |
| Project Title | : | Internet of Things (IoT) Enabled Portable Water Quality Monitoring System. |
| Investigators | : | Dr. S. K. Vishvakarma (Principal Investigator), Dr. Ajay K. Kushwaha (Co-PI), Dr. Hem Chandra Jha (Co-PI) : Dr. Jai Gopal Pandey, Principal Investigator & Senior Scientist, IC Design Group |
| Amount | : | INR 6 Lakhs |
| Duration | : | 1 Year (April 2017 - March 2018) |
| Funding Agency | : | National Project Implementation Unit (A Unit of MHRD, Govt of India for Implementation of World Bank Assisted Projects in Technical Education. |

## Publications:

During the year 2017-18, he has published 30 Journal papers and 14 conference papers.

1. Ambika Prasad Shah, Nandakishor Yadav, Ankur Beohar, Santosh Kumar Vishvakarma, "SUBHDIP: Process Variations Tolerant Subthreshold Darlington Pair Based NBTI Sensor Circuit," IET Computers & Digital Techniques (Accepted).
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, Aug. 2018 (Early Access).
3. Pooja Bohara and Santosh Kumar Vishvakarma, "Self-Amplified Tunneling Based SONOS Flash Memory Device with Improved Performance, " IEEE Transactions on Electron Devices (Early Access).
4. Bhupendra Singh Reniwal, Vikas Vijayvargiya, Pooran Singh Reniwal, Nandkishor Yadav, Santosh Kumar Vishvakarma and Devesh Dwivedi, "An Auto Calibrated Sense Amplifier with Offset Prediction Approach for Energy Efficient SRAM, "Circuits, Systems & Signal Processing (CSSP), Springer (Accepted).
5. Vishal Sharma, Maisagalla Gopal, Pooran Singh, S. K. Vishvakarma and Shailesh Singh Chouhan, "A Robust, Ultra Low-Power, Data-Dependent-Power-Supplied 11T SRAM Cell with Expanded Read/Write Stabilities for Internet-of-Things Applications," Analog Integrated Circuits and Signal Processing, Springer, pp 1-16, Aug, 2018.
6. Vishal Sharma, Santosh Kumar Vishvakarma, Shailesh Singh Chouhan and Kari Halonen, "A Write-Improved Low-Power 12T SRAM Cell for Wearable Wireless Sensor Nodes" International Journal of Circuit Theory and Applications, Wiley, Aug, 2018.
7. Ankur Beohar, Nandakishor Yadav, Ambika Prasad Shah and Santosh Kumar Vishvakarma, "Analog/RF attributes of 3D-Cyl underlap GAA-TFET based on Ge-Source using fringing field engineering for low power applications, " Journal of Computational Electronics, Springer, July 2018.
8. Ambika Prasad Shah, Nandakishor Yadav, Ankur Beohar, Santosh Kumar Vishvakarma, "An Efficient NBTI Sensor and Compensation Circuit for Stable and Reliable SRAM Cells," Microelectronics Reliability, Elsevier, Vol. 87, pp 15-23, August 2018.
9. Ambika Prasad Shah, Nandakishor Yadav, Ankur Beohar and Santosh Kumar Vishvakarma, "NMOS Only Schmitt Trigger Circuit for NBTI Resilient CMOS Circuits," IET Electronics Letter, Vol. 54 No. 14 pp. 868–870, July 2018.

10. Maisagalla Gopal, Atul Awadhiya, Nandakishor Yadav, Santosh Kumar Vishvakarma and Vaibhav Neema, “Impact of Varying Carbon Concentration in SiC S/D Asymmetric Dual-k Spacer for High Performance and Reliable FinFET", Journal of Semiconductors (in the press, available online).
11. Pooran Singh and Santosh Kumar Vishvakarma, "Ultra Low Power-High Stability, Positive Feedback Controlled (PFC) 10T SRAM cell for Look up Table (LUT) Design, "Integration, the VLSI Journal, vol 62, pp 1-13, June 2018.
12. Divya Yadav, Shailesh Singh Chouhan, Santosh Kumar Vishvakarma and Balwinder Raj, "Application Specific Microcontroller Design for IoT based WSN”, Sensor Letter, American Scientific Publishers, USA, vol. 16, no. 5, pp. 374–385, May 2018.
13. Vishal Sharma, Maisagalla Gopal, Pooran Singh and Santosh Kumar Vishvakarma, “A 220 mV Robust Read-Decoupled Partial Feedback Cutting based Low-Leakage 9T SRAM for Internet of Things (IoT) Applications,” International Journal of Electronics and Communications, Elsevier, vol. 87, pp. 144-157, April 2018.
14. Ambika Prasad Shah, Nandakishor Yadav, Ankur Beohar, and Santosh Kumar Vishvakarma, “On-chip Adaptive Body Bias for Reducing the Impact of NBTI on 6T SRAM Cells,” IEEE Transactions on Semiconductor Manufacturing, vol. 31, issue 2, pp. 242-249, May 2018.
15. Pooran Singh and Santosh Kumar Vishvakarma, " Ultra Low Power High Stability 8T SRAM for Application in Object Tracking System", IEEE Access, Vol. 6, pp. 2279 - 2290, 2018.
16. Abhishek Upadhyay, Ajay Kushwaha and Santosh Kumar Vishvakarma, " A Unified Scalable Quasi-Ballistic Transport Model of GFET for Circuit Simulations", IEEE Transactions on Electron Devices, issue 2, Vol. 65, pp. 739 - 746, Feb. 2018.
17. Maisagalla Gopal, Vishal Sharma and Santosh Kumar Vishvakarma, " SiGe Asymmetric Dual-k Spacer FinFETs-based 6T SRAM Cell to Mitigate Read-Write Conflict", Journal of Nanoelectronics and Optoelectronics (JNO), ASP, vol. 13, no. 4, pp 467-471, April 2018.
18. Shradhya Singh, S. K. Vishvakarma and Balwinder Raj, "Analytical Modeling of Split-Gate Junction-Less Transistor for a Biosensor Application”, Sensing and Bio-sensing, Elsevier, vol. 18, pp. 31-36, April 2018.
19. S. Mishra, P.S Londhe, M. Santhakumar, S.K. Vishvakarma, B.M Patre, “Task space motion control of a mobile manipulator using a nonlinear PID control along with an uncertainty estimator "in Special issue on Advancements in Automation, Robotics and Sensing - Computers and Electrical Engineering by Elsevier - An International Journal , Vol. 67, pp. 729-740, April 2018.
20. Pooran Singh and S. K. Vishvakarma, “Ultra low power process tolerant 10T (PT10T) SRAM with improved read/write ability for internet of things (IoT) applications," Journal of Low Power Electronics and Applications, vol. 7, no. 3, 24, pp. 1-22, Sept. 2017.
21. Maisagalla Gopal, Vishal Sharma and Santosh Kumar Vishvakarma, "Evaluation of Static Noise Margin (SNM) of 6T SRAM Cell using SiGe/SiC Asymmetric Dual-k Spacer FinFETs", IET Micro & Nano Letters, Vol. 12, Issues 12, pp. 1028-1032, December 2017.
22. Abhishek Upadhyay, Nitesh Chauhan and S.K. Vishvakarma, "A Compact Electrical Modeling for Top-Gated Doped Graphene Field-Effect Transistor", IETE Journal of Research, Taylor & Francis, Aug. 2017.
23. Ankur Beohar, Nanada Kishor Yadav and Santosh Kumar Vishvakarma, "Analysis of trap assisted tunneling in asymmetrical underlap 3D-cylindrical GAA-TFET based on hetero-spacer engineering for improved device reliability," IET Micro & Nano Letters, Vol. 12, Issues 12, pp. 982-986, December 2017.
24. Pooran Singh and S. K. Vishvakarma “Low Complexity-Low Power Object Tracking Using Dynamic Quad-tree Pixelation and Macro-block Resizing,” Pattern Recognition and Image Analysis, Springer, vol 27, issue 4, pp 731-739, Oct 2017.

25. Nandakishor Yadav, Ambika Prasad Shah and Santosh Kumar Vishvakarma, " Stable, Reliable and Bit-Interleaving 12T SRAM for Space Applications: A Device Circuit Co-design," IEEE Transactions on Semiconductor Manufacturing, issue 99, June 2017.
26. Vikas Vijayvargiya, Bhupendra Reniwal, Pooran Singh, Santosh Kumar Vishvakarma, "Impact of Device Engineering on Analog/RF Performances of Tunnel Field Effect Transistor", Semiconductor Science and Technology, IOP Science, Vol 32, No. 6, May 2017.
27. Pooran Singh, B. S. Reniwal, V. Vijayvargiya, Vishal Sharma and S. K. Vishvakarma, " Dynamic feedback controlled static random access memory for low power applications", Journal of Low Power Electronics, Vol. 13, No. 1, pp. 47-59 (13), March 2017, ASP, USA.
28. S. K. Vishvakarma, Ankur Beohar, Vikas Vijayvargiya and Priyal Trivedi, "Analysis of DC and Analog/RF performance on Cyl-GAA-TFET using distinct device geometry", Journal of Semiconductors, IOPscience, vol. 38, no. 7, pp. 074003- 1-5, July 2017.
29. Deepika Gupta and S. K. Vishvakarma, "Improvement of Short Channel Performance of Junction-Free Charge Trapping 3D NAND Flash Memory " IET Micro & Nano Letters, Vol. 12, Issues 1, pp. 64-68, 2017.
30. B. S. Reniwala, Praneet Bhatiab and S. K. Vishvakarma, "Design and Investigation of Variability Aware Sense Amplifier for Low Power, High Speed SRAM, " Microelectronics Journal, Elsevier, Vol. 59, pp. 22-32, Jan 2017.

**Conference Papers:**

1. Vishal Sharma, Pranshu Bisht, Abhishek Dalal, Shailesh Singh Chouhan, H. S. Jattana and Santosh Kumar Vishvakarma, "A Write-Improved Half-Select-Free Low-Power 11T Subthreshold SRAM with Double Adjacent Error Correction for FPGA-LUT Design" 22nd Symposium on VLSI Design and Test, Madurai, India June 28-30, 2018.
2. Jai Gopal Pandey, Mausam Nayak, Tarun Goel, Chhavi Mitharwal, Sajid Khan, Santosh Kumar Vishvakarma, Abhijit Karmakar and Raj Singh, "A VLSI Architecture for PRESENT Lightweight Cipher with FPGA and ASIC Implementations", 22nd Symposium on VLSI Design and Test, Madurai, India June 28-30, 2018.
3. Japa Aditya, T. Nagateja, Santosh Kumar Vishvakarma, Palagani Yellappa, Jun Rim Choi, and Ramesh Vaddi, " Tunneling Field Effect Transistors for Enhancing Energy Efficiency and Hardware Security of IoT Platforms: Challenges and Opportunities", 2018 International Symposium on Circuits and Systems (ISCAS)-2018, Florence, Italy, May 27-30, 2018.
4. Bhupendra Reniwal and S. K. Vishvakarma, " Variability Aware Design of Energy Efficient SRAM in Conventional & Non-Conventional MOS Technologies: A Sense Amplifier Perspective" 31st International Conference on VLSI Design and 17th International Conference on Embedded Systems, Pune, India, Jan 8-10, 2018.
5. Ambika Prasad Shah, Nandakishor Yadav, Ankur Beohar and S. K. Vishvakarma, "On-Chip NBTI Sensor Circuits for Stable and Reliable CMOS Circuits, "31st International Conference on VLSI Design and 17th International Conference on Embedded Systems, Pune, India, Jan 8-10, 2018.
6. Garima Shukla, Abhishek Kumar Upadhyay and S.K. Vishvakarma, " Effect of Back Gate Voltage on Double Gate Single Layer Graphene Field-Effect Transistor with Improved ION," 19th International Workshop on Physics of Semiconductor Devices (IWPSD), SSPL Delhi & IIT Delhi, Dec. 2017.
7. Abhishek Upadhyay, Ajay Kushwaha and S.K. Vishvakarma, "Modified Quasi Ballistic Transport Model for Graphene FET Simulation," 19th International Workshop on Physics of Semiconductor Devices (IWPSD), SSPL Delhi & IIT Delhi, Dec. 2017.
8. Pooja Bohara and S.K. Vishvakarma, "Independent Gate Operation of NAND Flash Memory Device with Improved Retention Characteristics," 19th International Workshop on Physics of Semiconductor Devices (IWPSD), SSPL Delhi & IIT Delhi, Dec. 2017.

9. Ankur Beohar, Ambika Prasad Shah, Nandakishor Yadav, and Santosh K. Vishvakarma, "Design of 3D Cylindrical GAA-TFET Based on Germanium Source with Drain Underlap for Low Power Applications," IEEE International Conference on Electron Devices and Solid-State Circuits (EDSSC 2017) at National Tsing Hua University, Hsinchu, Taiwan, October 18th to 20th, 2017.
10. Nandakishor Yadav, Ambika Prasad Shah, Ankur Beohar and Santosh Kumar Vishvakarma, " Source Drain Gaussian Doping Profile Analysis for High ON Current of InGaAs Based HEMT, " IEEE International Conference on Electron Devices and Solid-State Circuits (EDSSC 2017) at National Tsing Hua University, Hsinchu, Taiwan, October 18th to 20th, 2017.
11. Ambika Prasad Shah, Nandakishor Yadav, Ankur Beohar and Santosh Kumar Vishvakarma, "Subthreshold Darlington Pair Based NBTI Sensor for Reliable CMOS Circuits, " IEEE International Conference on Electron Devices and Solid-State Circuits (EDSSC 2017) at National Tsing Hua University, Hsinchu, Taiwan, October 18th to 20th, 2017.
12. Ambika Prasad Shah, Nandakishor Yadav and Santosh Kumar Vishvakarma, " LISOCHIN: An NBTI Degradation Monitoring Sensor for Reliable CMOS Circuits, " 21st International Symposium on VLSI Design and Test (VDAT 2017), Indian Institute of Technology Roorkee, India, 29th June to 2nd July 2017.
13. Pooran Singh, Bhupendra Reniwal, Vikas Vijayargiya, Vishal Sharma and S. K. Vishvakarma, "A 9T SRAM for ultra low power applications", 30th International Conference on VLSI Design and 16th International Conference on Embedded Systems, 7th-11th Jan 2017, Hyderabad, India.
14. Bhupendra Reniwal, Pooran Singh, Vikas Vijayvargiya and S. K. Vishvakarma, "A New Sense Amplifier Design with Improved Input Referred Offset Characteristics for Energy-Efficient SRAM", 30th International Conference on VLSI Design and 16th International Conference on Embedded Systems, 7th-11th Jan 2017, Hyderabad, India.

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

**Dr. Trapti Jain** received her Ph.D. 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)synchrophasor applications in power systems, (ii) grid integration of renewable energy systems, (iii) powerquality monitoring; and,(iv) artificial intelligence applications to power systems. During the year 2017-18, 1 doctoral candidate has graduated under her supervision and 4 more have enrolled. She organized a GIAN course on "Grid Integration of PV Solar and Wind Power Systems." Prof. Rajiv K Varma from the University of Western Ontario was the esteemed guest faculty. 47 students and professionals from across the country benefited from the lectures.

**Publications:**

During the year 2017-18, she published 6 journal papers and 4 conference papers in different journals and conferences of international repute.

**Journals:**

1. Prateek Jain and Trapti Jain, "Techno-Economic Aspects in Electricity Market Operations with Grid Interfaced Electric Vehicles", The Journal of CPRI, vol. 13, pp. 453-462, June 2017.
2. E.S.N. Raju P and Trapti Jain, "Robust Optimal Centralized Controller to Mitigate the Small Signal Instability in an Islanded Inverter based Microgrid with Active and Passive Loads", International Journal of Electrical Power and Energy Systems, vol. 90, pp. 225-236, September 2017.
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, October 2017.

4. Joice G Philip and Trapti Jain, "Analysis of low frequency oscillations in power system using EMO ESPRIT", International Journal of Electrical Power and Energy Systems, Vol. 95, pp. 499-506, February 2018.
5. T. Venkatesh and Trapti Jain, "Placement of synchronized measurements for power system observability during cascaded outages", International Journal of Emerging Electric Power Systems, Vol. 18, Issue 6, pp. November 2017.
6. Prateek Jain and Trapti Jain, "Application of V2G and G2V Coordination of Aggregated Electrical Vehicle Resource in Load leveling", International Journal of Emerging Electric Power Systems, Vol. 19, Issue 2, February 2018.

### Conferences:

1. Joice G Philip and Trapti Jain, "Optimal placement of PMUs of different channel capacity for complete observability with increased measurement redundancy" accepted for presentation in 1st International and 4th National Conference on Reliability And Safety Engineering to be held at IIITDM Jabalpur during February 26-28, 2018.
2. Karthik Thirumala, Amod C. Umarikar, and Trapti Jain, "DSP Implementation of the Empirical Wavelet Transform for Classification of Power Quality Disturbances," in Proc. of 2017 7th IEEE International Conference on Power Systems (ICPS), pp. 698-703, Pune, India, December 21-23, 2017.
3. Prateek Jain and Trapti Jain, "Smart Integration of Large Scale Electric Vehicle Storage into the Grid: Challenges and Opportunities," in Proc. of First International Conference on Large-scale grid integration of renewable energy in India, New Delhi, India, September 06-08, 2017.
4. T. Venkatesh, Ravi Bujethiya, Ramlakhan Meena and Trapti Jain, "Wide Area Static Security Assessment of Power Systems using Wavelet Support Vector Machine," in Proc. of IEEE Power & Energy Society General Meeting 2017, Chicago, Illinois, USA, July 16-20, 2017.

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## Dr. Vivek Kanhangad

Associate Professor
kvivek@iiti.ac.in


**Dr. Vivek Kanhangad** received his Ph.D. 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.

### Publications:

During the year he has published 6 journal papers and 2 conference papers in different Journals and conferences of International repute.

**Journal Papers:**

1. 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, March 2018.
2. Ankita Jain and Vivek Kanhangad, "Human Activity Classification in Smartphones using Accelerometer and Gyroscope Sensors", IEEE Sensors Journal, vol. 18, pp. 1169-1177, Feb. 2018.
3. Ankita Jain and VivekKanhangad, "Gender classification in smartphones using gait information", Expert Systems with Applications, vol. 93, pp. 257-266, March 2018.
4. Ashwani Tiwari, Vivek Kanhangad and Ram Bilas Pachori, "Histogram refinement for texture descriptor based image retrieval", Signal Processing: Image Communication, vol. 52, pp. 73-85, April 2017.
5. Shishir Maheshwari, Ram Bilas Pachori, Vivek Kanhangad, S.V. Bhandary, and U.R. Acharya, "Iterative variational mode decomposition based automated detection of glaucoma using fundus images", Computers in Biology and Medicine, vol. 88, pp. 142-147, Sept. 2017.
6. Ashwani Tiwari, Ram Bilas Pachori, Vivek Kanhangad and Bijaya Panigrahi, "Automated Diagnosis of Epilepsy using Key-point Based Local Binary Pattern of EEG Signals", IEEE Journal of Biomedical and Health Informatics, vol. 21, pp. 888-896, July 2017.

**Conference Publications:**

1. Ankita Jain and Vivek Kanhangad, "Human Activity Classification in Smartphones Using Shape Descriptors", 24th National Conference on Communications (NCC 2018), Feb. 2018, Hyderabad.
2. Sushree Behera, Mahesh Gour, Vivek Kanhangad, and Niladri Puhan, "Periocular recognition in cross-spectral scenario", International Joint Conference on Biometrics (IJCB 2017), Oct. 2017, Denver, USA.

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

**Dr. Vimal Bhatia** is currently a Professor. He completed his Ph.D. from the University of Edinburgh (UK) in 2005 and has over 11 years of industry experience both in India and the UK. His research is primarily on proposing new architecture and solutions for communications and signal processing problems.

He has over 140 publications, 4 book chapters and 11 patents, and external grants of over 12.5 crores as Principal Investigator (PI). In particular, his research focuses on providing effective solutions for visible light communications for efficient high speed data transfer.

Research on algorithm design for large/massive-MIMO and NOMA schemes is currently being explored in his research group. His group has also been able to demonstrate the 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.

The group has also explored compressed sensing based techniques for ultra-wideband 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 research has been widely accepted and recognized as innovative by the IEEE, Elsevier, Springer, OSA, IET, and IETE. Published articles have featured in the most downloaded/popular article list.

The research has been presented in leading conferences/workshops in communications and signal processing including ICC, Globecom, WCNC, VTC, SPAWC, SPCOM, ANTS, NCC, EUSIPCO, SSPD, Photonics and others. Some papers have received travel grant support from DST, MeitY, and IEEE Signal Processing Society.

His research focus is broadly in Wireless Communication, Signal Processing, Software Product Development, and Entrepreneurship Development.

During the year 2017-18, 3 doctoral candidates have graduated under his supervision.

Dr. Bhatia organized a GIAN course during the year on 'Advanced Radar Signal Processing'. Professor Amit Kr. Mishra delivered the lecture on the subject which benefited 50 students and professionals from across the country. He had been actively engaged in different workshops and seminars during the year including(i) 1st DST-UKIERI Workshop on 5G, (ii) Organizing committee member CEP – Information Communication Technologies (ICT): Concepts, Implementations and Prospects, (iii) Co-organizer for 2nd Joint IIT Indore-MCTE, (iv) General vice-chair for IEEE ANTS 2017.

He has been working in collaboration with many international research organizations including: University of Cape Town, South Africa; University of Edinburgh, UK; Heriot-Watt University, UK; University of Huddersfield, UK; University of Luxembourg, Luxembourg; University of Oslo, Norway; University of North Texas, US and others.

His Ph.D. students have also been short-listed for graduate awards at SPCOM, IISc Bengaluru, and demonstration of prototype at NCC, IIT Madras.

**During the year 2017-18, he has been granted with three patents:**

1. V. Bhatia, S. Kalsi, D. Singh, S. Goyal, "Method and apparatus for managing phone/device profile based on an event", 3415/MUM/2015.
2. V. Bhatia and A. Bishnu, "Method and apparatus for low complexity natural gradient based OFDM channel estimator", 201621034423.
3. V. Bhatia and A. Bishnu, "Method and apparatus for Detection of Active Taps Location in OFDM System", 201621036738.

**He has been instrumental in many start-ups, organizing various events, conference and presentation other accomplishments as detailed below:**

1. TEDx IIT Indore 2017: 1st TED event organised in IIT Indore.
2. IAC 2017: Organised with a participation of over 400+ members. This has led to increased publicity and inquiries for SIC and other facilities at IIT Indore.
3. IEEE ANTS 2017: Served as general vice-chair for 11th IEEE ANTS 2017 and publicity for IIT Indore for IEEE ANTS 2018. The IEEE ANTS is the only IEEE ComSoc conference in India technically and financially supported by IEEE.
4. i5Summit: A 2-day largest entrepreneurial summit jointly organised by IIT Indore and IIM Indore.
5. E-Summit: IIT Indore's week of entrepreneurship based activities.
6. Presentation of research publications in IEEE Globecom, ICC, SPAWC, VTC, ANTS, and other flagship conferences.
7. 3-year DST-UKIERI project for joint R&D on future wireless systems.

Alumni Start-ups incubated and mentored Swaaha, Chota Hospital, Esmatify, Engross with Prof. Bhatia's support and validation. Swaaha and Chota Hospital successfully received a Govt. of India certification as a recognised start-up.

**Publications:**

During the year 2017-18, he has published in 21 journals and has 23 conference publications. The total impact factor of his published research in the year 2017-18 is 50.4. He has been granted with three patents during the year.

1. "LogDet Covariance Based Spectrum Sensing under Colored Noise": A. Bishnu and V. Bhatia, IEEE Transactions on Vehicular Technology.
2. "Performance Analysis of OFDM Based 3-hop AF Relaying Network over Mixed Rician/Rayleigh

Fading Channels": P. Singya, N. Kumar, F. Khan and V. Bhatia, Elsevier - AEU International Journal of Electronics and Communications.

3. "Impulse Noise Mitigation in IR-UWB Communication using Signal Cluster Sparsity": S. Sharma, A. Gupta and V. Bhatia, IEEE Communications Letters.
4. "Performance Evaluation of QAM Schemes for Multiple AF Relay Network Under Rayleigh Fading Channels": N. Kumar and V. Bhatia, Springer Wireless Personal Communications.
5. "An IEEE 802.22 Transceiver Framework and its Performance Analysis on Software Defined Radio for TV White Space": A. Bishnu and V. Bhatia, Springer Telecommunication Systems.
6. "Noncoherent IR-UWB Receiver using Massive Antenna Arrays for Wireless Sensor Networks": S. Sharma, A. Gupta and V. Bhatia, IEEE Sensors Letters.
7. "Impact of Imperfect CSI on ASER of Hexagonal and Rectangular QAM for AF Relaying Network": P. Singya, N. Kumar and V. Bhatia, IEEE Communications Letters.
8. "Spectrum efficient distance-adaptive paths for fixed and fixed-alternate routing in elastic optical networks" : A. Agrawal, V. Bhatia and S. Prakash, Elsevier Optical Fiber Technology.
9. "Modified Multiple Feedback QR aided Successive Interference Cancellation Algorithm for Large MIMO Detection": M. Mandloi and V. Bhatia, Springer Wireless Personal Communications.
10. "Sparse Channel Estimation for Interference Limited OFDM Systems and its Convergence Analysis": A. Bishnu and V. Bhatia, IEEE Access.
11. "A simple low cost latent fingerprint sensor based on deflectometry and WFT analysis": J. Dhanotia, A. Chatterjee, V. Bhatia and S. Prakash, Optics and Laser Technology.
12. "ASER Analysis of Hexagonal and Rectangular QAM Schemes in Multiple Relay Networks": N. Kumar, P. Singya and V. Bhatia, IEEE Transactions on Vehicular Technology.
13. "Precoded Chebyshev-NLMS based pre-distorter for nonlinear LED compensation in NOMA-VLC": R. Mitra and V. Bhatia, IEEE Transactions on Communications.
14. "Packet Scheduling Algorithm in LTE/ LTE-Advanced based Cellular Networks": S. Shukla and V. Bhatia, Defence Science Journal.
15. "Performance Analysis of AF OFDM System using Multiple Relay in presence of Nonlinear-PA over i.n.i.d. Nakagami-m Fading": P. Singya, N. Kumar and V. Bhatia, Wiley International Journal of Communication.
16. "Low complexity post-distorter for visible light communications" : R. Mitra and V. Bhatia, IEEE Communications Letters.
17. "Improved accuracy in slope measurement and defect detection using Fourier fringe analysis" : J. Dhanotia, R. Disawal, V. Bhatia and S. Prakash, Elsevier Optik-International Journal for Light and Electron Optics.
18. "Anti-spoof touchless 3D fingerprint recognition system using single shot fringe projection and biospeckle analysis": A. Chatterjee, V. Bhatia and S. Prakash, Elsevier Optics and Lasers in Engineering.
19. "Error Recovery Based Low-Complexity Detection for Uplink Massive MIMO systems": M. Mandloi and V. Bhatia, IEEE Wireless Communications Letters.
20. "Iterative Time-Domain Based Sparse Channel Estimation for IEEE 802.22" : A. Bishnu and V. Bhatia, IEEE Wireless Communications Letters.
21. "Mitigating NLD for Wireless Networks: Effect of Nonlinear Power Amplifiers on Future Wireless Communication Networks": P. Singya, N. Kumar and V. Bhatia, IEEE Microwave Magazine.

22. A. Datta, and V. Bhatia, "Mutation based Bee Colony Optimization Algorithm for near-ML Detection in GSM-MIMO", Springer ICSC-2018, Delhi, 2018.
23. R. Mitra, and V. Bhatia, "Precoding technique for ill-conditioned massive MIMO-VLC system", IEEE 87th Vehicular Technology Conference, Portugal, 2018.
24. S. Sharma, V. Bhatia and A. Gupta, "An Iterative Transmitted Reference UWB Receiver for Joint ToA and Data Symbols Estimation", IEEE ICC, US, 2018.
25. A. Chatterjee, J. Dhanotia, V. Bhatia and S. Prakash, "Hilbert transform based phase extraction algorithm for fringe projection profilometry", IEEE ICMAP, 2018.
26. A. Chatterjee, J. Dhanotia, V. Bhatia and S. Prakash, "Virtual optical encryption using phase shifted digital holography and RSA algorithm", IEEE ICMAP, 2018.
27. J. Dhanotia, A. Chatterjee, S. Prakash and V. Bhatia, "Comparison of 3D sensing algorithms for single shot fringe projection profilometry", IEEE ICMAP, 2018.
28. A. Chatterjee, J. Dhanotia, V. Bhatia and S. Prakash, "Optical Image Encryption using Fringe Projection Profilometry, Fourier Fringe Analysis, and RSA Algorithm", IEEE INDICON, 2017.
29. A. Chatterjee, J. Dhanotia, V. Bhatia and S. Prakash, "Comparative Analysis of Single and Multistep Interferogram Processing Techniques", IEEE INDICON, 2017.
30. A. Datta and V. Bhatia, "Social Spider Optimizer Based Large MIMO Detector", IEEE ANTS, 2017.
31. A. Agrawal, P. Sharma, V. Bhatia and S. Prakash, "Survivability Enhancement of Backbone Optical Networks Leveraging Seismic Zone Information", IEEE ANTS, 2017.
32. P. Swami, V. Bhatia, S. Vuppala and T. Ratnarajah, "Outage Analysis of NOMA-HCN Using Repulsive Point Process", IEEE Globecom 2017, Singapore, 2017.
33. S. Sharma, A. Gupta and V. Bhatia, "Joint Estimation of ToA and Data Symbols in UWB Communication in Presence of Impulsive Interference", IEEE Globecom 2017, Singapore, 2017.
34. A. Bishnu and V. Bhatia, "A Zero Attracting Natural Gradient Non-Parametric Maximum Likelihood for Sparse Channel Estimation", IEEE Globecom 2017, Singapore, 2017.
35. P. Shaik, A. Bishnu and V. Bhatia, "Performance Comparison of Space Frequency Block Codes and Maximum Ratio Receiver Combining in the presence of Co-Channel Interference for LTE", Conference on Information and Communication Technology, India, 2017.
36. A. Datta and V. Bhatia, "A Robust MIMO Detection Algorithm using Gravitationally Co-ordinated Swarm", Conference on Information and Communication Technology, India, 2017.
37. A. Chatterjee, J. Dhanotia, V. Bhatia and S. Prakash, "Non-Destructive 3D Profiling of Orthopaedic Titanium Bone Plate Using Fringe Projection Profilometry and Fourier Transform Analysis", IEEE CERA, IIT Roorkee, 2017.
38. A. Datta and V. Bhatia, "A near-ML Performance Hybrid Dijkstra and Firefly algorithm for Large MIMO Detection", 8th ICCCNT, IIT Delhi, 2017.
39. U. Singh, V. Bhatia and A. K. Mishra, "Delay and Doppler shift Estimation for non-Constant Envelope Modulation in OFDM-RADAR System", RADAR, 2017.
40. U. Singh, R. Mitra, V. Bhatia and A. K. Mishra, "Target Range Estimation in OFDM-Radar System via Kernel Least Mean Square Technique", RADAR, 2017.
41. P. Swamy, V. Bhatia, S. Vuppala and T. Ratnarajah, "User Fairness and Performance Enhancement for Cell Edge User in NOMA-HCN with Offloading", IEEE 85th Vehicular Technology Conference, Australia, 2017.

42. P. Singya, N. Kumar, V. Bhatia and F. A. Khan, "Outage Probability Analysis of Shared UE-side Distributed Antenna System based Cooperative AF Relaying Network for 5G Systems", IEEE 85th Vehicular Technology Conference, Australia, 2017.

43. N. Kumar, P. Singya and V. Bhatia, "ASER Analysis of Rectangular QAM with SC Receiver in OFDM-Based Nonlinear AF Relay Network Over Nakagami-m Fading", IEEE 85th Vehicular Technology Conference, Australia, 2017.

44. S. Sharma, V. Bhatia and A. Gupta, "A Simple Modified Peak Detection Based UWB Receiver for WSN and IoT Applications", IEEE 85th Vehicular Technology Conference, Australia, 2017.

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**Dr. Vipul Singh**
Associate Professor
vipul@iiti.ac.in

**Dr. Vipul Singh** is an Associate Professor. He is a Ph.D. 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.

Some notable achievements of his group are:

- Demonstration of high sensitivity organic phototransistor.
- Highly sensitive Deep UV photodetector.
- UV/Visible hybrid photodetector using inorganic, organic semiconducting materials.
- Amperometric biosensors for blood glucose detection.
- Fully functional orange light emitting OLED.
- Large-scale nanofibers of Conducting Polymers.
- Jointly developed energy harvesting devices based on piezoelectric materials.

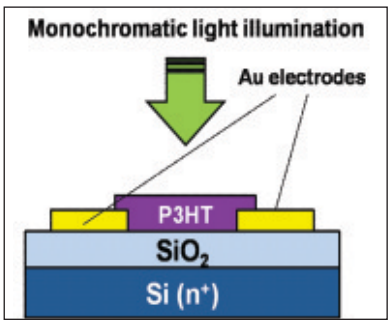
During the year, 5 doctoral candidates have graduated under his supervision, 1 has submitted his thesis, 3 have enrolled under TA category, 3 candidates are under FA.

His team has conducted GIAN course on "Next Generation Solar Cells in the Realm of Future Energy Challenges: From Materials Design to Device Architecture". All together, 18 students and professionals have benefited from the course. Dr. Shyam S Pandey delivered the lectures.

Dr. Singh has collaborative research projects with national and international institutes and people:

a. Dr. I A Palani, Discipline of Mechanical Engineering, IIT Indore.
b. Dr Mukesh P Joshi, Laser Materials Processing Division, RRCAT Indore.
c. Prof. M S R Rao, Department of Physics, IIT Madras, Chennai.
d. Prof. Shyam S Pandey, Kyushu Institute of Technology, Japan.
e. Prof. Daisuke Nakamura, Kyushu University, Japan.

He has been awarded 'best technology development' at IIT Indore for his work on "Novel Lead Free Nano Generators For Smart Urinal Applications in Under Developed Countries": P Rajagopalan, Vipul Singh and I A Palani.




High photosensitivity of 104 was observed

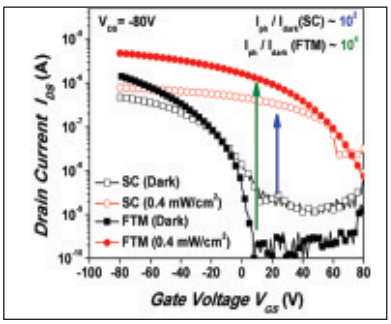
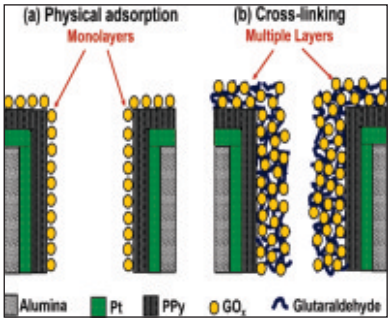



Figure shows Schematic and transfer characteristics of High Sensitivity photosensitive OFET.

- High Sensitivity Glucose Biosensor has been demonstrated using template assisted nanostructures of Polypyrrole grown electrochemically. Enzymatic detection technique was employed to demonstrate high sensitivity glucose biosensor based on Amperometric technique of detection.



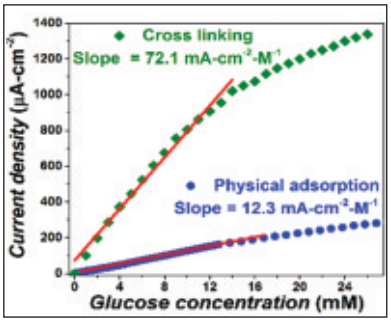




Figure showns High Sensitivity Enzymatic Amperometric Glucose Biosensor

- Developed Hybrid Inorganic/ Organic Photodetector. The developed device showed good response towards green light and when used decorated with metal nanoparicles became sensitive towards UV spectrum of light, demonstrating the capability of the device towards UV photodetection and wavelength tunability.

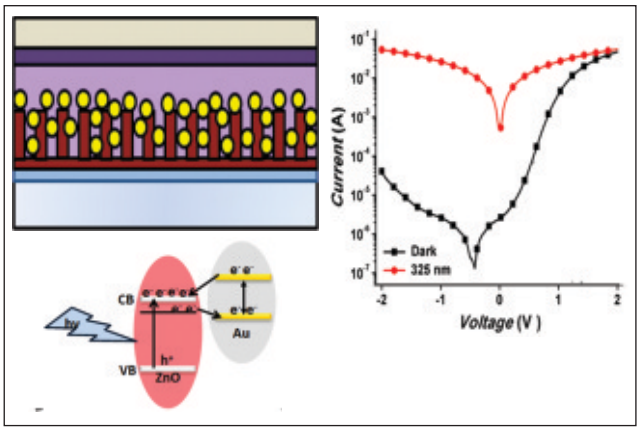



Figure Shows the LSPR enhanced response in ·Au nanoparticle decorated ZnO Nanorod Array based Hybrid Photodetectors

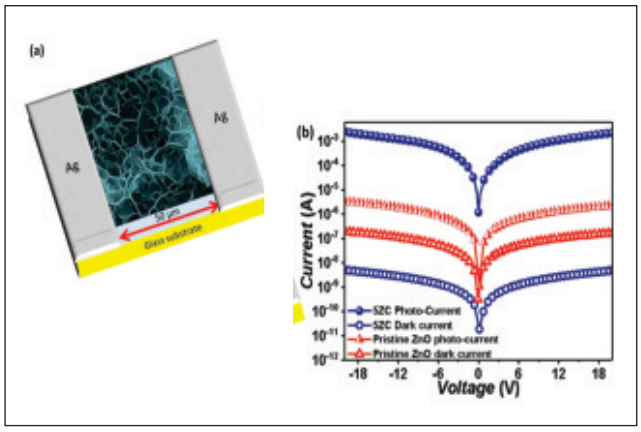



Figure shows the device schematic of the ZnO nanostructure based photodetector and its response against light illumination.

## Publications:

He has published 18 research papers in different journals of International repute.

1. "All Organic Near Ultraviolet Photodetectors Based on Bulk Heterojunction of P3HT and DH6T": Shalu C, Nidhi Yadav, Kshitij Bhargava, Mukesh P Joshi and Vipul Singh, Semicon Sci & Technol, Vol. 33 (2018) 095021.
2. "Zinc Interstitial Rich ZnO Honeycomb Nanostructures for Deep UV Photodetection": Jitesh Agrawal, Tejendra Dixit, I A Palani, M S R Rao and Vipul Singh, Phys. Stat. Sol. RRL, (2018) 1800241.

3. "Solvent Assisted Improvement of Dielectric Properties and Hysteresis Behavior in Poly(4-Vinylphenol) (PVP) Thin Films": Shalu C, Mukesh P Joshi and Vipul Singh, Microelectronics Engineering, Vol. 198 (2018) 85.
4. "A Comparative Analysis of ZnO Nanorods and Nanopencils Towards Amperometric Biosensing Applications": Mayoorika Shukla, Pramila Jakhar, I A Palani and Vipul Singh, Journal of Nanoscience and Nanotechnology, (2018, in press).
5. "Facile Hydrothermal Synthesis of Mn Doped ZnO Nanopencils for Development of Amperometric Glucose Biosensors": Mayoorika Shukla, Pramila Jakhar, Jitesh Agrawal, Tejendra Dixit, I A Palani and Vipul Singh, Mater Res Exp, Vol. 5 (2018).
6. "Influence of LiClO4 Concentration on 1-D Polypyrrole Nanofibers for Enhanced Performance of Glucose Biosensor": Pramila Jakhar, Mayoorika Shukla and Vipul Singh, J Eectrochem Soc, Vol. 165 (2018) G80.
7. "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.
8. "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.
9. "Enhancement of ZnO-based Flexible nano generators via sol-gel technique for sensing and energy harvesting applications": P Rajagopalan, Vipul Singh and I A Palani, Nanotechnology, Vol. 29 (2018) 105406.
10. "Comparative Analysis of Contact Resistance and Photoresponse in Poly(3-hexylthiophene) and Poly(3-octylthiophene) based Organic Field-Effect Transistors": Kshitij Bhargava, Mayoorika Shukla and Vipul Singh, Synth Met, Vol. 233 (2017) 15.
11. "Influence of Aspect Ratio and Surface Density on Hydrothermally Grown ZnO Nanorods Towards Amperometric Glucose Biosensing Applications": Mayoorika Shukla, Pramila Jakhar, T Dixit, R Prakash, I A Palani and V Singh, Appl. Surf. Sci, Vol. 422 (2017) 798.
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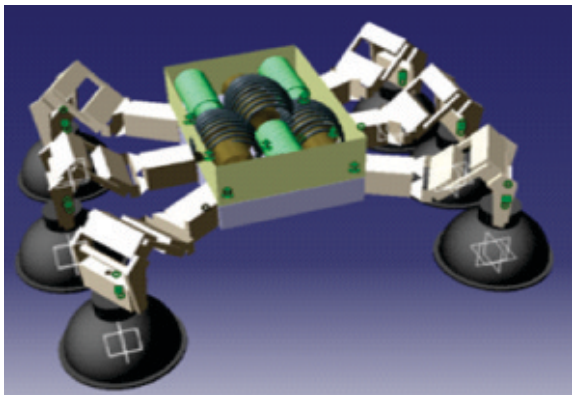
13. "Laterally grown show better performance: ZnO nanorods network based field effect transistors": Ashish Kumar, Tejendra Dixit, Kshitij Bhargava, I A Palani and Vipul Singh, Journal of Materials Science: Materials in Electronics, Vol. 28 (2017) 11202.
14. "Effect of Immobilization technique on the performance of ZnO nanorods based enzymatic electrochemical glucose biosensor": Mayoorika Shukla, Pramila Jakhar, I A Palani and Vipul Singh, Journal of Physics: Conference Series, Vol. 924 (2017) 012013. (DOI: 10.1088/ 1742-6596/924/1/012013).
15. "Parametric Investigations on the Influence of 532 nm Nd:YAG laser in synthesizing spherical copper and aluminum nanoparticles using pulsed laser ablation technique for surface plasmon applications": Nandini Patra, Vipul Singh and I. A. Palani, Advanced Science Engineering & Medicine, Vol. 12 (2017) 7.
16. "Role of Surface Plasmon Decay Mediated Hot Carriers Towards the Photoluminescence Tuning of Metal Coated ZnO Nanorods": Tejendra Dixit, I A Palani and Vipul Singh, Journal of Physical Chemistry C, Vol. 121 (2017) 3540.
17. "Charge Transport in Thin Films of MDMO-PPV Dispersed with Lead Sulfide Nanoparticles": S R Mohan, M P Joshi, T S Dhami, V Awasthi, Shalu, C B Singh and V Singh, Synthetic Metals, Vol. 224 (2017) 80.
18. "Performance Improvement of ZnO/P3HT Hybrid UV Photodetector": Anubha Bilgaiyan, Tejendra Dixit, I A Palani and Vipul Singh, Physica E, Vol. 86 (2017) 136.

# 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 department 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.

## Research Highlights of the past year

- **Dr. Bhupesh Kumar Lad**

i) Received a DST (FAST Track) grant of INR 21,58,422 for executing the project titled "Investigation and modeling of the relationships among cutting tool wear, product quality and operating conditions based on online condition monitoring."

ii) Received a grant of GBP 50,000 from Royal Academy of Engineering, U.K for executing the project titled "Development of a system that enables embedded intelligence in manufacturing equipment through effective data gathering, communication, analytics and decision-making capabilities."

iii) Received a onetime GPU grant from NVIDIA for executing the project titled "Developing Parallel Computing Capability in Smart Manufacturing."

- **Dr. I.A. Palani**

i) Received a DST Technology grant of INR 45,00,000 for executing the project titled "Design and development of Laser Decal Transfer based Micro 3D Printer for printing micro devices".

ii) Received a SERB grant of INR 47,00,000 for executing the project titled "Design and Development NiTi SMA belt drive and their application towards energy Harvesting".

iii) Received a DST and DAAD grant of INR 8,00,000 and Euro 15500 for executing the project titled "Investigations on Structural and thermomechanical behavior of the Cu- based shape memory alloy bimorphs".

iv) DRDO, IMRA grant of INR 22,00,000 is under approval for executing the project titled "Design and Fabrication of Prestrained Post buckled Shape Memory Alloy (SMA) Composites to Develop Adaptive Flapper for Missiles".

v) Uchatar Avishkar Yojaba (MHRD) and Volvo Eicher grant of INR 74,39,000 for executing the project titled "Development of SMA bi-morph belt for deriving waste energy from the automobile engine Development of SMA bi-morph belt for deriving waste energy from the automobile engine".

- **Dr. Shailesh Kundalwal**

i) SERB Early Career Research Award

ii) Two SERB International Travel Grant Awards

iii) DST Inspire Fellowship

iv) Three major research grants. Total funding: INR 72,00,000

- **Dr. Indrasen Singh**

i) Prof. B K Subba Rao Medal (Gold Medal) for the year 2016-17 "Best PhD thesis award from IISc Bangalore"

- **Dr. Santhakumar Mohan**

i) Four innovative ideas related to various kinematic motions of robots have been filed for the patent in the Indian patent office.

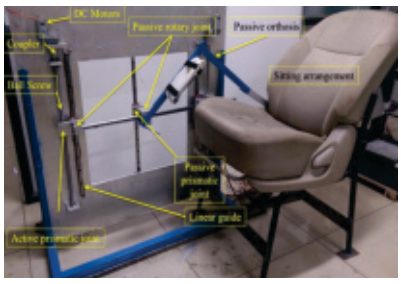
- **Dr. Subbareddy Daggumati**

I) Started collaboration with the Mechanics of Composite Materials Research group at Ghent University, Belgium.

ii) Manufactured a first two meter long prototype wind turbine rotor blade in composite materials lab at IIT Indore.

## Research at a Glance – Discipline of Mechanical Engineering

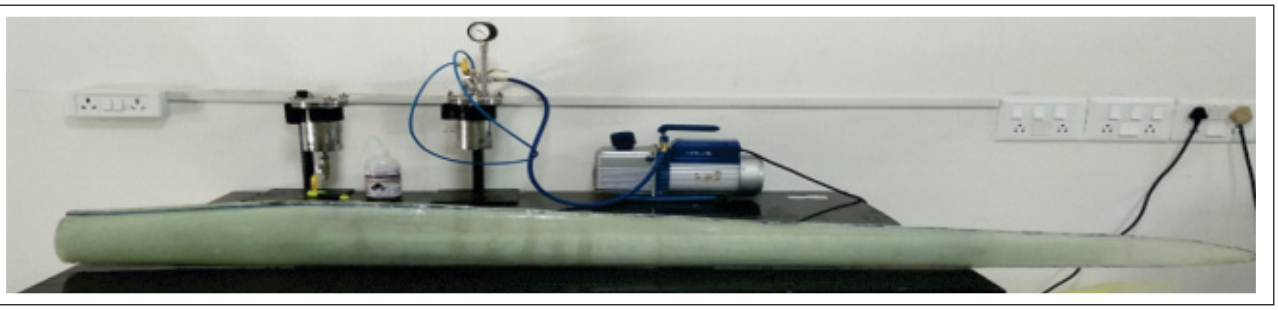
Pulsed Laser Deposition System



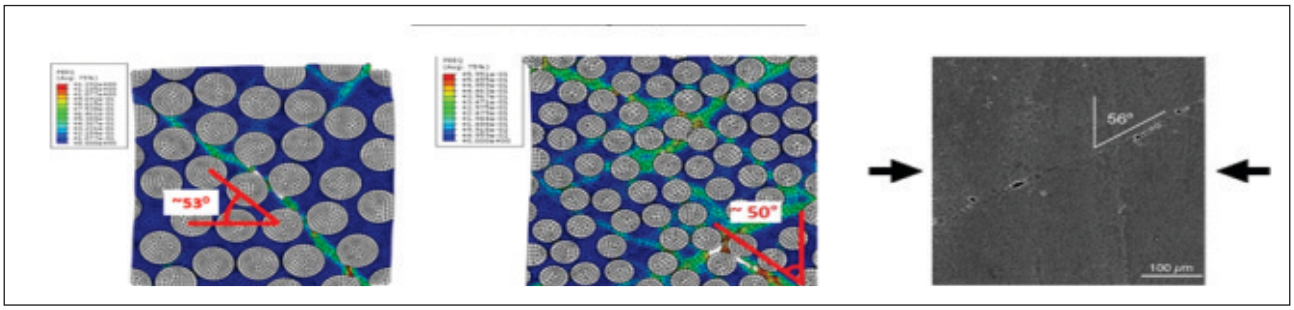
Real-time scaled down prototype of ANKUR-LL 2

Design of Hybrid Underwater Vehicle with fin propulsion

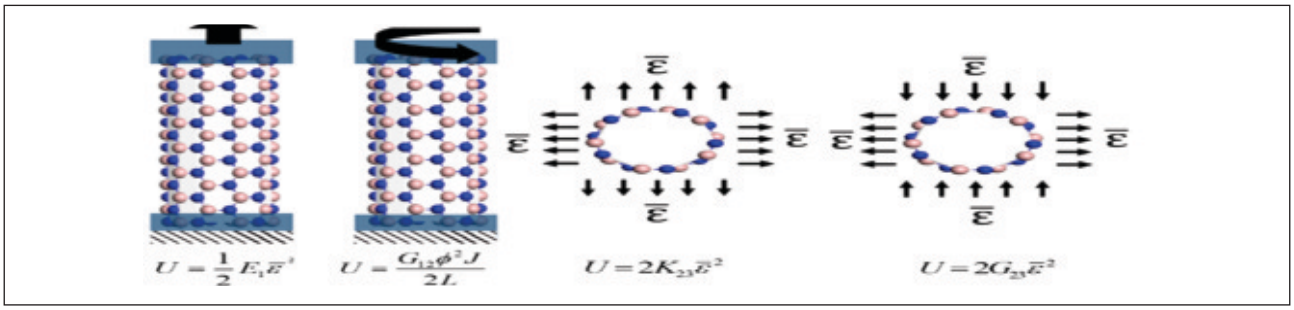
Design, manufacturing and computational research @ composite materials lab



Continuum simulations @ composite meterials lab




Molecular dynamic studies at ATOM lab



**Dr. Devendra Deshmukh**

Associate Professor
dldeshmukh@iiti.ac.in

Ph.D.: Indian Institute of Science, Bangalore.

**Dr. Devendra Deshmukh** received his Ph.D. 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 biofuels, spray and combustion diagnostics, and the modelling of the IC engine processes.

Doctoral students: Rajan Lanjekar, Aniket Kulkarni, Vasudev Chaudhari

Webpage: http:// me.iiti.ac.in/Deshm.html

**Dr. E. Anil Kumar**

Associate Professor
(on-lien at IIT Tirupati )
anil@iiti.ac.in

Ph.D.: Indian Institute of Technology Madras

**Dr. Anil Kumar** works on hydrogen storage and related engineering applications, $C0_2$ separation from industrial flue gases and development of sorption heating/cooling systems. At present his group is developing experimental setups for studying the sorption characteristics of different gases (Hydrogen, $Co_2$ and $NH_3$) on adsorbents. His team is also developing prototypes for demonstration and evaluation of performance of sorption systems.

Doctoral students: Vinod Singh, Dharmendra Kumar Panchariya, Debashis Panda and Dhananjay Mishra

Webpage: http://me.iiti.ac.in/Anil.html

**Dr. I.A. Palani**

Associate Professor
palaniia@iiti.ac.in

Ph.D.: 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: Opto-Mechatronics system design; Laser assisted micro-manufacturing, smart materials and structures. His research concerns the development of shape memory alloy for micro-device development. He has more than 90 research publications in International journals and conference proceedings. He has also written book chapters and been granted three patents.

Webpage: http://drpalaniia.webs.com/

**Dr. Santosh K. Sahu**
Associate Professor
sksahu@iiti.ac.in

Ph.D.: 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 has received his Master's (2004) and Ph.D. (2009) degrees from Indian Institute of Technology Bombay and Indian Institute of Technology Kharagpur India, respectively. His research interests include rewetting of hot surfaces, quenching of hot stationary and moving surfaces, heat transfer enhancement with nanofluids, heat transfer behavior of gaseous flows in micro devices, pool boiling heat transfer, impinging jets, heat exchanging equipments, phase change materials and synthetic jets. He has published 41 international indexed journal papers and 51 articles in international conference proceedings, besides contributing 3 articles in an edited book published by Springer and 01 Indian Patent. He has received the prestigious IUSSTF Research Fellowship by the Indo-US Science and Technology Forum for Engineering Sciences in 2011. Under the Indo-US Research Fellowship programme, he has visited Purdue University, West Lafayette, Indiana, USA during September 2011 to January 2012. He is a reviewer of 20 reputed international journals and has edited text books from various publishers. Website: http://people.iiti.ac.in/~santosh/

PhD students: (i) Completed: Manish Agrawal, Hari Mohan, Sandesh Chougule, Mayank Modak (ii) Ongoing: Avadhesh Sharma, Saurabh Yadav, Vishal Nirgude, Rohit Kothari, Pushpanjay Kumar Singh and Anuj Kumar.

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

Ph.D.: Indian Institute of Technology Kanpur (2003)

**Prof. Neelesh Kumar Jain** joined IIT Indore as Associate Professor in Jan 2010 and became Professor in Dec. 2013. He completed his Ph.D. (2003) and M.Tech (1995) from IIT Kanpur, specializing in Manufacturing Science and BE in Mechanical Engineering from SGSITS Indore in 1993. 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. He has supervised 9 Ph.D. theses and 25 M.Tech theses. Currently, 6 Ph.D. theses are under progress.

Research Interests: Prof. Jain works on various aspects of advanced and hybrid machining processes, micro-machining, nano-finishing and micro-joining processes through experimental investigations. He has worked extensively on establishing electrochemical honing (ECH) processes as a precision gear finishing process, establishing WEDM as a near-net shape manufacturing process for miniature gears and the development of micro-plasma transferred arc processes for metallic deposition and the joining of SS thin sheets for the repair of cracks in dies and gears. His work also includes modeling and developing parameter optimization of machining processes and process selection of manufacturing processes.

The following are details of his research contributions:

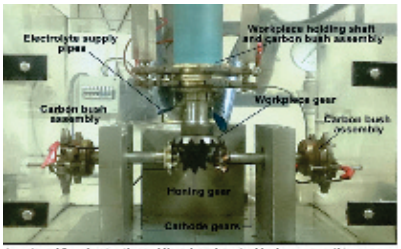
- Development of electrochemical honing (ECH) and pulse-ECH process as an economical and sustainable alternative process for high quality finishing of internal cylinders and different types of cylindrical and conical gears by developing four experimental apparatus, investigations on effects of parameters on surface roughness, surface integrity, micro-geometry, noise, vibration and wear characteristics and finishing productivity in gears finishing by ECH/PECH, modeling of MRR and surface roughness and identification of optimum process parameters.

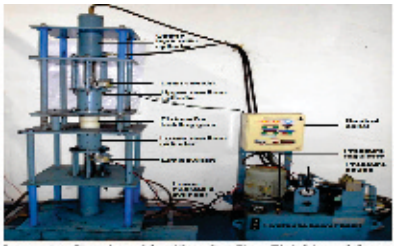
- Development of micro-plasma transferred arc (μ-PTA) wire and powder deposition processes for various meso-sized additive layer manufacturing (ALM) applications of metallic materials, for joining of thin stainless steel sheets (thickness < 1 mm), for joining of tailored blanks (i.e. joining of sheets of different materials and/or different thickness) and for repair of cracks in dies and gears. For this, he has led the development of two experimental apparatus, investigations on effects of process parameters on width, height, dilution, microstructure, microhardness, abrasive wear resistance and HAZ of deposition, thermal modeling of multi-layer, multi-track and multi-material deposition by ALM and identification of optimum parameters of μ-PTA wire and powder deposition process.
- Establishing WEDM as near-net shape manufacturing process for high quality meso sized cylindrical and conical gears through extensive experimental research, modeling and optimization.
- Development of abrasive flow finishing (AFF) process for high quality finishing of spur and bevel gears (under progress)
- Development of design support system (DSS) for process selection and real-coded genetic algorithms (GA) based parametric of advanced machining processes, DSS for rapid prototyping (RP) processes and casting processes for non-ferrous materials.
- Development of very economical experimental apparatus for abrasive jet machining (AJM) and ultrasonic machining (USM) processes as BTech projects.

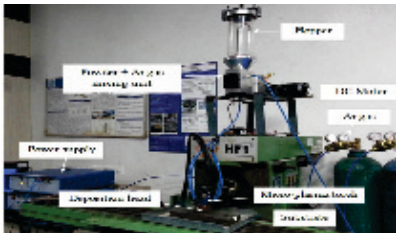
Prof. Jain has played a significant role in the development of the temporary and permanent campuses of IIT Indore since Jan. 2010, Virtual Classroom (VCR) under National Knowledge Network (NKN) and Central Workshop. He has developed five state of the art research and teaching labs at IIT Indore namely 1. Gear Research Lab; 2. Metrology Lab; 3. Advanced Manufacturing Processes Lab, 4. Machining Science Lab; 5. Manufacturing Process Lab. He has hada crucial role in conceptualizing, coordinating and securing funding for the DST-FIST Center of Excellence in Gear Engineering at IIT Indore in 2015. He has been the coordinator of this Center of Excellence since Aug. 2015.

Prof. Jain has served as Member of 1st Board of Governors of IIT Indore from April 2010 to July 2012. He has served as Acting Director of IIT Indore on various occasions since 2010 (for a duration spanning more than 11 months). He was appointed as the first Dean, Academic Affairs of IIT Indore in Oct 2010 and has been reappointed in 2013 for second term and in Oct 2016 for third term. As DOAA, he has played a significant role in developing course curriculum, academic procedures and regulations; and, academic infrastructure for various B.Tech, M.Tech, M.Sc., Ph.D. and dual degree programs; and has organized 7 orientations and 4 convocations in IIT Indore. He has been appointed a Member of Finance Committee of IIT Indore in Feb 2017 and a Member of BoG of NIT Raipur in July 2015.

Prof. Jain is a reviewer of many reputed high impact factor journals such as Journal of Materials Processing Technology, International Journal of Machine Tools and Manufacture, Measurement, Precision Engineering, Journal of Manufacturing Processes, International Journal of Advanced Manufacturing Technology, Materials and Manufacturing Processes, Proc. IMechE Part B: Journal of Engineering Manufacture, International Journal of Manufacturing Technology and Management. He has delivered several invited lectures at different IITs and NITs. He was awarded BOYSCAST Fellowship of DST, Govt. of India, included in Marquis's Who's Who in 2010 and excellence in teaching award by Lions Club Unique in 2011.





Apparatus Developed for Abrasive Flow Finishing of Gears



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

Ph.D.: Indian Institute of Technology Kharagpur

**Dr. Satyajit Chatterjee** joined Mechanical Engineering department as Assistant Professor. Having a background in Production Engineering with Tool Engineering specialization, he is involved in teaching Production and Manufacturing Technologies since the very beginning of his career at IIT Indore. 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. 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. Dr. Chatterjee is also working for the 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 aerospace, automotive, chemical and electrical industries.

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

Ph.D.: Indian Institute of Technology Kharagpur

**Dr. Kazi** works on thermally sprayed ceramic coatings applied on metallic substrates to upgrade their functional capabilities. Presently his group works on plasma sprayed Al2O3-Cr2O3 coatings on steel substrate to enhance the mechanical properties of the surface. Their work is focused on the correlation of the phases present in the coating material with its properties. It is observed that tribo-mechanical properties of the coating are enhanced with an increase in stable α-phase in the coating. A small quantity of Cr2O3 added to the Al2O3 feedstock helps to stabilize the metastable phases present in the final coating.

Web page: http://me.iiti.ac.in/Kazi.html

Doctoral student: Balmukund Dhakar

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

Ph.D.: Indian Institute of Technology Kharagpur

**Dr. Shanmugam Dhinakaran** is an Associate Professor in the Discipline of Mechanical Engineering, IIT Indore. He is also the coordinator of The Centre for Fluid Dynamics, IIT Indore. Besides, Dr. Dhinakaran has an adjunct appointment in the Discipline of Biosciences and Biomedical Engineering, IIT Indore. He received his Ph.D 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 Université de Valenciennes et du Hainaut-Cambrésis, France.

Dr. Dhinakaran's research interests are in bluff body flows; heat and mass transfer in porous media; Nanofluids; Biofluid mechanics and Bio-heat transfer. He is a reviewer of several international peer reviewed journals such as International Journal of Heat and Mass Transfer; Energy; Applied Energy; Journal of Porous Media, etc. just to name a few. He has guided 2 PhD students and 5 M.Tech students.

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

Ph.D.: Indian Institute of Technology Delhi

Research Interests: **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.

Doctoral students: Yogesh Pandya (completed), Ankur Saxena (completed), Naresh Raghuwanshi(completed), Vikas Sharma, Ram Bihari Sharma (completed), Amandeep Singh Ahuja(Ongoing), Palash Dewangan(ongoing), Pavan Gupta (ongoing), Dada Saheb Ramteke(ongoing)

Web page: http://me.iiti.ac.in/Anand.html

**Dr. Bhupesh Kumar Lad**
Associate Professor
bklad@iiti.ac.in

Ph.D.: Indian Institute of Technology Delhi

**Dr. B. K. Lad** worked with GE Global Research Center, Bangalore, India as a Research Engineer from 2010 to 2011. Currently, he is an Associate Professor. He is a Regional Editor (South Asia) for the International Journal of Performability Engineering, USA. He is the author of the book, *Machine Tool Reliability* (Scrivener-Wiley Publishing, USA), 2016. He is an investigator of various research projects funded by national and international funding agencies. His major research interests include: smart manufacturing, reliability engineering, and prognostics. Dr. Lad was a recipient of the Hamied-Cambridge Visiting Lecture Fellowship of University of Cambridge, UK, in 2016.

Web page: http://bklad.webs.com/

**Dr. Santhakumar Mohan**
Associate Professor
santhakumar@iiti.ac.in

Ph.D.: Indian Institute of Technology Madras

Visiting positions: RWTH Aachen, Germany, KAIST, ROK; IISc Bangalore and PSG Tech. Coimbatore, India

Research Interests: **Dr. Santhakumar** is working on the Dynamic analysis and Controller development of Robotic manipulators and systems. He has developed a novel indirect adaptive control scheme for underwater vehicle-manipulator systems and parallel robotic motion platforms. His research and interest in robotic platforms has brought about a new family of parallel robotic manipulators. These can provide a basis to develop new technologies for precise and micro positioning applications using smart actuators. His team also brought a new spatial parallel manipulator which has overcome the clear majority of shortcomings of current manipulators. His team is working towards bringing a new meso-size machining / material handling centre. Web page: http://santhakumarm.wix.com/crciiti

**Dr. Ritunesh Kumar**
Associate Professor
ritunesh@iiti.ac.in

Ph.D.: Indian Institute of Technology Delhi

Research Interests: **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.

Web page: http://me.iiti.ac.in/Ritunesh.html

**Dr. Shailesh I. Kundalwal**

Assistant Professor
kundalwal@iiti.ac.in

Ph.D.: Indian Institute of Technology Kharagpur

Postdocs: University of Toronto; Masdar Institute

Before joining IIT Indore in 2017, **Dr. Shailesh Kundalwal** was Banting Fellow at the University of Toronto. He was awarded his M.Tech and Ph.D. degrees in Solid Mechanics from IIT Kharagpur. He proposed a novel multifunctional Fuzzy Fiber Reinforced Composite in his doctoral studies which led to a critical breakthrough 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 founded the Applied and Theoretical Mechanics (ATOM) Laboratory at IIT Indore and is currently guiding 7 PhD (1 DST Inspire Fellow), 5 M.Tech and 4 B.Tech students.He has authored 35 research articles (excluding conference papers and chapters) in reputed international journals. He contributes as a reviewer on several international journals and Elsevier books in the broad field of mechanics and is a member of professional bodies such as ISTAM, ASME, CSME, APS, and IEI (I).

**Dr. Indrasen Singh**

Assistant Professor
indrasen@iiti.ac.in

Ph.D.: Indian Institute of Science Bangalore

Research interests: **Dr. Indrasen Singh** received his B.Tech degree in mechanical engineering in 2004 from NIT, Allahabad. Subsequently, he joined as a scientist at ARDE, Pune, a premier lab of DRDO, where he worked with the design team of mechanical fuzes for various ammunition. In 2007, he moved to PTC software (India) Pvt. Ltd., Pune and worked there for 3 years as a software developer. He joined the Ph.D. programme in the Department of Mechanical Engineering at IISc, Bangalore in Aug 2010. His Ph.D. focused on understanding fracture and deformation 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. At present, he is supervising one Ph.D.

**Dr. Yuvraj K Madhukar**
Assistant Professor
yuvrajmadhukar@iiti.ac.in

Ph.D.: 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.

**Dr. Subbareddy Daggumati**
Assistant Professor
daggumati@iiti.ac.in

Ph.D.: Ghent University, Belgium

After recieving his Ph.D. and before joining IIT Indore, **Dr. Subbareddy** worked in GE global research as well as SIEMENS R&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 twofold: i) to produce high-quality fundamental research work in the field of multiscale modeling of composite materials/structures; ii) to establish state-of-the-art advanced fiber reinforced composite manufacturing and experimental testing center.

## Publications

**Dr. Kazi Sabiruddin,** Associate Professor

### In Peer-reviewed Journals:

1. Balmukund Dhakar, Satyajit Chatterjee, Kazi Sabiruddin, "Phase stabilization of plasma sprayed alumina coatings by spraying mechanically blended alumina-chromia powders", Materials and Manufacturing Process, 2017, Vol. 32(4), 355-364, DOI:10.1080/10426914.2016.1198028.
2. Balmukund Dhakar, Satyajit Chatterjee, Kazi Sabiruddin, "Measuring Mechanical Properties of Plasma Sprayed Alumina Coatings by Nano-indentation Technique", Materials Sciences and Technology, 2017, Vol. 33(3), 285-293, DOI: 10.1080/02670836.2016.1195643.
3. Balmukund Dhakar, Satyajit Chatterjee, Kazi Sabiruddin, "Influence of process parameters on the formation of phases and mechanical properties of plasma sprayed $Al_2O_3$-$Cr_2O_3$ coating", Materials Research Innovations, Vol 21, Issue 6, 2016, pp 367-376, IF 0.83, DOI: 10.1080/14328917.2016.1265246.
4. Balmukund Dhakar, Akshay Namdeo, Satyajit Chatterjee, Kazi Sabiruddin, "Heat Treatment of Plasma Sprayed $Al_2O_3$-$Cr_2O_3$ Composite Coatings", Surface Engineering, 2017, pp 1-10, IF 1.243, DOI:10.1080/02670844.2017.1316029.
5. Balmukund Dhakar, Satyajit Chatterjee, Kazi Sabiruddin, "Linear reciprocating wear behaviour of plasma sprayed alumina-chromia coatings at different loading and sliding conditions", Sadhana, Vol 42, No. 10, Oct 2017, pp 1763-1772.
6. Balmukund Dhakar, Satyajit Chatterjee, Kazi Sabiruddin, "Effect of Hydrogen flow rate and stand off distance on the formation of phases in Plasma Sprayed $Al_2O_3$ Coatings", Transactions of IMF, Vol 95, Issue 6, Sep 2017, pp 321-327.

### In Proceedings of International Conferences:

1. Balmukund Dhakar, Satyajit Chatterjee, Kazi Sabiruddin, "A Study on Phase Stabilization and characterization of Plasma Sprayed $Al_2O_3$-$Cr_2O_3$ Composite Coatings", International conference of Lasers and Plasma Application in Materials Science, (LAPAMS-2015), 15th -17th January, 2015, Kolkata, India.
2. Balmukund Dhakar, Akshay Namdeo, Satyajit Chatterjee, Kazi Sabiruddin, "Influence of post heat treatment on the formation of phases in plasma sprayed Alumina based coatings". International conference on Surface Modification Technology (SMT30), 29th June to 1st July 2016, Milan, Italy. Around.

**Dr. I. A Palani,** Associate Professor

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3. Optimal conceptual design and vision-based control of a fruit harvesting robot, KS Kumar, PSS Shankaran, SR Asif, S Karthick, IA Palani, BK Lad, A Patil, International Journal of Intelligent Machines and Robotics 1 (1), 45-59,2018
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5. Enhancement of ZnO-based flexible nano generators via a sol–gel technique for sensing and energy harvesting applications, P Rajagopalan, V Singh, IA Palani, Nanotechnology 29 (10),2018 105406
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8. Fabrication of high responsivity deep UV photo-detector based on Na doped ZnO nanocolumns, J Agrawal, T Dixit, IA Palani, MSR Rao, V Singh, Journal of Physics D: Applied Physics 51 (18), 185106
9. Laser-assisted dry, wet texturing and phase transformation of flexible polyethylene terephthalate substrate revealed by Raman and ultraviolet-visible spectroscopic studies
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13. Investigation on thermo-mechanical behavior of SMA spring under the influence of different actuation medium T Nath, K Akash, P Chouhan, BK Lad, IA Palani Microsystem Technologies 24 (6), 2813-2821.
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15. Shape memory effect, temperature distribution and mechanical properties of friction stir welded nitinol, SS Mani Prabu, HC Madhu, Chandra S Perugu, K Akash, R Mithun, P Ajay Kumar, Satish V Kailas, Manivannan Anbarasu, IA Palani, Journal of Alloys and Compounds, 2018
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19. Investigation on thermo-mechanical behavior of SMA spring under the influence of different actuation medium, Tameshwer Nath, K Akash, Priya Chouhan, Bhupesh Kumar Lad, IA Palani, 24,6,2813-2821,2018.
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23. Mayoorika Shukla, Tejendra Dixit, Rajiv Prakash, IA Palani, Vipul SinghInfluence of aspect ratio and surface defect density on hydrothermally grown ZnO nanorods towards amperometric glucose biosensing applicationsApplied Surface Science2017/6/10.

24. Ashish Kumar, Tejendra Dixit, IA Palani, D Nakamura, M Higashihata, Vipul SinghUtilization of surface plasmon resonance of Au/Pt nanoparticles for highly photosensitive ZnO nanorods network based plasmon field effect transistorPhysica E: Low-dimensional Systems and Nanostructures, 2017/6/3.
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26. K Akash, Shukla Ashish, SS Mani Prabu, Dhiraj Chindhuji Narayane, S Kanmanisubbu, IA Palani" Parametric investigations to enhance the thermomechanical properties of CuAlNi shape memory alloy Bi-morph", Journal of Alloys and Compounds, 2017.
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**Dr. Santosh K. Sahu,** Associate Professor

**Patents:**

1. Avadhesh Kumar Sharma, Mayank Modak. Akash Kumar Jain, Santosh K. Sahu, Design and development of stationary/moving surfaces for impingement jet cooling (Indian patent application No: 201721017344, Published on: July 07, 2017)

**International Journals**

1. Kothari R., Sahu S. K. and Kundalwal S. I., 2018, Comprehensive analysis of melting and solidification of a phase change material in an annulus, Heat and Mass Transfer. (https://doi.org/10.1007/s00231-018-2453-9)
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3. Kothari R., Sahu S. K. and Kundalwal S. I., 2018, Transversely isotropic thermal properties of carbon nanotubes containing vacancies, Acta Mechanica, 229 (7), 2787-2800.
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5. Sharma A. K., Mishra S. K., Modak M. and Sahu S. K., An Experimental Investigation of Rewetting of Hot Horizontal Surface by Bottom Jet Impingement, Proceedings of 24th National and 2nd International ISHMT-ASTFE Heat and Mass Transfer Conference (IHMTC2017), BITS Hyderabad, Telangana, India, Dec 27-31, 2017.
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**Dr. Shanmugam Dhinakaran,** Associate Professor

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2. R.D.S. Kumar and S. Dhinakaran (2017). Effective viscosity of nanofluids — A modified Krieger–Dougherty model based on particle size distribution (PSD) analysis. Journal of Molecular Liquids (Elsevier), 225, 20 - 27.
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**Dr. Devendra Deshmukh,** Associate Professor

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2. Lanjekar RD, Deshmukh D, Experimental and numerical investigations on spray characteristics of fatty acid methyl esters, R. Soc. Open Sci., vol. 5(2), article 171121, 2018
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**Dr. Shailesh Kundalwal,** Assistant Professor

1 Vijay Choyal, V. K. Choyal, S.I. Kundalwal. Effect of atom vacancies on elastic and electronic properties of transversely isotropic boron nitride nanotubes: A comprehensive computational study. Computational Materials Science 156 (2019) 332–345 (IF = 2.575).

2 S. I. Kundalwal, K. B. Shingare and Ankit Rathi. Effect of flexoelectricity on the electromechanical response of graphene nanocomposite beam. International Journal of Mechanics and Materials in Design (accepted) (IF: 1.896).

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**Dr. N. K. Jain , Professor**

**[A.1] Book**

1. Kapil Gupta, Neelesh Kumar Jain and R.F. Laubscher (2017), "Advanced Gear Manufacturing and Finishing: Classical and Modern Processes" (1st Edition) Academic Press (an imprint of Elsevier Inc.) London, UK, 2017, DOI: 10.1016/B978-0-12-804460-5.00008-0 [ISBN: 978-012-80-4506-0 (eBook); ISBN: 978-012-80-4460-5 (Paperback)]

**[A.2] Book Chapter**

1. Sagar H. Nikam, Neelesh Kumar Jain (2017), "Laser-Based Repair of Damaged Dies, Molds, and Gears" Chapter 6 in *Advanced Manufacturing Technologies: Modern Machining, Advanced Joining, Sustainable Manufacturing* (Editor: Kapil Gupta), Springer International Publishing AG, Switzerland, pp. 137-159, ISBN (online): 978-3-319-56099-1. (DOI: 10.1007/978-3-319-56099-1_6)

**[A.3] Papers in Refereed Journals**

1. Sagar H Nikam, N. K. Jain (2018), "3D-Finite element simulation and image processing based prediction of width and height of single layer deposition by micro-plasma transferred arc process" International Journal of Advanced Manufacturing Technology, 95(9) 3679-3691, DOI: 10.1007/s00170-017-1472-x (March 2018) (Impact factor: 2.6)
2. Sujeet K Chaubey, N.K. Jain (2018), "State-of-art review of past research on manufacturing of meso and micro cylindrical gears" Precision Engineering, 51, 702-728 DOI: 10.1016/j.precisioneng.2017.07.014 (Jan 2018) (Impact factor: 2.58)
3. Sujeet K Chaubey, N.K. Jain (2017), "Investigations on microgeometry of meso bevel and meso helical gears manufactured by WEDM process" International Journal of Advanced Manufacturing Technology, 93(9), 4217-4231, DOI: 10.1007/s00170-017-0884-y (Dec 2017) (Impact factor: 2.6)
4. Mayur S Sawant, N.K. Jain (2017), "Characteristics of single-track and multi-track depositions of Stellite by micro-plasma transferred arc powder deposition process" Journal of Materials Engineering and Performance, 26(8), 4029-4039 (30 July 2017) (DOI: 10.1007/s11665-017-2828-y) (Impact Factor: 1.34)
5. Sagar H Nikam, N.K. Jain (2017), "Three-dimensional thermal analysis of multi-layer metallic deposition by microplasma transferred arc process using finite element simulation" Journal of Materials Processing Technology, 249, 264-273 (DOI: 10.1016/j.jmatprotec.2017.05.043) (Impact factor: 3.65)
6. Sunil Pathak, N.K. Jain (2017), "Critical review of electrochemical honing: sustainable and alternative gear finishing process. Part 2: effects of various process parameters on surface characteristics and material removal rate" Transactions of the IMF: The International Journal of Surface Engineering and Coatings, 95(5), 241-254 (Sep 2017) (DOI: 10.1080/00202967.2017.1338401) (Impact factor: 0.95)

7. Sunil Pathak, N.K. Jain (2017), "Critical review of electrochemical honing (ECH): sustainable and alternative gear finishing process. Part 1: Conventional Processes and Introduction to ECH" Transactions of the IMF: The International Journal of Surface Engineering and Coatings, 95(3), 147-157 (May 2017) (DOI: 10.1080/00202967.2017.1306378). (Impact factor: 0.95)
8. Sunil Pathak, N.K. Jain (2017)," Modeling and Experimental Validation of Volumetric Material Removal Rate and Surface Roughness Depth of Straight Bevel Gears in Pulsed-ECH Process" International Journal of Mechanical Sciences, 124-125, 132-144 (May 2017) (DOI: 10.1016/j.ijmecsci.2017.03.011) (Impact factor: 3.57).
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**[A.4] Papers in the Refereed Conference Proceedings**

1. Sunil Pathak, N.K. Jain (2017), "Effects of Various Parameters of Micro-Geometry on Performance Characteristics of Gears" Proceedings of 3rd International Conference and Exhibition on Automobile Engineering, September 28-29, 2017 Berlin, Germany, p 12 (DOI: 10.4172/2167-7670-C1-008).

**Dr. Satyajit Chatterjee,** Assistant Professor

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. Afzaal Ahmed, Balmukund Dhakar, R Kaul, R Palai, A Roy Choudhury, Satyajit Chatterjee, Hardfacing of AISI304 steel: Fabrication of oxide-boride-nitride ceramic matrix composite layer by laser assisted high temperature chemical reaction, Transactions of the Institute of Materials Finishing, 2017, Vol . 95, No . 4, 207-216.
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5. Balmukund Dhakar, Satyajit Chatterjee, Kazi Sabiruddin, Measuring Mechanical Properties of Plasma Sprayed Alumina Coatings by Nano-indentation Technique, Materials Science and Technology, 2017, Volume 33(3), p285.
6. Balmukund Dhakar, Satyajit Chatterjee, Kazi Sabiruddin, Influence of process parameters on the formation of phases and mechanical properties of plasma sprayed $Al_2O_3$-$Cr_2O_3$ coating, Materials Research Innovations, 2017, Vol . 21, No. 6, 367–376.
7. Balmukund Dhakar, Akshay Namdeo, Satyajit Chatterjee, Kazi Sabiruddin, Heat Treatment of Plasma sprayed alumina-chromia composite coatings, Surface Engineering, 2017, DOI:10.1080/02670844.2017.1316029.
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**Dr. Bhupesh Kumar Lad,** Associate Professor

**International Journal**

1. Jain, A. K., and Lad, B. K. (2017), Dynamic Optimization of Process Quality Control and Maintenance Planning, IEEE Transactions on Reliability, 66(2), 502-517.
2. Jain, A. K., and Lad, B. K. (2017), A novel integrated tool condition monitoring system, Journal of Intelligent Manufacturing, 1-14.
3. Purohit, B. S., Kumar, S., Lad, B. K., Manjrekar, V., and Singh, V. (2017), Optimization of Multi-item Operation Sequences and Batch Size for Non-Parallel Capacitated Machines: A Case Study, International Journal of Performability Engineering, 13(5), 557.
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5. Upasani, K., Bakshi, M., Pandhare, V., and Lad, B. K. (2017), Distributed maintenance planning in manufacturing industries, Computers and Industrial Engineering, 108, 1-14.
6. Kumar, S., Purohit, B. S., Manjrekar, V., Singh, V., and Lad, B. K. (2018), Investigating the value of integrated operations planning: A case-based approach from automotive industry, International Journal of Production Research, 1-22.
7. Kundu, P., Nath, T., Palani, I. A., and Lad, B. K. (2018), Integrating GLL-Weibull Distribution Within a Bayesian Framework for Life Prediction of Shape Memory Alloy Spring Undergoing Thermo-mechanical Fatigue, Journal of Materials Engineering and Performance, 1-12.
8. Nath, T., Akash, K., Chouhan, P., Lad, B. K., and Palani, I. A. (2018), Investigation on thermo-mechanical behavior of SMA spring under the influence of different actuation medium, Microsystem Technologies, 24(6), 2813-2821.
9. Rawat, M., and Lad, B. K. (2018), Novel Approach for Machine Tool Maintenance Modelling and Optimization Using Fleet System Architecture, Computers & Industrial Engineering. (Accepted)

**International Conference**

1. Bakliwal, K., Dhada, M. H., Palau, A. S., Parlikad, A. K., and Lad, B. K. (2018), A Multi Agent System architecture to implement Collaborative Learning for social industrial assets, IFAC-Papers On Line, 51(11), 1237-1242.

**Dr. Anand Parey ,** Professor

1. A. Parey, A. Singh, Gearbox fault diagnosis using acoustic signals, continuous wavelet transform and adaptive neuro-fuzzy inference system, Applied Acoustics, In Press, doi.org/10.1016/j.apacoust.2018.10.013
2. R. B. Sharma, A. Parey, Modelling of acoustic emission generated due to pitting on spur gear, Engineering Failure Analysis, 86 (2018), 1-20.
3. V. Sharma, A. Parey, Performance evaluation of decomposition methods to diagnose leakage in a reciprocating compressor under limited speed variation, Mechanical Systems and Signal Processing, In Press, doi.org/10.1016/j.ymssp.2018.07.029
4. A. Saxena, M. Chouksey, A. Parey, Measurement of FRFs of coupled geared rotor system and the development of an accurate finite element model, Mechanism and Machine Theory, 123 (2018), 66-75.
5. A. Singh, A. Parey, Gearbox fault diagnosis under non-stationary conditions with independent angular re-sampling technique applied to vibration and sound emission signals, 144(2019), 11-22.
6. R. B. Sharma, A. Parey, Modelling of acoustic emission generated in rolling element bearing, Applied Acoustics, 144 (2019), 96-112.
7. V. Sharma, A. Parey, Evaluating the performance of signal processing techniques to diagnose fault in a reciprocating compressor under varying speed conditions, Advances in Intelligent Systems and Computing, 748 (2019), 171-183.

8. N.K. Raghuwanshi, A. Parey, Experimental measurement of mesh stiffness by laser displacement sensor technique, Measurement, 128 (2018), 63-70.
9. V. Sharma and A. Parey, Effect of lubricant on the stiffness and damping characteristicsin a single stage gearbox: A theoretical analysis, 1st international and 4th National Conference on Reliability and Safety Engineering", Feb 26-28, 2018, IIITDM Jabalpur, India.

## Notable Students Achievements during the Year

1. DRDO DRUSE 2018:

   A team of 4 Mechanical Engineering Undergraduates Avadhoot Sinkar, Shreyas Singh, Aditya Pandey led by Chaitanya Mehta, participated in DRDo's DRUSE (DRDO Robotics and Unmanned System Exposition). Out of the 1180 Entries from all over the country, the team qualified for the Zonal Level Screening in the Central Zone (@ DIAT, Pune) and presented its work on A Novel Spherical Robot with Jumping Capability under the heme of multistorey building Surveillance. The team achieved 3rd Position in the Central Zone and was among the top 30 Finalists, and got special mention for the Multibody Dynamics Simulations performed of the Spherical Robot by the Judges during the Thanksgiving Ceremony. The team bagged the total cash prize of Rs. 50,000/- from the event.
2. Hero Campus Challenge 2018:

   A team of 3 Mechanical Engineering Undergraduates Agam Gupta, Chaitanya Mehta, Soorya Pratap, has successfully completed the Aptitude round of Hero Campus Challenge 2018, and is currently working on the development of solution of the Problem statement in Technical Domain.
3. Third Rank in ASIA Pacific zone in ASME Student design Competition 2018. It was our first attempt at this competition and we have secured this rank after defeating IIT Kharagpur and IIT Bombay in the same competition.
4. 5$^{th}$ Position in 6$^{th}$ Inter IIT Tech Meet: Out of 17 IITs that participated in Inter IIT Tech meet for Engineers' Conclave: A competition in which All IITs have presented their top projects. We were the only new IIT in Top 5. It was our first presence at Inter IIT Tech meet.

# 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
- Himalayan Glaciology
- Smart cities, Urban planning
- Structural Health monitoring
- Sustainable Construction
- Water-Energy-Food nexus

## From the HoD's Desk

**Dr. Sandeep Chaudhary**
Professor
schaudhary@iiti.ac.in

The Discipline of Civil Engineering has been functioning since 2016. The Discipline offers a four-year course leading to the Bachelor's Degree in Civil Engineering and Ph.D. in Civil Engineering. The Discipline is involved in 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 faculty members of the Discipline 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.

## Head of the Discipline

**Dr. Sandeep Chaudhary**
Professor & Head
schaudhary@iiti.ac.in

**Research Interests:**

- Structural Engineering
- Steel Concrete Composite Structures
- Microstructure and Durability of Concrete
- Advanced Characterisation Techniques for Building Materials
- Service load behaviour of Structures
- Finite Element Analysis

## Faculty Members

**Dr. Munir Ahmad Nayak**
Assistant Professor
munir_nayak@iiti.ac.in

**Research Interests:**

- Water Resources Systems Analysis
- Hydrology
- Hydroclimatology
- Bayesian Statistics

**Dr. Lalit Borana**
Assistant Professor
lalitborana@iiti.ac.in

**Research Interests:**

- Unsaturated Soil Mechanics
- Geotechnical health monitoring,
- Soil-Structure Interaction
- Soft Soil and Creep
- Ground Improvement Technics
- Environmental Geotechnics

**Dr. Manish Kumar Goyal**
Associate Professor
mkgoyal @ iiti.ac.in

**Research Interests:**

- Resilience of River Basins and Hydrological Modeling
- Hydro-climatology & Statistical Downscaling
- Irrigation Management and Crop Modeling Applications
- Multivariate Statistical Analysis, Machine Learning Models and Data Mining

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

**Research Interests:**

- Seismic Microzonation of Mega Cities
- SiteEffects and Seismic Design of Foundations
- Dynamic Soil Structure Interaction Analysis
- Liquefaction Studies
- Landslide Hazard Assessment and Monitoring
- Rock Mechanics and Underground Structures

**Dr. Mohd. Farooq Azam**
Assistant Professor
farooqazam@iiti.ac.in

**Research Interests:**

- Hydro-Meteorological monitoring
- Glacier Mass and Dynamic studies
- Energy Balance of Glacier and Snow Cover
- Hydrological modelling of Himalayan Watersheds
- Climate Change impacts on Himalayan Water Resources

## Associated Faculty Members

**Dr. Santanu Manna**
Visiting Assistant Professor
smanna@iiti.ac.in

**Research Interests:**

- Earthquake Statistics
- Seismic Wave Propagation
- Mathematical Seismology
- Mathematical Modelling & Simulation

## Adjunct Professors

**Prof. Dr.-Ing. Balthasar Novak**
Adjunct Professor
balthasar.novak@
ilek.uni-stuttgart.de

**Research Interests:**

- Design of bridges
- Assessment of existing bridges including health monitoring
- Development of bridge management systems
- Reinforcing elements using carbon fibres
- Earthquake resistant design of concrete structures

# Dr. Munir Ahmad Nayak's Research Group

## Thrust Areas

1. Dynamic adaptive water management for a changing climate
2. Hydrologic extremes in a changing climate: understanding background physical atmospheric process and developing statistical modeling for extremes

## Research Activities

Dr. Munir's research group focuses on improving reservoir operations for flood control and water supply objectives, especially in regions which rely on fixed seasonal reservoir pools to mitigate water shortage risks. The group develops models to investigate the potential for devising operating policies that incorporate the conjunctive use of surface and sub-surface water and the state-of-the-art weather hindcasts. The policies aim to allow transfer of surplus flood releases to groundwater storage and the use of weather hindcasts allow the efficient supply of water while maintaining flood protection. Such dynamic polices are adaptive in a sense that they respond to the changing climate. An example from our work (Nayak et al., 2018), Figure A, below highlights that excellent benefits to be gleaned from our hypotheses (red and yellow lines) when compared to the actual operations (green line) of a particular reservoir.

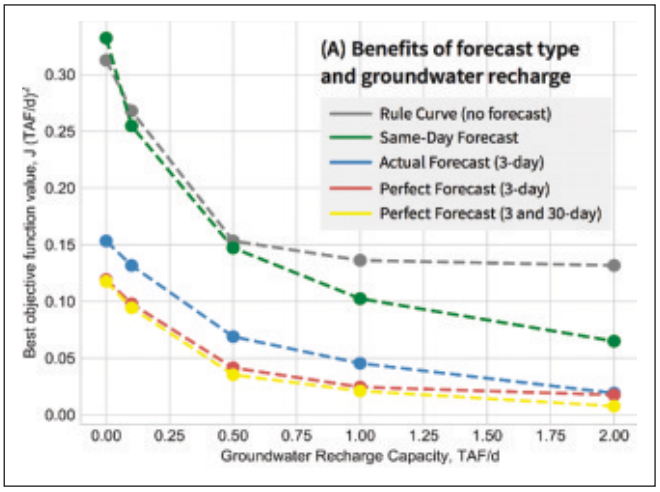



Figure A:a) Optimal objective function under all scenarios (varying conjunctive use capacity and forecast type) from October 1980 to December 2015.

Combating the threat of the changing climate, the group is actively involved in developing physical understanding and advanced statistical models to untangle subtle yet significant patterns in the atmosphere that drive the variability of hydrologic extremes, such as floods and droughts.

## References:

Nayak, M. A., Herman, J. D., and Stein schneider, S. (2018). Balancing flood risk and water supply in California: Policy search integrating short term forecast ensembles with conjunctive use. Water Resources Research, 54. https://doi.org/ 10.1029 /2018WR023177[Impact Factor: 4.36]

## 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. [Impact factor = 4.36]
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: https://doi.org/10.1002/2016WR019033. [Impact factor = 4.36] Featured in Water Resources Research
3. Nancy A. Barth, Gabriele Villarini and Munir A. Nayak, 2017: Mixed populations and annual flood frequency estimates in the western United States: The role of atmospheric rivers. Water Resources Research, 53(257–269), doi: https://doi.org/10.1002/2016WR019064. [Impact factor = 4.36]
4. 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. [Impact factor = 5.475]

**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 Ph.D. 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 climate. Dr. Nayak has published scientific research articles in world-leading hydroclimatology and water resources journals (with the highest impact factors): Water Resources Research, Journal of Hydrology, Journal of Hydrometeorology, Geophysical Research Letters, and Computer-Aided Civil and Infrastructure Engineering. Dr. Nayak has received many prestigious awards, which include the Visiting Fellow Award from Loughborough University, UK; NASA Earth and Space Science Fellowship, USA; Early Career Research Award (ECRA), India, to name a few.

## Dr. Neelima Satyam's Research Group

Landslide

**Dr. Neelima Satyam**

Associate Professor
neelima.satyam@iiti.ac.in

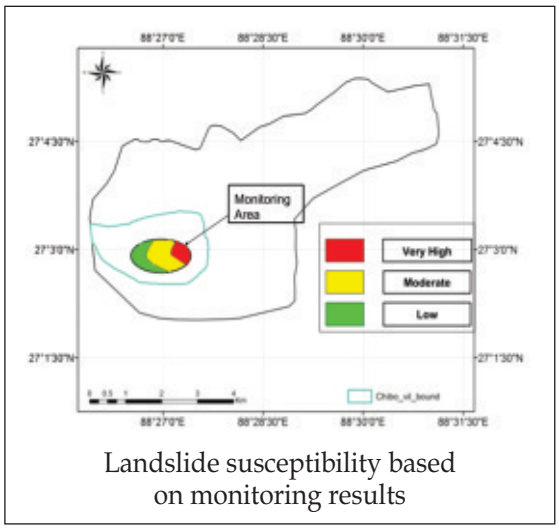
Ph. D., Civil Engineering, Indian Institute of Technology, Delhi
M.Tech., Geotechnical Engineering, Indian Institute of Technology, Delhi
B.Tech, Civil Engineering, Sri Venkateswara University, Tirupati

**Thrust Area:**

Analysis and Modelling of Rainfall Induced Shallow Landslides

**Details of the work:**

With the sole exception of earthquakes, landslides are the most common natural disaster in the Indian Himalayan region. Landslides affect 15% of India's land area (around 0.49 million km$^2$). The damage caused due to landslides is massive; leading to loss of life, property and agricultural land. Studies on landslides have gained worldwide attention due to the rapid increase in urbanization and change in climate; and consequently, its increasing impact on socio-economic factors. There is a dire need for understanding landslides, estimating its occurrence potential, and formulating strategies to minimize its impact.




Landslide susceptibility based on monitoring results

The vast majority of the landslides in the Himalayas are categorized as shallow landslides. These are caused or reactivated primarily by rainfall. Therefore, it is important to understand the relationship between landslide incidences and rainfall conditions.

There are mainly two types of methods to understand this relationship: physical and empirical. Physical process models are based on numerical models which study the relationship between rainfall and pore water pressure leading to slope instability whereas empirical methods study landslides caused by rainfall events –heavy downpours that trigger instantaneous landslides; and, low but continuous antecedent rain that destabilizes the slope and triggers a landslide. As empirical methods produce only binary results (landslides either occur or do not)the group has also adopted and evaluated probabilistic methods. The study also explores the relationship between rainfall and landslide occurrences by using a mathematical model to simulate the potential triggering conditions.

IoT sensor-based field observations have been carried out to validate and assess the empirical model. The installed sensors are: (i) Microelectromechanical Systems (MEMS) tilt sensor; and,(ii) volumetric water content sensor. While the former measures the tilting angle of the instrument at shallow depths; the later measures the soil moisture levels. The work shows that early warning systems can be designed based on these rainfall thresholds as the first line of action. Such studies can go a long way in understanding the relationship between rainfall and landslide occurrences across the Himalayan region and develop suitable disaster mitigation and management strategies.

**Awards and Achievements:**

- Executive member (Elected), Indian Geotechnical Society for the term 2019-2020
- Co-opted Member, Program Advisory Committee (PAC), Civil and Environmental Engineering, Science and Engineering Research Board (SERB), DST
- Chairperson, for MONBUKAGAKUSHO: MEXT Scholarships of Japanese Government (for selecting PhD/MS students from India) in Earthquake / Civil Engg stream
- Awarded research grant from ISRO to carry out Geospatial numerical modelling of debris flow for quantitative landslide risk assessment considering the entrainment
- Visiting Researcher (June - July 2018), Institute of Geophysics, University of Stuttgart, Germany
- An Invited talk for research collaboration on Landslide prediction models and real time warning system on May 4th 2018 at NCESS Trivandrum
- Conducted Short Course on Recent Advances in Geotechnical and Structural Engineering, March 8-10 2018
- An invited talk on Geotechnical challenges at IISC Bangalore on 14$^{th}$ Dec 2018

**Recognitions:**

- Executive member (Elected), Indian Geotechnical Society for the term 2019-2020
- Co-opted Member, Program Advisory Committee (PAC), Civil and Environmental Engineering, Science and Engineering Research Board (SERB), DST
- Chairperson, for MONBUKAGAKUSHO: MEXT Scholarships of Japanese Government (for selecting Ph.D./M.S. students from India) in Earthquake / Civil Engg stream

**Projects**

***Sanctioned***

- A Project titled "Geospatial numerical modelling of debris flow for quantitative landslide risk assessment considering the entrainmnet" Indian Space Research Organization (No.DS-2B-13012(2)/42/2018)

***Ongoing***

1. A Project titled "Landslide hazard assessment and monitoring at Chibo Pashyar, Kalimpong'', NRDMS, DST (NRDMS/02/31/015)

## Research Publications

- Book Chapter on "Determination of Anelastic Attenuation Factor (Q) and Decay Factor (K) from Ground Motion Records of the Intra-plate Region" *Geotechnics for Natural and Engineered Sustainable Technologies,* Chapter no:21, Springer Nature Singapore Pte Ltd, PP 345-369
- Abhirup Dikshit, Neelima Satyam, Ikuo Towhata (2018), " Early warning system using tilt sensors in Chibo Kalimpong, Darjeeling Himalayas, India" Natural Hazards, Springer (I.F.- 1.958) (https://doi.org/10.1007/s11069-018-3417-6)
- Abhirup Dikshit and Neelima Satyam (2018), Landslide Hazard Assessment and Monitoring in Chibo Pashyor, Kalimpong, India, Geophysical Research Abstracts Vol. 20, EGU2018-68-2
- Abhirup Dikshit and Neelima Satyam (2018), Probabilistic Assessment of Paglajhora Landslide, Proceedings of Indian Geotechnical Conference, TH03_40
- Abhirup Dikshit and Neelima Satyam (2019), Monitoring of unstable slope with low cost sensor network in Chibo, Kalimpong, Darjeeling Himalayas, India, XVI Pan American Conference on Soil mechanics and Geotechnical Engineering, Nov 17-19, 2019, Mexico (Accepted)
- Neharika Rao and Neelima Satyam (2018), PSHA Analysis for Jorethang Slope in Sikkim State, India, Proceedings of Indian Geotechnical Conference, TH03_52
- Abhirup Dikshit and Neelima Satyam (2019), Early warning of surface failure of slopes using tilt sensors in Chibo Pashyor, Kalimpong, XVI Asian Regional Conference on Soil Mechanics and Geotechnical Engineering, Oct 14-18, 2019, Taipei, Taiwan (Accepted)
- Swathi Priyadarsini and Neelima Satyam (2018), ''Design of pile foundation system for wharf structure in liquefiable soils", Proceedings of Indian geotechnical conference, TH06_30
- Ambika Srivastav and Neelima Satyam (2018), Sesimic analysis of a circular tunnel considering different rockmass quality Q, 16th symposium on Earthquake Engineering, IIT Roorkee

# Dr. Lalit Borana's Research Group

Development of Fiber Optic Sensor Networks for
Monitoring Soil Slopes and Early-warning Systems

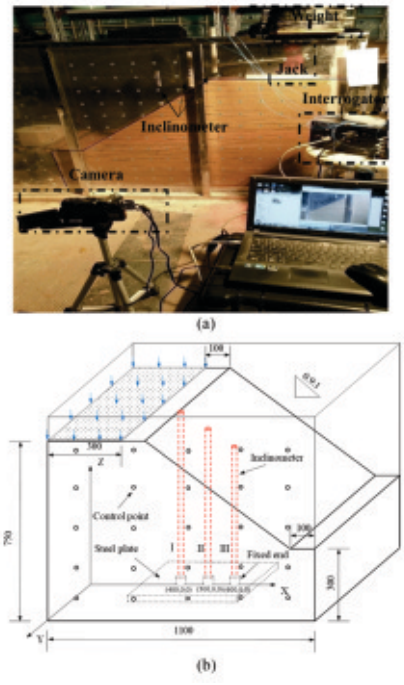



Fig. 1. (a) Photograph of the indoor model test, and (b) the dimensions of the model slope (Adopted from Pei et.al. 2019)

## Introduction

We are presently facing serious challenges in fostering eco-innovation and contributing to sustainable growth. Preserving sustainable infrastructure requires a proper understanding of the soil and climate condition. There are several factors that influence ground behavior (which include physical, chemical and stress state variables). Fibre optic technology has great potential in monitoring the structural health of some key structures (such as bridges, tunnels, abutments, retaining walls, soil nails, etc). Studies have been conducted by Dr. Borana research group to develop an effective and convenient method to analyze slope stability in real time, based on fiber Bragg grating (FBG) sensors. First, a new type of FBG inclinometer has been designed to capture the internal slopedis placement variation considering temperature compensation, and an optimum displacement algorithm is selected by an experiment. Once the monitoring work is prepared, the potential slope slip surface is determined by monitored displacement in an optimization model based on the maximum displacement increment of the objective function. Finally, integral processing is used with the Bishop method to simplify the calculation, and a safety factor is estimated by the integral method.

Development of an early-warning system for slope collapse is essential to ensure the safety of human beings and assets. Based on fiber optic sensing technology and Internet Of Things, a new sensing transducer for internal earth pressure in the soil slope is being developed and tested. With the new real-time fiber optic sensing technology and rainfall data, the factor of safety for the soil slope is calculated and used to determine the health condition of the instrumented slope. The newly developed early-warning system is found to be very effective for health monitoring and preformation evaluation of soil slopes.

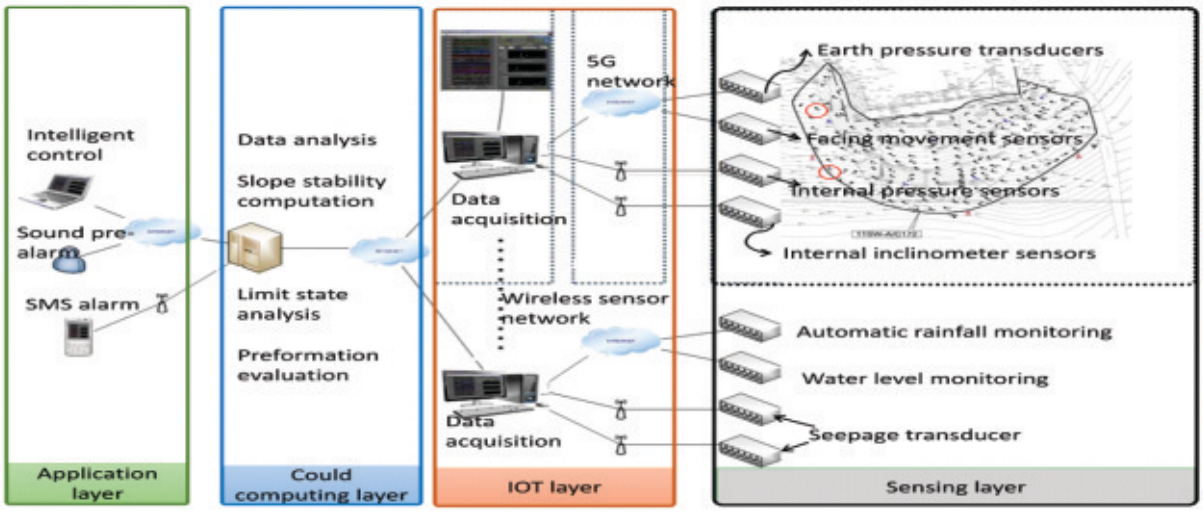



Fig. 2 The hierarchical structure of early-alarm system for soil slope (from Xu et.al., 2017)

**Dr. Lalit Borana**
Assistant Professor
lalitborana@iiti.ac.in

**Dr. Lalit Borana** has received his Ph.D. in Geotechnical Engineering from The Hong Kong Polytechnic University (PolyU) in 2014 and M.Tech in Geotechnical Engineering from Indian Institute of Technology Guwahati (IITG) in 2008. 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. Dr. Borana has authored and co-authored more than 25 quality publications in esteemed international journals and peer-reviewed conferences. His current research interests involve Unsaturated soil mechanics, Structural Health monitoring, Soil-Structure Interaction, Geoenvironmental Engineering, and Ground Improvement techniques. Dr. Borana serves as a reviewer for more than 15 International SCI Indexed Journals. He has received "Outstanding Reviewer Award-2018" from the journal of "Computers and Geotechnics" by ELSEVIER, Netherlands. Recently, he has also been appointed as a Guest Editor for "International Journal of Distributed network sensors" by Sage Publishers (UK).

## Reference


- Pei, H.F., Zhang, S-Q., L., Borana, L., Zhao, Yi., and Yin, J. H. (2019). "Slope stability analysis based on real-time displacement measurements." Measurement, Elsevier, 131: 686-693. ( I F: 2.3)
- Pei, H-F., Zhang, S-Q., Borana, L., Yuan,B. (2018). "Development of a preliminary slope stability calculation method based on internal horizontal displacements." Journal of Mountain Science. Vol 15 (5): 1129-1136. (IF: 1.1)
- Xu, D.S., Dong, L., Borana,L., and Liu Hua-Bei. (2017). "Early-warning system with quasi- distributed fiber optic sensor networks and cloud computing for soil slopes." IEEE Acess. DOI 10.1109/ACCESS.2017.2771494. (IF: 3.24)
- Chen, W.B., Feng, W.Q., Yin. J.H., Borana, L., and Chen. R.P. (2018). "Characterization of Permanent Axial Strain of Granular Materials Subjected to Cyclic Loading Based on Shakedown Theory." Construction and Building Materials ( Under review) (IF: 4.03)

# Dr. Manish Goyal's Research Group

1. **Thrust areas**

- Resilience, climate change and extreme studies
- Water resources and hydrology
- Drought and flood assessment

2. **Academic Awards/Recognitions/Achievements:**

- Recipient of American Society of Civil Engineers (ASCE)-Best Theoretical-Oriented Paper Award 2018

3. **Sponsored Research Projects:**

***Project sanctioned:***

- Title of project: Identification hydropower sites and critical glacial lakes for sustainable water resources management in Himachal Pradesh, Sponsoring Agency: MOEF & CC

***Ongoing projects:***

- Assessment of impact of climate change on crop water requirements and productivity of major crop in Sikkim, Himalayan region of northeast India, Sponsoring Agency: DST
- An integral assessment of groundwater and surface water using stable isotopes of water, Sponsoring Agency: BRNS
- Quantification of Soil organic carbon sequestration using remote sensing and field based approach, Sponsoring Agency: DST
- Assessment of snowmelt and glacier melt runoff contribution in upstream part of Teesta river catchment using hydrological modeling and field based measurements, Sponsoring Agency: DST

4. **Research Publications:**

Gilbert Hinge, Rao Y Surampalli, Goyal Manish Kumar (2018), Prediction of soil organic carbon stock using digital mapping approach in humid India, Env Earth Science, 77:172 (DOI: 10.1007/s12665-018-7374-x)

5. **Development of new course:**

Developed a new course CE 635: Water and climate: sustainability and policies for PG and Ph. D. students.

**Dr. Manish Kumar Goyal**

Associate Professor
mkgoyal @ iiti.ac.in

**Dr. Manish Kumar Goyal** is presently working as an Associate Professor in the Discipline of Civil Engineering at IIT Indore. Earlier, he worked in IIT Guwahati, McGill University, Montreal, Canada and Nanyang Technological University (NTU) Singapore. He has published more than 75 international papers in peer reviewed journals and presented his work in several national and international conferences/workshops.

Recently, he has been awarded the American Society of Civil Engineers (ASCE's)-Visiting International Fellowship 2019 and he also received Best Theoretical-Oriented Paper Award by the American Society of Civil Engineers (ASCE) 2018. Earlier, he was awarded Indo-US WARI Fellow to pursue research at University of Nebraska, Lincoln, USA and The Japan Society for the Promotion of Science (JSPS) Fellowship Program to pursue research at University of Tokyo, Tokyo, Japan. He was also awarded Young Scientist Award from APEC Climate Centre, Busan, Republic of Korea and he was also recipient of Canadian commonwealth scholarship award to pursue research at University of Waterloo, Waterloo, Canada. Dr. Goyal is in the Editorial Board of about half a dozen journals.

# Dr. Mohd. Farooq Azam's Research Group

Third Pole Research at IIT Indore

**Thrust Area:** Glaciology and Hydrology

The Himalaya, aptly called the "Third Pole", holds around a quarter of the planet's mountain glaciers. These glaciers provide the headwaters to the regional rivers (the Ganges, Indus, and Brahmaputra) and partly cater to the fresh water requirements of over 900 million people. However, we know little of the impact of climate change on these glaciers and expected consequences of regional hydropower generation on irrigation, industries, and the local population.

**Research Activities:**

Dr. Mohd. Farooq Azam's research group is involved in inter-disciplinary research on the Himalayan glaciers. Their work involves extensive field-based research, remote sensing and long-term modelling of glacier mass balance and associated water resources. Major ongoing research activities are: (i) Glacier mass balance and its dynamic response to recent ice mass wastage, (ii) Volumetric estimation of ice locked in the Himalayan glaciers, (iii) Modelling of the glacier and snow ice melt under changing climate and future projections of runoff in the Himalayan rivers, and (iv) Impact of black carbon on glaciers melting in the Himalaya. Recently, the research group has presented their findings in a study on the changes in glaciers along the Himalayan-Karakoram range, as well as discussed their climate-change context. Their study suggests that Himalayan glaciers have been retreating and shrinking since the 1850s. These findings are in close agreement with climate warming. This mass wastage in the Himalaya has resulted in increasing debris cover and the growth of glacial lakes. Remotely sensed measurements indicate nearly balanced mass budgets for Karakoram glaciers since the 1970s. This anomalous behaviour of Karakoram glaciers is probably linked with increased snowfalls, cooler summers and their lower sensitivity to temperature change. Melt contributions from Himalayan-Karakoram glaciers are projected to increase until 2050 and then decrease, though a wide range of present-day area and volume estimates propagates large uncertainties in the future runoff.

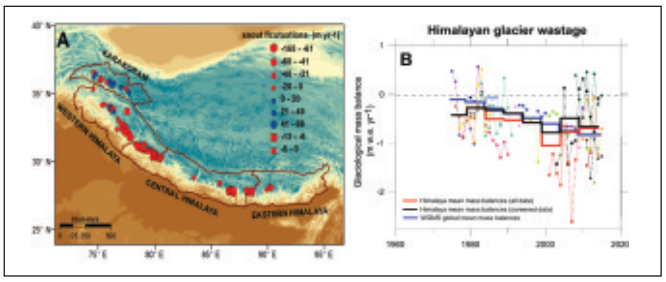



Figure 1: Panel A shows the glacier recession rates (some since the 1850s) along the Himalayan- Karakoram Range while panel B shows the average glacier wastage from Himalayan glaciers along with all annual glacier mass balance observations.

**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 a Master's degree in chemistry in 2007 but took a 180-degree turn towards glaciology. He has worked on Chhota Shigri Glacier in Himachal Pradesh, India, since 2008 as a Master of Philosophy student at Jawaharlal Nehru University, India. He obtained his Doctorate in Earth, Universe & Environmental Sciences from Grenoble-Alps University, France. In order to strengthen his research, Dr.Farooq has done advance level mountaineering courses with the Indian army. He has also received the prestigious 'INSPIRE Faculty Scheme' award in 2015.

## Publications:


- M. F. Azam, P. Wagnon, E. Berthier, C. Vincent, K. Fujita, and J. Kargel (2018). Review of the status and mass changes of Himalayan-Karakoram glaciers. Journal of Glaciology, 64 (243), 61-74. https://doi.org/10.1017/jog.2017.86 (Impact Factor = 3.2, Citations = 7).

- R. Ramsankaran, A. Pandit and M. F. Azam (2018) Spatially distributed ice-thickness modelling for Chhota Shigri Glacier in western Himalayas, India. International Journal of Remote Sensing, 39(10), 3320-3343. https://doi.org/10.1080/01431161.2018.1441563 (Impact Factor = 1.72, Citations = 2).
- C. Vincent, A. Soruco, M. F. Azam, R. Basantes-Serrano, M. Jackson, B. Kjøllmoen, E. Thibert, P. Wagnon, D. Six, A. Rabatel, A. Ramanathan, E. Berthier, D. Cusicanqui, P. Vincent and A. Mandal (2018). A non-linear statistical model for extracting a climatic signal from glacier mass-balance measurements. Journal of Geophysical Research: Earth Surface, 123, 2228 2242. https://doi.org/10.1029/2018JF004702. (Impact Factor = 3.41).

**4. Book Chapter**

- 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 Nature. 2018. https://www.springer.com/us/book/9783319922874#aboutBook

**Achievements:**

- UNESCO project: Awarded a UNESCO project "Himalayan Glaciers and risks to local communities" under IGCP scheme. This 5-year project is led by Dr. Adina Racoviteanu at Aberystwyth University (UK) and Dr. Mohd Farooq Azam is Indian coordinator. This project aims to train PhD and early career scientists from India, Nepal and Bhutan about the Himalayan glaciers and related risks by organizing two workshops each year in different countries.
- Organized a workshop, "Use of Remote Sensing and GIS Techniques for Geosciences Application: An introductory workshop", June 3-4, 2018, with Royal Thimphu College, Ngabiphu, Thimphu, Bhutan under UNESCO/IGCP project.
- Two-month Visiting Scientist position in France: Received a two month Visiting Scientist Fellowship from IGE (Institut des Géosciences de l'Environnement), Grenoble, France for summer 2019.
- Published interview for non-scientific community: A news story "Himalayan glaciers are wasting away, threatening mountain communities" about our work on Himalayan-Karakoram glaciers covered by "Mongabay", an environmental science and conservation news magazine on 14th May 2018 (reporter Ms. Neha Jain interviewed Mohd. Farooq Azam).
  https://india.mongabay.com/2018/05/14/himalayan-glaciers-are-wasting-away-threatening-mountain-communities/

## Dr. Sandeep Chaudhary's Research Group

**Thrust Area:**

- Development of novel low cost bricks and characterisation of building materials.
- Rheological studies of different concrete mixes.
- Development of functionally graded building products.

**Projects Sanctioned:**

- "Natural-coloured functionally graded rubberised geopolymer system: A cement-less solution for optimised concrete paver manufacturing" funded by DST, GOI. Indo-UK Project. (2018-2020). Approval received. Collaborating Institute: University of Edinburgh, UK.

**On Going Projects:**

- "Waste utilisation in concrete as aggregate: Asian perspective" funded by Asian Concrete Federation (2016-2019). Team leader of researchers from China, Hong Kong and Thailand.
- "Sustainable and economical functionally graded rubberized concrete pavements" funded by DST, GOI. Indo-Tunisia Project. (2017-2020).Collaborating Institute: University of Carthage, Tunisia.

## Publications:

- Siddique, S., Shrivastava, S., and Chaudhary, S. (2018). "Durability properties of bone china ceramic fine aggregate concrete." Construction and Building Materials, 173, 323-331 (I.F. 3.49)
- Siddique, S., Shrivastava, S., and Chaudhary, S. (2018). "Influence of ceramic waste as fine aggregate in concrete: Pozzolanic, XRD, FT-IR and NMR investigations." Journal of Materials in Civil Engineering, ASCE, 30(9), 04018227-1-12 (I.F. 1.76)
- Saxena, R., Gupta, T., Sharma, R. K., Chaudhary, S., and Jain A. (2018). "Assessment of Mechanical and Durability Properties of Concrete Containing PET Waste." Accepted for Publication, Scientia Iranica, DOI: 30.894.160830 (I.F. 0.48)
- Siddique, S., Shrivastava, S., Chaudhary, S., and Gupta, T. (2018). "Strength and impact resistance properties of concrete containing fine bone china ceramic aggregate." Construction and Building Materials, 169, 289-298. (I.F. 3.49)
- Siddique, S., Shrivastava, S., and Chaudhary, S. (2017). "Lateral force microscopic examination of interfacial transition zone in ceramic concrete." Construction and Building Materials, 155, 688- 725. (I.F. 3.49)

Photographs of the facilities and activities:

Dynamic Shear Rheometer

Brick Making Machine

Bricks Developed

**Dr. Sandeep Chaudhary**

Professor & Head
schaudhary@iiti.ac.in

**Dr. Sandeep Chaudhary** received his PhD in civil engineering from Indian Institute of Technology Delhi in 2006. He later joined Kunsan National University (South Korea) as postdoctoral fellow in 2010. He joined Indian Institute of Technology Indore in 2017 and has been working as Professor since 2018. He is the Principle Investigator of many ongoing international research grants focusing on the area of sustainable building and composite structures. He is an active member of Institute of Engineers India and Asian Concrete Federation. For the past eight years he has been actively involved as a steering committee member of the Young Researchers Graduate Symposium (YRGS).

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.

His main research interest are (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. He has published more than 50 papers in SCI/SCI(E) Journals on the above mentioned research areas.

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.

# Dr. Santanu Manna's Research Group

### Thrust Area: Seismic Wave Propagation, Modelling & Simulation on Seismology

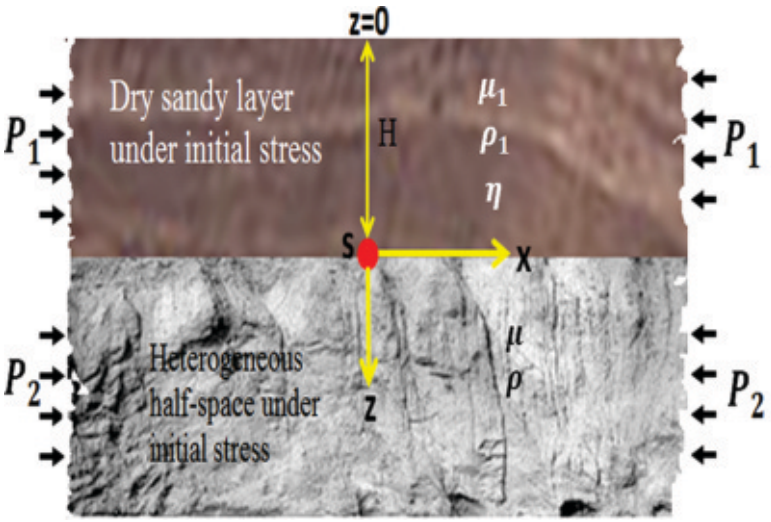
Seismology is the science that studies the shaking of the Earth through seismic waves. It reveals the inner structure of the Earth and the physics of earthquakes. It occupies an important position within more general fields of Geophysics and Earth Sciences. It also throws up fascinating theoretical problems regarding the analysis of elastic wave propagation in complex media.

### About Publications during 2017-2018:

We have published two papers:

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 (SCI, IF: 2.332).

   This paper aims to study the analytical problem of torsional surface wave propagation in an initially stressed heterogeneous anisotropic layer over a Voigt type viscoelastic half-space. It is known that an elastic homogeneous medium does not allow torsional surface waves to pass through it, while a viscoelastic medium does allow it. The closed-form solutions of the dispersion equation have been derived by solving the displacement equations subject to sufficient boundary conditions.




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, Accepted. (SCI, IF: 1.818).

### Conference:

The group has successfully organized one International Conference on Mathematical Modelling and Scientific Computing (ICMMSC–2018) during July 19-21, 2018 at IIT Indore. There were around 200 delegates at the conference. Speakers and participants were from: Technische Universität Berlin, Germany; Northern Illinois University, U.S.A.; Syracuse University, U.S.A.; Miami University, U.S.A.; University of Botswana, South Africa; Qassim University, Kingdom of Saudi Arabia; IISc Bangalore; TIFR Bangalore; IIT Madras; IIT Dhanbad; IIT Guwahati; IIT Roorkee; IIT Delhi; CSIR- SERC Chennai; DRDL Hyderabad; IIT Kharagpur and IIT Mandi.

### Development of a new course:

The research group has developed a course "Earthquake Engineering (CE 494/CE 694)" (2-1-0-3) for UG, PG & Ph.D. students.

# 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-Mass spectrometry (GC-MS)<br>• Nuclear Magnetic Resonance (NMR, 400 MHz) | • 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 Ph.D. 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 IIT's in India to introduce a two-year master's 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.

**Notable achievements:** Dr. Biswarup Pathak has received the 'Early and Mid-Career Research Award' from Indian National Science Academy in 2017.

**Awards, Fellowships & Achievements:**

1. SERB-Overseas Doctoral Fellowship in 2018 for one of Dr. Chelvam Venkatesh's Ph.D. students to conduct research at Purdue University, USA with Prof. Kavita Shah.
2. Commonwealth Fellowships have been awarded to two of Dr. Chelvam Venkatesh's Ph.D. students in 2018 at Loughborough University, UK to work on Cancer Diagnosis and Therapeutics with Prof. Paul Roach.
3. DAAD Master's Sandwich Award has been conferred on two M.Sc project students (Ms. Vanitha Reddy & Mr. Chetan Sharma).

4. The research areas in which the discipline is very actively involved includes 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 (by Prof. R. Misra), solid state supra molecular Chemistry (by Prof. M. Shaikh) , single molecule fluorescence imaging (by Prof. T. Mukherjee), molecular design of dynamic peptide based materials for the applications in biology and nanosciences (Prof. A. Das) , computational study of nanomaterials for fuel cell application, spintronics, catalysis (by Prof. B. Pathak), organo-catalytic mediated asymmetric synthesis, total synthesis of highly biologically active compounds, metal mediated synthetic transformations (by Prof. S. Samanta), synthetic inorganic and organometallic chemistry of transition metals and nano-materials for catalysis (by Prof. S. Singh).

**Global Initiative of Academic Networks (GIAN):** Faculty members are actively involved in conducting GIAN courses. Successful GIAN courses include: Computationally Aided Materials Designing for Materials Genome, Metal-Ligand Interplay in Advanced Coordination Chemistry, Advanced Concepts in the Synthesis of Pharmaceutical Drugs, Chemistry and Biology of Carbohydrates.

**Workshops and Symposiums:** Faculty members in Chemistry are actively involved in conducting workshops to serve society under the "Continuing Educational Programme" (CEP) scheme. The workshops were: "Modern Spectroscopic Techniques-I & II". These were conducted in partnership with Sophisticated Instrumentation Centre (SIC) during which faculties, scientists, researchers, postgraduate and undergraduate students from various institutes across the country participated in large numbers. The discipline has also organized two national symposiums namely; the Frontier Lecture Series on Chemistry; and, Frontiers in Organometallic and Inorganic Chemistry. Both symposiums featured the active participation of renowned national professors.

*Faculty members in Chemistry*

**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.

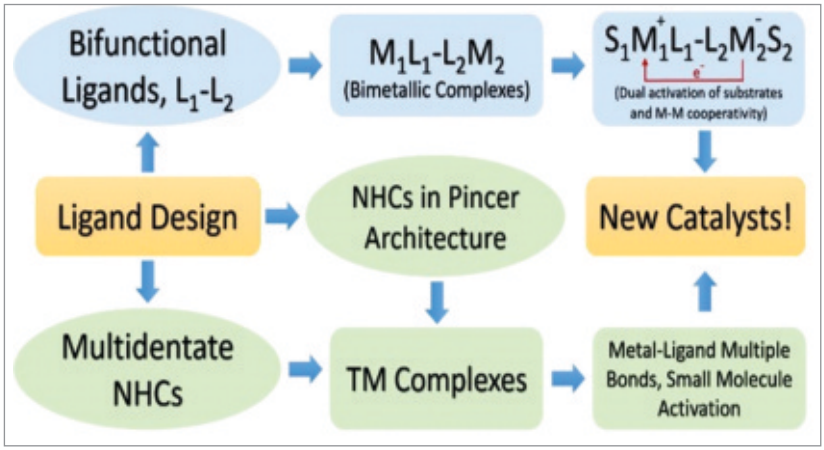
The discipline is also engaged in interdisciplinary collaborations with institutes of national (Banaras Hindu University, RRCAT, IACS, IIT Kharagpur, SNU) and international (Uppsala University, Sweden, Kalshrue Institute of Technology, University of Mainz, Germany, National Institute of Advanced Industrial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

**Dr. Amrendra K. Singh**
Assistant Professor
HoD
aks@iiti.ac.in

**Dr. Amrendra K. Singh** (Ph.D. 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.

The idea of cooperative catalysis has inspired synthetic chemists to create artificial dual activation catalysts that use dual, cooperative activation modes, allowing for mild reaction conditions and high turnover numbers. Our group is working towards the development of a new class of bifunctional, binucleating pincer ligands for effecting multi-electron reduction of small molecules, where the two metal centres are electronically coupled through a redox-active ligand backbone. Unlike nature, which uses sophisticated enzyme active sites as a catalyst, we rely on the subtle electronic and steric interactions between the substrate and the tailor-made artificial low molecular weight catalysts with two or more metallic centres. One metal centre serves to activate an electrophile, whereas the second metal can, be used to generate a nucleophile. Two ligand architectures; namely pincer ligands and tripodal chelating ligands, have been shown to provide powerful platforms for small molecule activation. Pincer ligands have been extensively investigated due to the ease by which their steric and electronic properties can be tuned. The easy tunability of NHCs facilitates systematic modifications of sterics and electronics and their integration in tripodal or pincer type ligand architectures is beneficial due to the already established robustness of such ligand systems.




## Publications

(April 2017 - Mar 2018)

1. K. E. Aldrich, B. S. Fales, A. K. Singh, R. J. Staples, B. G. Levine, J. McCracken, M. R. Smith III, and A. L. Odom, Electronic and Structural Comparisons Between Iron(II/III) and Ruthenium(II/III) Imide Analogs, Inorg. Chem. (minor revision).
2. P. Mathur, M. Tauqeer, R. Shyam-Ji, A. K. Singh, S. M. Mobin and G. K. Lahiri, Synthetic and structural study of orthometallated ferrocene complexes: Non-planar metallabenzene and 5 membered metallacycle complexes with closed Os3-triangle, Eur. J. Inorg. Chem. 2018, 3126.
3. A. Raghuvanshi, A. K. Singh, S. M. Mobin and P. Mathur, Fe(CO)5 Catalyzed [2+2+1] cycloaddition of alkyne, carbodiimide and CO for the synthesis of 5-Iminopyrrolones, Chemistry Select 2017, 2, 9245.

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

**Prof. Pradeep Mathur** (Ph.D.: 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)

**Research Interests:** Synthesis and molecular structures of organometallic clusters, design and facile synthesis of mixed metal clusters, reactivity, activation of organic molecules on them and use of metal carbonyls in catalytic processes.

**Metal mediated transformations of acetylenes:** Using simple mononuclear metal carbonyls, some unusual transformations have been observed, including the first example of a structurally characterized pentahapto-coordinated cyclopentadienone ligand system. Ferrocenyl-substituted thiophene and selenophene derivatives and ferrocenylchalco genopropargyl complexes can now be obtained under facile conditions. These have served as precursors to unusual ferrocenyl-containing metal clusters with novel five-membered FeSCH:CCH2 ring ligand systems. Intermediates in the formation of ferrocenyl-substituted quinones have been isolated and structurally characterized.

**Metal-acetylide chemistry:** New types of acetylide coupling on mixed-metal clusters, including the first example of tail-to-tail coupling, and influence of secondary bridging ligands on acetylide reactivity have been investigated. Several other new ligand systems have been generated on mixed-metal clusters, featuring, C-S and C-Se formation and acetylide flip. Reactivity of metal acetylide with CS2 has resulted in isolation of thiones and an unusual h3-coordinated S2CCCPh ligand. Electrochemistry and non-linear activity of some of the new systems have been investigated.

**Synthesis of mixed-metal clusters:** Methodology of using the lone pairs of some single atom ligands for addition of coordinatively unsaturated metal carbonyl fragments has been successful for designed construction of metal cluster compounds. The most significant feature of this strategy is that variation in the transition metal as well as main group element ligands can now be controlled. Identical cluster core geometries but with variable compositions has enabled systematic studies to be made on variation of properties such as non linear optical activity on composition of clusters. Ferrocenyl-incorporated metal carbonyl complexes: extension of reactivity of new cluster compounds is the reactivity of ferrocenyl and related acetylenes to form organics arising from unusual oligomerisation and co-oligomerisation reactions. This forms the present thrust of the main research projects. The research work involves synthesis, spectroscopic and structural characterisation by single crystal X-ray diffraction methods.

## Publications

(April 2017 - Mar 2018)

1. Singh, S. M. Mobin, P. Mathur, Preparation of the Ru3(CO)8-pyridine-alcohol cluster and its use for the selective catalytic transformation of primary to secondary amines, Dalton Trans. 2018, 47, 14033.
2. P. Mathur, M. Tauqeer, R. Shyam-Ji, A. K. Singh, S. M. Mobin and G. K. Lahiri, Synthetic and structural study of orthometallated ferrocene complexes: Non-planar metallabenzene and 5-membered metallacycle complexes with closed Os3-triangle, Eur. J. Inorg. Chem. 2018, 3126.
3. A. Singh, P. Kumari, A. Raghuvanshi, S. M. Mobin, P. Mathur, Ferrocene-substituted bis (ethynyl) anthracene compounds as anticancer agents, Appl. Organomet. Chem. 2018, 32, 2.
4. Jha, R. K. Joshi, A. Raghuvanshi, S. M. Mobin and P. Mathur, A photochemical route to ferrocenyl-substituted ferrapyrrolinone complexes, 5.Appl. Organomet. Chem. 2017, 31, 11.

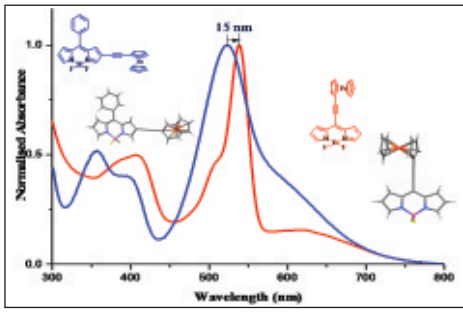
5. P. Mathur, R. Shyam-Ji, A. Raghuvanshi, M. Tauqeer, S. M. Mobin, Cleavage of phosphorus-sulfur bond and formation of (μ4-S)Fe4 core from photochemical reactions of Fe(CO)5 with [(RO)2PS2]2; R=Me, Et, iPr) J. Organomet. Chem. 2017, 835, 31.
6. Raghuvanshi, A. K. Singh, S. M. Mobin and P. Mathur, Fe(CO)5 Catalyzed [2+2+1] cycloaddition of alkyne, carbodiimide and CO for the synthesis of 5-Iminopyrrolones, ChemistrySelect 2017, 2, 9245.
7. Y. V. Torubaev, K. A. Lyssenko, P. Y. Barzilovich, G. A. Saratov, A. Singh, S. M. Shaikh and P. Mathur, Self-assembly of conducting cocrystals via iodine•••π(Cp) interactions, CrystEngComm 34, (2017), 5114.

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

**Dr. Rajneesh Misra** (Ph.D.: 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 as compared to the β-position. 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 β-pyrrolic position, indicating higher degree of conjugation.




Electronic absorption spectra of ferrocenyl substituted BODIPYs

## Publications

Organic materials: Organic Electronics and Photonics

1. Madhurima Poddar, Rajneesh Misra, NIR Absorbing Donor–Acceptor Based 1,1,4,4–Tetracyanobuta–1,3–Diene (TCBD) and Cyclohexa–2,5 –Diene–1,4–Ylidene–Expanded TCBD Substituted Ferrocenyl Phenothiazines, Chem. Asian J. 2017, 12, 2908–2915.
2. Yogajivan Rout, Prabhat Gautam and Rajneesh Misra, Unsymmetrical and symmetrical push–pull phenothiazines, J. Org. Chem. 2017, 82, 6840–6845.
3. Anupama Ekbote, Thaksen Jadhav, Rajneesh Misra, T-Shaped donor–acceptor– donor type tetraphenylethylene substituted quinoxaline derivatives: aggregation induced emission and mechanochromism, New J. Chem. 2017, 41, 9346–9353.
4. Madhurima Poddar, Prabhat Gautam, Yogajivan Rout, Rajneesh Misra, Donor– acceptor phenothiazine functionalized BODIPYs, Dyes and Pigments 2017, 146, 368– 373.
5. Yuvraj Patil, Rajneesh Misra, Tetracyanobutadiene bridged ferrocene and triphenylamine functionalized pyrazabole dimers, J. Organomet. Chem. 2017, 840, 23– 29.
6. Yuvraj Patil, Jivan Shinde, Rajneesh Misra, Near-Infrared Absorbing Metal Functionalized Diketopyrrolopyrroles, J. Organomet. Chem. 2017, 852, 48–53.
7. Ramesh Maragani, S. Bijesh, Rekha Sharma, Rajneesh Misra, Cs-Symmetric Donor Acceptor Bisthiazoles: Synthesis, Photophysical, Electrochemical and Computational Studies, Asian J. Org. Chem. 2017, 6, 1408–1414.

8. Prabhat Gautam, Rajneesh Misra and Michael Thomas, Francis D'Souza, Ultrafast charge separation in triphenylamine-BODIPY derived triads carrying centrally positioned, highly electron deficient, dicyanoquinodimethane or tetracyanobutadiene acceptors, Chem. Eur. J. 2017, 23, 9192–9200.
9. Thaksen Jadhav, Jeong Min Choi, Jivan Shinde, Jun Yeob Lee and Rajneesh Misra, Mechanochromism and electroluminescence in positional isomers of tetraphenylethylene substituted phenanthr oimidazoles, J. Mater. Chem. C 2017, 5, 6014–6020.
10. Ramesh Maragani, Rekha Sharma, Rajneesh Misra, Donor-Acceptor Triphenylvinyl and Tetraphenyl Conjugates: Synthesis, Aggregation and Computational Studies, Chemistry Select 2017, 2, 10033–10037.
11. Rajneesh Misra, Thaksen Jadhav, Dustin Nevonen, Ellen M. Monzo, S. M. Mobin, Victor N. Nemykin, Synthesis, Structures, and Redox Properties of Tetracyano-Bridged Diferrocene Donor–Acceptor–Donor Systems, Organometallics 2017, 36, 4490–4498.
12. Cs-Symmetric Triphenylamine-Linked Bisthiazole-Based Metal-Free Donor−Acceptor Organic Dye for Efficient ZnO Nanoparticles-Based DyeSensitized Solar Cells: Synthesis, Theoretical Studies, and Photovoltaic Properties, ACS Omega 2017, 2, 5981–5991.
13. Anupama Ekbote, Si Hyun Han, Thaksen Jadhav, Shaikh M. Mobin, Jun Yeob Lee, Rajneesh Misra, Stimuli responsive AIE active positional isomers of phenanthroimidazole as non-doped emitters in OLEDs, J. Mater. Chem. C 2018, 6, 2077– 2087.
14. Yogajivan Rout, Rajneesh Misra, Rahul Singhal, Subhayan Biswas, Ganesh D. Sharma, Phenothiazine-based small- molecules organic solar cells with power conversion efficiency over 7% and open circuit voltage of about 1.0 V using solvent vapor annealing, Phys. Chem. Chem. Phys. 2018, 20, 6321–6329.
15. Yuvraj Patil, Charu Popli, Rajneesh Misra, Near infrared absorbing tetracyanobutadiene bridged diketopyrrolopyrroles, New J. Chem. 2018, 42, 3892–3899.
16. Rekha Sharma, Ramesh Maragani, Rajneesh Misra, C3-Symmetric Star Shaped Donor Acceptors truxenes: Synthesis, Photophysical, Electrochemical and computational studies, New J. Chem. 2018, 42, 882–890.
17. Mohammadshaad Ansari, Ramesh Maragani, Avishek Banik, Rajneesh Misra, Mohammad Qureshi, Enhanced photovoltaic performance using biomass derived nano 3D ZnO hierarchical superstructures and a D−A type CS-Symmetric triphenylamine linked bisthiazole, Electrochimica Acta 2018, 259, 262–275.
18. Yuvraj Patil, Rajneesh Misra, Diketopyrrolopyrrole-Based and Tetracyano-Bridged Small Molecules for Bulk Heterojunction Organic Solar Cells, Chem. Asian J. 2018, 13, 220–22

**Dr. Suman Mukhopadhyay**

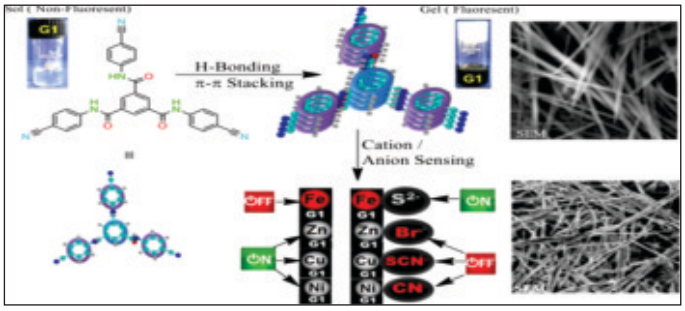
Professor
suman@iiti.ac.in

**Prof. Mukhopadhyay** (Ph.D.: 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.

A carboxamide based molecule has shown unique gelation property in an aqueous mixture of DMF or DMSO. The gel itself has shown aggregation-induced fluorescence enhanced emission (AIEE) which can be utilized effectively in sensing ferrous and ferric ion as both switch off the fluorescence completely. An investigation by IR spectroscopy reveals that an enhanced p interaction of nitrile group with iron center could be the possible reason behind complete

quenching of AIEE. This molecule is further investigated for the formation of metallogels for a wide array of cations. These in turn can act in tandem to behave as a dynamic array to detect several anions by either switching off or switching on the emission property of the metallogels.

## Publications




(April 2017 - March 2018)

1. Zeolite encapsulated host-guest Cu (II) Schiff base complexes: superior activity towards oxidation reactions over homogenous catalytic systems, Bidyut Kumar Kundu, Vaishali Chhabra, Novina Malviya, Rakesh Ganguly, Gopal S Mishra, Suman Mukhopadhyay, Microporous Mesoporous Mater, 2018, 271, 100.
2. Analysis of instrumented scratch hardness and fracture toughness properties of laser surface alloyed tribological coatings, Debjit Misra, S. M. Shariff, Suman Mukhopadhyay, Satyajit Chatterjee, Ceramic International, 2018, 44, 4, 4248
3. Ruthenium(II) Arene NSAID Complexes : Inhibition of Cyclooxygenase and Antiproliferative Activity Against Cancer Cell Lines, Poulami Mandal, Bidyut Kumar Kundu, Komal Vyas, Vidya Sabu, A. Helen, Sandeep Singh Dhankar, C. M. Nagaraja, Debojit Bhattacherjee, Krishna Pada Bhabak, Suman Mukhopadhyay, Dalton Transactions, 2018, 47, 517.
4. RAPTA Complexes Containing N-substituted Tetrazole Scaffolds: Synthesis, Characterization and Antiproliferative Activity, Poulami Mandal, Novina Malviya, Bidyut Kumar Kundu, Sandeep Singh Dhankhar, C. M. Nagaraja, Suman Mukhopadhyay, Appl. Organomet. Chem, 2018, e4179. 40.
5. Investigation on chemical protease, nuclease and catecholase activity of two copper complexes with flexidentate Schiff base ligands, Mriganka Das, Bidyut Kumar Kundu, Ritudhwaj Tiwari, Poulami Mandal, Debasis Nayak, Rakesh Ganguly, Suman Mukhopadhyay, Inorg. Chim. Acta, 2018, 111, 468.
6. Targeted synthesis of cadmium(II) Schiff base complexes towards corrosion inhibition on mild steel, Mriganka Das, Amrita Biswas, Bidyut Kundu, Shaikh Mobin, Udayabhanu G, Suman Mukhopadhyay, RSC Adv 2017, 7, 48569
7. A smart organic gel template as metal cation and inorganic anions sensor, Novina Malviya, Mriganka Das, Poulami Mandal, Suman Mukhopadhyay, Soft Matter, 2017, 13, 6243.
8. Copper(II) Tetrazolato Complexes : Role in oxidation catalysis and binding, Manideepa Saha, Komal M. Vyas, Luisa, M. D. R. S. Martins, Nuno M. R. Martins, Armando J. L. Pombeiro, Shaikh M. Mobin, D, Bhattacherjee, Krishna, P. Bhabak, Suman Mukhopadhyay, Polyhedron, 2017, 132, 53.

**Dr. Apurba K. Das**

Associate Professor
apurba.das@iiti.ac.in

**Dr. Apurba K. Das** (Ph.D.: 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. His group is focused on multidisciplinary (Chemistry, Biology and Nanosciences) research. He is the co-author of 70 research publications.

This group's research focuses on the molecular design of dynamic peptide based materials for the applications in Biology and Nanosciences. Several chemical reactions are used to generate dynamic peptide libraries. The group has a long-

standing interest on supramolecular electronics, 3D-bioprinting and nanocatalysis applications of synthesized self-assembled molecular materials.

## Publications

(April 2017 - March 2018)

1. Investigations of Peptide-Based Biocompatible Injectable Shape-Memory Hydrogels: Differential Biological Effects on Bacterial and Human Blood Cells, P. Gavel, D. Dev, H. S. Parmar, S. Bhasin, A. K Das, ACS Applied Materials & Interfaces, 2018, 10, 10729-10740.
2. Redox-Active Peptide Functionalized Quinquethiophene Based Electrochromic π-gel, M. Konda, R. G. Jadhav, S. Maity, A. K. Das, Chemistry - An Asian Journal, 2018, 13, 204-209.
3. Understanding the Conformational Analysis of Gababutin Based Hybrid Peptides, M. Konda, R. G. Jadhav, S. Maiti, S. M. Mobin, B. Kauffmann, A. K. Das, Organic and Biomolecular Chemistry, 2018, 16, 1728-1735.
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6. Nanoporous Conducting Covalent Organic Polymer (COP) Nanostructures as Metal-Free High Performance Visible-Light Photocatalyst for Water Treatment and Enhanced CO2 Capture, S. Bhowmik, R. G. Jadhav, A. K. Das, J. Phys. Chem. C, 2018, 122, 274-284.
7. Induction of Supramolecular Helical Handedness in a Chemical Reaction Directed Self-Healable Soft Material, A. Reja, A. Biswas, J. Yadav, D. Dev, A. K. Das, ChemistrySelect, 2017, 2, 10984-10989.
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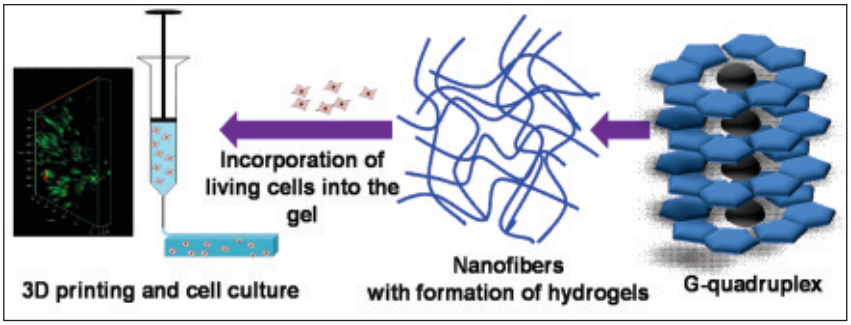


9. Direct Evidence of Intrinsic Blue Fluorescence from Oligomeric Interfaces of Human Serum Albumin, A. Bhattacharya, S. Bhowmik, A. K. Singh, P. Kodgire, A. K. Das, T. K. Mukherjee, Langmuir, 2017, 33, 10606-10615.
10. Light Induced Construction of Porous Covalent Organic Polymeric Networks for Significant Enhancement of CO2 Gas Sorption, S. Bhowmik, M. Konda and A. K. Das, RSC Advances, 2017, 7, 47695-47703.

**Dr. Anjan Chakraborty**

Associate Professor
anjan@iiti.ac.in

**Dr. Anjan Chakraborty** (Ph.D.: 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. We would like to study the interaction of liposomes of different chain length and head groups with gold and silver nanoparticles of different sizes functionalized by different small ligands such as 3-Mercaptopropionic acid, glutathione, biotin, cystine, cystamine etc. These nanoparticles will be allowed to be adsorbed on the liposomes surface and will interact with the head groups of the liposomes. The interactions are to be monitored through steady state and time resolved fluorescence. If the nanoparticles decorated liposomes are found to stabilize the liposomes and prevent premature leakage, we shall proceed for conducting drug delivery using different drug molecules like doxorubicin, topotecan or campothecin. Further, we would like extend our study to different amphiphilic gold and silver nanoparticles. The interaction of amphiphilic nanoparticles will be studied by different spectroscopic means as mentioned earlier. The steady state and time resolved spectroscopy including the time resolved anisotropy measurements will be conducted along with confocal imaging. We also plan to study the interaction of different very small size zwitterionic nanoparticles with liposomes. The nanoparticles will be incorporated in liposomes through the reverse phase evaporation method. The interaction study will be conducted by spectroscopic studies and DLS and confocal imaging measurements. The stability of the nanoparticles at different pH would be checked. The leakage study will be conducted followed by drug release study.

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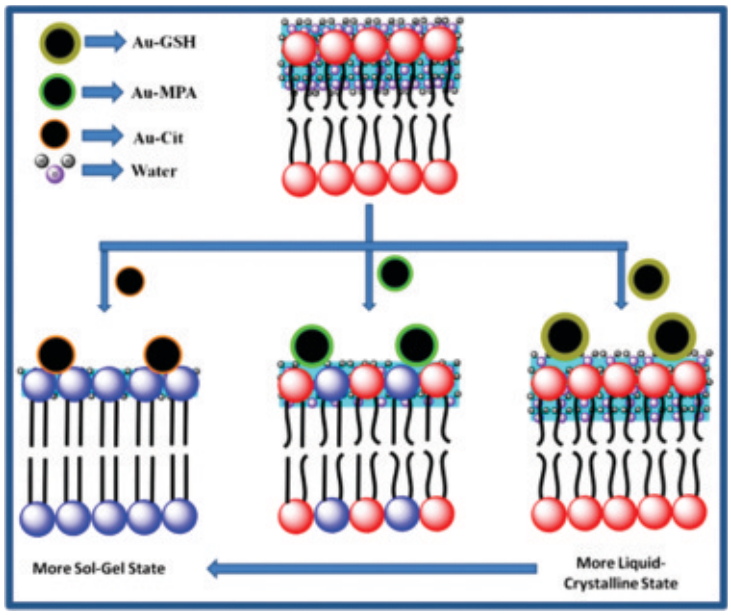
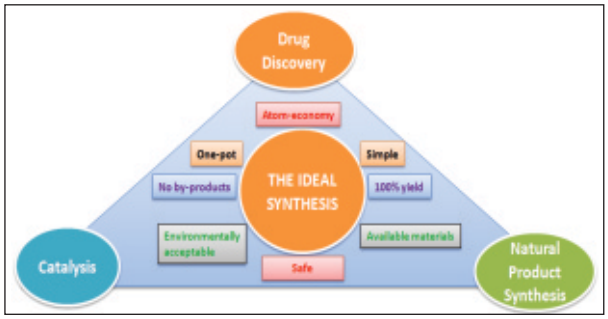
1. Spectroscopic evidence for hydration and dehydration of lipid bilayers upon interaction with metal ions: a new physical insight. De, S. K.; Kanwa, N.; Ahamed, M.; Chakraborty, A. Phys. Chem. Chem. Phys. 2018, 20, 14796
2. Spectroscopic Study of the Interaction of Carboxyl-Modified Gold Nanoparticles with Liposomes of Different Chain Lengths and Controlled Drug Release by Layer-by-Layer Technology. Kanwa, N.; De S. K.; Adhikari, C.; Chakraborty, A. J. Phys. Chem. B 2018, 121, 11333.



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

**Dr. Sampak Samanta** (Ph.D.: 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. In this context, the development of novel domino reactions will be followed by their implementation in the total synthesis of biologically active natural products and analogs, with a special emphasis on compounds relevant for anti-cancer/Huntintong's disease drugs. In this context, the group has developed a highly efficient, catalytic, practical protocol for the preparation of biologically significant spirooxindoles/pyridocoumarin derivatives. In the search for new reactions, the group utilizes the readily available metal-free catalysts efficiently and pursue organic reactions in a green manner, aiming at achieving high selectivities (chemo-, regio-, diastereo- and enantioselectivity) while reaction. Moreover, the design of high-performance catalysts is the primary focus in the research group. The keywords, "synthetic power", "environmental harmony", "atom economy", and "sequential transformations" illustrate the research group.




## Publications

(April 2017 - March 2018)

1. S. Guin, D. Majee, S. Biswas and Sampak Samanta Microwave-assisted Microwave-Assisted and Base-Promoted Domino Reaction of Cyclic N-Sulfonyl Ketimines with α, β-Disubstituted Nitroalkenes: a Green Access to 2-Hydroxyarylpyridines, Asian J. Org. Chem. 2018, 7, 1810
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3. M. Ahuja, S. Biswas, P. Sharma and Sampak Samanta, Synthesis and Photophysical Properties of α-Pyrone-fused-pyrido[3, 2,1-jk]carbazolone Derivatives :DFT/TD-DFT Insights, Chemistry Select 2018, 3, 4354.
4. S. K. Arupula, S. Biswas, S. Guin and Sampak Samanta, Stereoselective Synthesis of 3,3-Disubstituted Oxindoles and Spirooxindoles via Allylic Alkylation of Morita-Baylis-Hillman Carbonates of Isatins with Cyclic Sulfamidate Imines Catalyzed by DABCO. J. Org. Chem. 2018, 83, 2660.
5. A. Dagar, S. Guin and Sampak Samanta, AgSbF6-Catalyzed Tandem Reaction of 2-Alkynylanilines with Cyclic Enynones: Efficient access to 3-Furo[3,2-c]chromenylindoles and Related Scaffolds , Asian J. Org. Chem. 2018, 7, 123.
6. S. Biswas, D. Majee, S. Guin and Sampak Samanta, Metal- and Solvent-Free Approach to Diversely Substituted Picolinates via Domino Reaction of Cyclic Sulfamidate Imines with β,γ-Unsaturated α-Ketocarbonyls, J. Org. Chem. 2017, 82, 10928.

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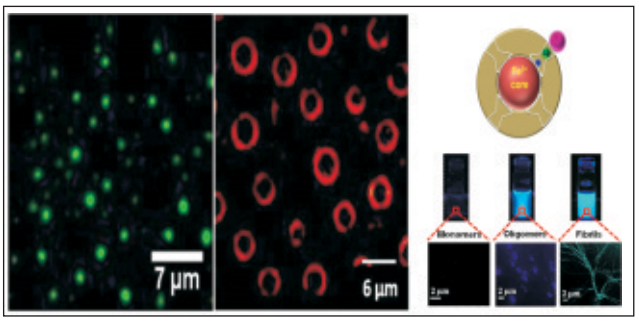
8. D. Majee, S. Guin, S. Biswas and Sampak Samanta, A Metal-Free Based New Approach to 2,4-Disubstituted Pyridines via One-Pot Sequential Reaction of Cyclic Sulfamidate Imines with β-Substituted Acroleins, Chemistry Select, 2017, 2, 3423.

9. D. Majee, S. Biswas, and Sampak Samanta, Domino reaction of cyclic sulfamidate imines with Morita-Baylis-Hillman acetates promoted by DABCO: a metal-free approach to functionalized nicotinic acid derivatives, Org. Biomol. Chem. 2017, 15, 3286.

## Dr. Tushar K. Mukherjee

Associate Professor
tusharm@iiti.ac.in

**Dr. Tushar K. Mukherjee** (Ph.D.: 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.




The PL properties of chemically synthesized individual nanomaterials such as silicon-QDs, cadmium telluride QDs, carbon dots and silver nanoparticles have been successfully explored by using our home-made epifluorescence microscope. The well-known "necklace and bead"-like structures of protein-surfactant and polymer surfactant complexes have also been visualized for the first time by using our epifluorescence microscope. In addition, the interactions of various biologically important proteins with nanoparticles have been probed using conventional spectroscopic techniques. Recently, a unique and unusual blue fluorescence has been discovered from oligomeric interfaces of human serum albumins by combining various spectroscopic and imaging techniques.

## Publications

1. Prajapati, R.; Mukherjee, T. K. Effect of Surfactant Assemblies on the Resonance Energy Transfer from 4', 6-Diamidino-2-Phenylindole to Silver Nanoclusters. J. Photochem. Photobiol. A 2018, 353, 130-137.

2. Bhattacharya, A.; Mukherjee, T. K. Synergistic Enhancement of Electron-Accepting and –Donating Ability of Nonconjugated Polymer Nanodot in Micellar Environment. Langmuir 2017, 33, 14718-14727.

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4. Bhattacharya, A.; Bhowmik, S.; Singh, A. K.; Kodgire, P.; Das, A. K.; Mukherjee, T. K. Direct Evidence of Intrinsic Blue Fluorescence from Oligomeric Interfaces of Human Serum Albumin. Langmuir 2017, 33, 10606-10615.

**Dr. Biswarup Pathak**
Associate Professor
biswarup@iiti.ac.in

**Dr. Biswarup Pathak** (Ph.D.: 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. He has delivered over 35 talks in several national/international conferences. Dr. Pathak has published over 100 papers (20 papers published in 2017-2018) in highly reputed international journals. Some of his outstanding works has been published in prominent journals such as Journal of American Chemical Society (JACS), Angew. Chem. Int. Ed, ACS Energy Latters, and so on. His works have been cited ~2000 times. Dr. Pathak has received Early and Mid-Career Research Award from Indian National Science academy in 2017 and IIT Indore Best Researcher Award in 2016.

## Publications

1. High-energy-density dual-ion battery for stationary storage of electricity using concentrated potassium fluorosulfonylimide, K. Kravchyk, Preeti Bhauriyal, L. Piveteau, C. Guntlin, Biswarup Pathak, Maksym Kovalenko, Nature Communications, 2018.
2. High Curie Temperature and Half-metallicity in Atomically Thin Main Group Based Boron Phosphide System: Long Range Ferromagnetism, Gargee Bhattacharyya, Indrani Choudhuri, Biswarup Pathak, Physical Chemistry Chemical Physics; 20, 22877-22889, 2018.
3. First-Principles Study of Magnesium Peroxide Nucleation for Mg-Air Battery, Preeti Bhauriyal, Kuber S. Rawat, Gargee Bhattacharyya, Priyanka Garg, Biswarup Pathak, Chemistry - An Asian Journal; 2018.
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5. Crystal Defect Induced Facet Dependent Electrocatalytic Activity of 3D Gold Nanoflower towards the Selective Nanomolar (nM) Detection of Ascorbic Acid, S. K. De, S. Mondal, P. Sen, U. Pal, K. S. Rawat, Biswarup Pathak, M. Bardhan, M. Bhattacharya, B. Satpati, A. De, D. Senapati, Nanoscale; 10, 11091-11102, 2018.
6. Electron-Rich Graphite-Like Electrode: Stability vs. Voltage for Al Battery, Preeti Bhauriyal, Priyanka Garg, Mahendra Patel, Biswarup Pathak, Journal of Materials Chemistry A; 6, 10776-10786, 2018.
7. The Significance of Acid-Base Properties in the Key Ligand for CO2 hydrogenation: Role of Amido Ligand, Kuber Singh Rawat, Biswarup Pathak, Journal of Chemical Sciences; 130, 65, 2018.
8. Flexible Proton Responsive Ligand-based Mn(I)-Complexes for CO2 Hydrogenation: A DFT Study, Kuber Singh Rawat, Biswarup Pathak, Physical Chemistry Chemical Physics; 20, 12535-12542, 2018.
9. Topologically Protected Hybrid States in Graphene-Stanene-Graphene Heterojunction,Chiranjit Mondal, Sourabh Kumar, Biswarup Pathak, Journal of Materials Chemsitry C; 6, 1920-1925, [JMC Hot Paper] 2018.
10. Graphene-Like Carbon-Nitride Monolayer: A Potential Anode Material for Na and K-Ion Batteries, Preeti Bhauriyal, Arup Mahata, Biswarup Pathak, Journal of Physical Chemsitry C; 122, 5, 2481-2489, 2018.
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12. Stanene Based Gas Sensors: Effect of Spin-Orbit Coupling, Priyanka Garg, Indrani Choudhuri, Biswarup Pathak, Physical Chemistry Chemical Physics;19, 31325-31334, 2017.

13. Exploiting Le Chatelier.s Principle for One-Pot Synthesis of Nontoxic HHogGNPs with Sharpest Nanoscopic Features Suitable for Tunable Plasmon Spectroscopy and High Throughput SERS Sensing, M. Bhattacharya, V. Mazov, B. Satpati, S. D. Chakraborti, Sourabh Kumar, Biswarup Pathak, D. V. Kuznetsov, D. Senapati, Chemical Communication; 53, 10402-10405, 2017.
14. Semiconducting Phase in Borophene: Role of Defect & Strain, Gargee Bhattacharyya, Arup Mahata, Indrani Choudhuri, Biswarup Pathak, Journal of Physics D: Applied physics; 50, 405103, 2017.
15. Ferromagnetism and Half-metallicity in Atomically Thin Holey Nitrogenated Graphene Based System, Indrani Choudhuri, Biswarup Pathak, ChemPhysChem; 18, 2336-2346, 2017.
16. Bimetallic Core-Based Cuboctahedral Core-Shell Nanocluster for Hydrogen Peroxide (2e- reduction) over Water (4e- reduction) Formation: Role of Core Metals, Arup Mahata, Biswarup Pathak, Nanoscale; 9, 9537-9547, 2017.
17. Aliphatic Mn-PNP Complexes for CO2 Hydrogenation Reaction: A Base Free Mechanism, Kuber Singh Rawat, Biswarup Pathak, Catalysis Science & Technology; 7, 3234-3242, (Impact Factor:5.287) 2017.
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20. Thermochemical and Electrochemical CO2 Reduction on Octahedral Cu Nanocluster: Role of Solvent towards Product Selectivity, Kuber S. Rawat, Arup Mahata, Biswarup Pathak, Journal of Catalysis; 349, 118-127, (Impact Factor:7.354) 2017.

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**Dr. Chelvam Venkatesh**

Assistant Professor
cvenkat@iiti.ac.in

**Dr. Chelvam Venkatesh** (Ph.D.: IIT Kanpur; Alexander von Humboldt fellowship: Freie University Berlin, Germany; Postdoctoral Fellow: Purdue University, USA). His research interest are: synthesis of anticancer 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 especially for the detection and treatment of cancer, inflammatory and neurodegenerative diseases. He has more than 10 years of experience in carrying out in vitro, in vivo mouse and rat models on various diseases like cancer, arthritis, and inflammatory diseases.

He has also developed various drug delivery systems for treatment of prostate, ovarian cancers as well as inflammatory diseases like arthritis, atherosclerosis etc., Currently he is working developing small molecule ligands and inhibitors for detection and therapy of various cancers including prostate, pancreas, breast etc., These small molecule inhibitors have the potential for treating various neurological diseases. Recently he has developed small molecules to target cannabinoid receptor (CB2), GPCR protein, which is highly expressed in immune cells for treating inflammatory diseases like neuropathic pain and pathological diseases.

### Awards, Fellowships & Achievements:

1. SERB-Overseas Doctoral Fellowship in 2018 for his Ph.D. student to conduct research at Purdue University, USA with Prof. Kavita Shah.
2. Commonwealth Fellowships for two Ph.D. students in 2018 at Loughborough University, UK to work on Cancer Diagnosis and Therapeutics with Prof. Paul Roach.

### Publications


1. Synthesis of tubuphenylalanine and epi- tubuphenylalanine via regioselective hydroboration-oxidation of 1,1-substituted amino alkenes, Reddy, R. B., Dudhe, P., Chauhan, P., Sengupta, S., Venkatesh, C., Tetrahedron, 000, (2018) (in press).
2. Efficient "turn-on" nanosensor by dual emission-quenching mechanism of functionalized Se doped ZnO nanorods for mercury (II) detection, Rao, A. V. R. K., Reddy, R. B., Sengupta, S., Venkatesh, C., Applied Nanoscience, (2018), doi.org/10.1007/s13204-018-0875-9
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4. Preparation of ligand targeted drug conjugates for cancer therapy and their evaluation in vitro, Krishnan, M. A., Sengupta, S., Venkatesh, C. Curr. Protoc. Chem. Biol., 000, (2018) (doi: 10.1002/cpch.50).
5. In vivo evaluation of ligand targeted drug conjugates for cancer therapy, Krishnan, M. A., Pandit, A., Venkatesh, C. Curr. Protoc. Chem. Biol., 000, (2018) (doi: 10.1002/cpch.49).
6. First report on 3D-QSAR and molecular dynamics-based docking studies of GCPII inhibitors for targeted drug delivery applications, Pandit, A., Sengupta, S., Krishnan, M. A., Reddy, R. B., Sharma, R., Venkatesh, C., J. Mol. Struct., 1159, 179–192, (2018).
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8. Selective liposome targeting of folate receptor positive immune cells in inflammatory diseases, Poh, S., Venkatesh, C., Ayala-Lopez, W., Putt, K. S., Low, P. S., Nanomedicine:Nanotechnology, Biology, and Medicine, 14, 1033–1043, (2018).
9. Folate-conjugated liposomes target and deliver therapeutics to immune cells in a rat model of rheumatoid arthritis, Poh, S., Venkatesh, C., Lindsay, K., Ayala-Lopez, W., Balasubramanian, V., Putt, K. S., Low, P. S., Nanomedicine(Lond.), 12, 2441–2451, (2017).


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**Dr. Sanjay K. Singh**

Associate Professor
sksingh@iiti.ac.in


**Dr. Sanjay K. Singh** (Ph.D.: 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. Dr. Singh's research group has undertaken the task to develop 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 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. He was also awarded Excellence in Teaching in 2017 (IIT Indore). He is actively involved in teaching undergraduate and masters students. Four of his PhD students have already been awarded along with two Masters students. These students are now pursuing their respective Post-doc and PhD positions at renowned institutions such as RWTH-Aachan, KAUST, Hokkaido University.

## Publications


1. Sanjay K. Singh, Heterogeneous Bimetallic Catalysts for Upgrading Biomass-derived Furans, Asian J. Org. Chem., 2018, Accepted (Invited Focus Review) (IF 2.496)
2. Mahendra Kumar Awasthi, Deepika Tyagi, Soumyadip Patra, Rohit Kumar Rai, Shaikh M. Mobin, and Sanjay K. Singh, Ruthenium complexes for catalytic dehydrogenation of hydrazine and transfer hydrogenation reactions, Chem. Asian J., 2018, doi: 10.1002/asia. 201800315 (IF 4.083)
3. Ambikesh Dhar Dwivedi, Vinod Kumar Sahu, Shaikh M. Mobin, and Sanjay K. Singh, Cyclopentadienyl-Ru(II)-pyridylamine complexes: Synthesis, X-ray structure and application in catalytic transformation of bio-derived furans to levulinic acid and diketones in water, Inorg. Chem., 2018, 57, 4777-4787 (IF 4.857)
4. Kavita Gupta, and Sanjay K. Singh, Room temperature total hydrogenation of biomass-derived furans and furan/acetone aldol adducts over Ni-Pd alloy catalyst, ACS Sustainable Chem. Eng., 2018, 6, 4793-4800 (IF 5.951)
5. Kavita Gupta, Rohit K. Rai, and Sanjay K. Singh, Metal catalysts for Efficient Transformation of Biomass-derived HMF and Furfural to Value Added Chemicals: Recent Progress, ChemCatChem, 2018, doi: 10.1002/cctc.201701754 (Review Article) (IF 4.803)
6. Chinky Binnani, Rohit K. Rai, Deepika Tyagi, Shaikh M. Mobin, and Sanjay K. Singh, Ligand-tuned C-H bond activation/arylation of 2-arylpyridines over pyridine based N,O/N,N ligated ruthenium-arene complexes, Eur. J. Inorg. Chem., 2018, 1435-1445 (IF 2.444)
7. Dharmendra Panchariya, Rohit Kumar Rai, E. Anil Kumar,* and Sanjay K. Singh, Core-shell Zeolitic Imidazolate Frameworks for Enhanced Hydrogen Storage, ACS Omega, 2018, 3, 167-175
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9. Deepika Tyagi, Rohit K. Rai, Shaikh M. Mobin, and Sanjay K. Singh, N-Substituted Iminiopyridine Arene-ruthenium Complexes for the Regioselective Catalytic Hydration of Terminal Alkynes, Asian J. Org. Chem., 2017, 6, 1647-1658 (IF 2.788)
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11. Rohit K. Rai, Deepika Tyagi, and Sanjay K. Singh, Room temperature catalytic reduction of aqueous nitrate to ammonia over Ni nanoparticles immobilized on Fe3O4@n-SiO2@H-SiO2-NH2 support, Eur. J. Inorg. Chem., 2017, 2450-2456 (IF 2.444)
12. Ambikesh Dhar Dwivedi, Rohit K. Rai, Kavita Gupta, and Sanjay K. Singh, Catalytic hydrogenation of arenes in water over in situ generated ruthenium nanoparticles immobilized on carbon, ChemCatChem, 2017, 8, 1930-1938 (IF 4.803)
13. Dharmendra K. Panchariya, Rohit K. Rai, Sanjay K. Singh and E. Anil Kumar*, Synthesis and Characterization of MIL-101 incorporated with Darco type Activated Charcoal, Materials Today: Proceedings, 2017, 4, 388-394
14. Kavita Gupta, Rohit K. Rai., Ambikesh Dhar Dwivedi, and Sanjay K. Singh, Catalytic aerial oxidation of biomass-derived furans to furan carboxylic acids in water over bimetallic Ni-Pd alloy nanoparticles, ChemCatChem, 2017, 9, 2760-2767 (IF 4.803)(A part of a Special issue on the "Catalytic Conversion of Biomass")

**Awards:**

Award for Excellence in Teaching, 2017, IIT Indore

DAAD Master's Sandwich award to M.Sc. project student (Ms. Vanitha Reddy, 2018)

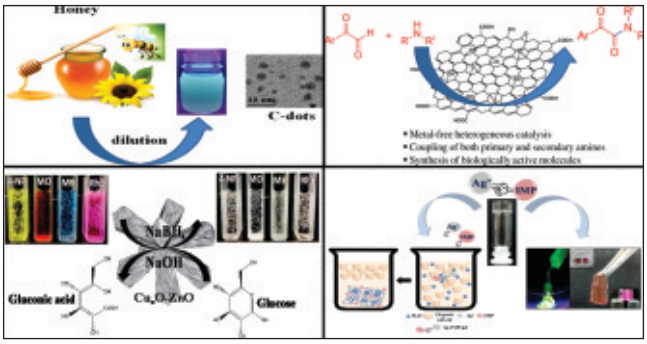
**Dr. Tridib K. Sarma**

Assistant Professor

tridib@iiti.ac.in

**Dr. Tridib K. Sarma** (Ph.D. 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. Nanoparticles of noble metals like gold, silver, platinum and other transition metals such as palladium, titanium, vanadium, molybdenum are being exploited for organic catalysis, photocatalysis, hydrogels, solar cells, LED applications etc. Self and directed assembly of inorganic and organic materials has been explored to develop these functional materials. His group is equally involved in studying metal-biomolecule interactions and development of functional materials derived from them.

## Publications

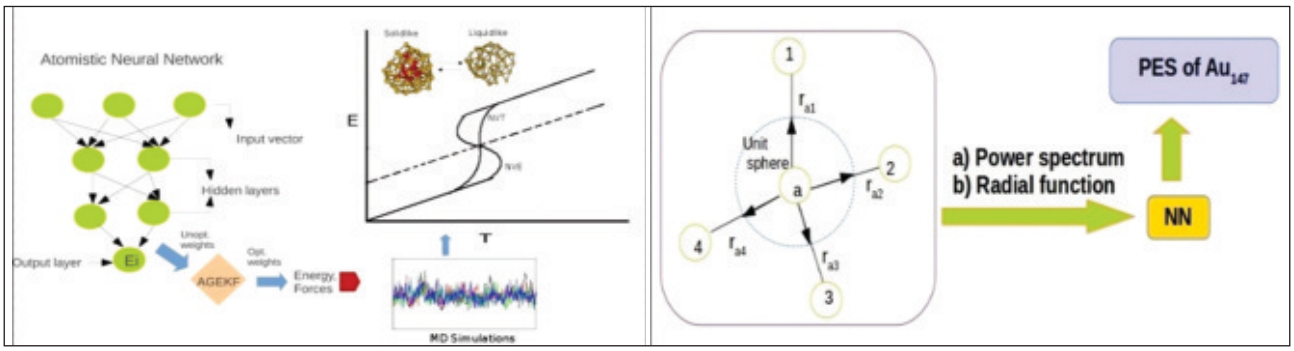



1. Bhagwati Sharma, Sonam Mandani, Neha Thakur and Tridib K. Sarma: Cd (II)–nucleobase supramolecular metallo-hydrogels for in situ growth of color tunable CdS quantum dots, Soft Matter, 2018, 14, 5715.
2. Siddarth Jain, Suryakant Mishra , and Tridib K. Sarma: Zn2+ Induced Self-Assembled Growth of Octapodal CuxO–ZnO Microcrystals: Multifunctional Applications in Reductive Degradation of Organic Pollutants and Nonenzymatic Electrochemical Sensing of Glucose, ACS Sustainable Chem. Eng., 2018, 6 , 9771.
3. Neha Thakur, Bhagwati Sharma , Suman Bishnoi, Subodh Kumar Mishra, Debasis Nayak, Amit Kumar, and Tridib K. Sarma: Multifunctional Inosine Monophosphate Coordinated Metal–Organic Hydrogel: Multistimuli Responsiveness, Self-Healing Properties, and Separation of Water from Organic Solvents, ACS Sustainable Chem. Eng., 2018, 6, 8659.
4. Bhagwati Sharma, Ashmeet Singh, Tridib K. Sarma, Neha Sardana and Asish Pal Chirality control of multi-stimuli responsive and self-healing supramolecular metallo-hydrogels New J. Chem., 2018, 42, 6427.
5. Sonam Mandani, Deepa Dey, Bhagwati Sharma, Tridib K. Sarma: Natural occurrence of fluorescent carbon dots in honey, Carbon, 2017, 119, 569.
6. Sonam Mandani, Pratibha Majee, Bhagwati Sharma, Daisy Sarma, Neha Thakur, Debasis Nayak, Tridib K. Sarma: Carbon dots as Nanodispersants for Multi-walled Carbon Nanotubes: Reduced Cytotoxicity and Metal Nanoparticle Functionalization, Langmuir, 2017, 33, 7622.
7. Biju Majumdar, Daisy Sarma, Tamalika Bhattacharya, Tridib K. Sarma: Graphene oxide as metal-free catalyst in oxidative dehydrogenative C-N coupling leading to -ketoamides: Importance of dual catalytic activity, ACS Sustainable Chem. Eng., 2017, 5.

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

**Dr. Satya S. Bulusu** (Ph.D.: 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. In Computational Chemistry, machine learning (ML) is being increasingly used in the past decades to save the computational cost and overcome the bottleneck of evaluating atomic forces required for geometry optimizations and molecular dynamics. Development of algorithms and softwares, involving ML techniques, will help us in extending quantum mechanics and molecular dynamics to nanoscale. With above goals in mind, his research group is trying to develop ML methods, such as artificial neural networks (ANN) to construct interatomic potentials which are many orders of magnitude faster and accurate in evaluating atomic forces. The group is trying to use these methods to evaluate total energies and atomic forces of medium sized gold clusters, nanoalloy clusters and thio protected gold clusters. Using a better input functions in ANN to decribe the atomic environments we could easily extend this to nanoparticles of sizes greater than 1.5nm. The research mainly focuses on the following:

1. Developing ANN methods and appying it to bare gold and coated gold nanoparticles.
2. Modelling of atomic enviroments
3. Developing sampling algorithms
4. Appying above methods to study gold nanoparticles, nanoalloys, coated gold nanoparticles.
5. Using hardware technologies to parallelize our programs that will help to extend the above methods to experimentally relevant sizes.




## Publications

1. Correlation of structure with UV-visible spectra by varying SH composition in Au-SH nanoclusters S Chiriki, S Jindal, P Singh, SS Bulusu. The Journal of chemical physics 149 (7), 074307 (2018).
2. An algorithm to use higher order invariants for modelling potential energy surface of nanoclusters. S Jindal, SS Bulusu. Chemical Physics Letters 693, 152-158 (2018).
3. c-T phase diagram and Landau free energies of (AgAu)55nanoalloy via neural-network molecular dynamic simulations. S Chiriki, S Jindal, SS Bulusu. The Journal of chemical physics 147 (15), 154303.
4. Spherical harmonics based descriptor for neural network potentials: Structure and dynamics of Au147 nanocluster. S Jindal, S Chiriki, SS Bulusu. The Journal of chemical physics 146 (20), 204301.

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

**Dr. Shaikh M. Mobin** (Ph.D.: 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.

**Basic Research:**

1. Design and Synthesis of Inorganic and Organometallic Complexes
2. Applications in Catalysis, Crystal Engineering
3. Applied Research: Addressing Societal Problems

**Health Care:**

1. Working on observation of live cells for detection of diseases such as Cancer, Alzheimer etc.
2. Development of chip based bio-sensors for detection of potential diseases in urine and blood.

**Security Threat:**

1. Detection of explosives (TNT / Picric Acid etc) in trace amount.

**Water Purity:**

1. Detection of impurities in water by Photo-catalysis for Heavy Metals and Dyes.

**Achievements:**

Research work on novel dye for tracking lysosomes in live cell imaging covered by Free Press Journal Indore edition (April 14, 2018 and available on website).

1. Dr. Shaikh has been listed amongst highly prolific authors by Current Science, rivalling researchers from prestigious institutions such as CSIR-IICT, CSIR-NCL and IIT Kharagpur. Recognised among top 10 researchers in Chemistry in India by Careers 360 (Most Outstanding Researcher Award, 2018) with a h-index of 41, more than 370 publications and 6449 citations to date.

**Group Achievements:**

- Ms Navpreet Kaur, received the Best Poster Presentation Award at 4th National Workshop on NEMS/MEMS & Theranostic Devices, at IIT Guwahati, February 26-28, 2018.
- Ms Richa Rajak, received the best Poster Presentation Award at RSC-IIT Indore Symposium on Advances in Chemical Sciences, January 30, 2018. Received from Dr. Serena Corr, Associate Editor, Nanoscale.
- Mr. VInay Sharma (BSBE), received the best Oral Presentation Award at International Conference on NANO- AND FUNCTIONAL MATERIALS: Interface between Science and Engineering (NFM-2017), November 16-18, 2017.
- Multicolour fluorescent carbon nanoparticle probes for live cell imaging cum dual palladium and mercury sensor. Sharma, V., Saini, A. K. and Shaikh M. Mobin. J. Mater. Chem. B., 2016,4, 2466.

  (This article is part of the themed collection: 2016 Journal of Materials Chemistry B Most Accessed Manuscripts).
- Back to back two consecutive Institute Best Research Paper Award were received from BSBE and Chemistry, IIT Indore for the year 2017 and 2018.

## Publications

1. Benign approach for methyl-esterification of oxygenated organic compounds using TBHP as methylating and oxidizing agent. Ghosh. T., Chandra, P., Mohammed, A. and Shaikh M. Mobin. Appl. Catal. B: Environmental, 2018, 226, 278-288.
2. An Emerging Robust Heterostructure of MoS2-rGO For High Performance Supercapacitors. Saraf, M.; Natarajan, K.; Mobin, S. M. ACS Appl. Mater. Interfaces, 2018, 10, 16588-16595.

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, Accepted.
4. Multifunctional fluorescent "Off-On-Off" nanosensor for Au3+ and S2− employing N-S co-doped carbon–dots. Sharma, V.,Kaur, N., Tiwari, P. and Mobin, S. M. Carbon, 2018, Accepted.
5. Water soluble two-photon fluorescent organic probe for long-term imaging of lysosomes in live cells and tumor spheroids. Kumari. P., Sanjay, K. V. and Shaikh M. Mobin. Chem. Commun., 2018, 54,539-542.
6. A novel mesoionic carbene based highly fluorescent Pd(II) complex as an endoplasmic reticulum tracker in live cells. Verma. S. K., Kumari, P., Ansari, S. N. and Shaikh M. Mobin. Dalton Trans. (Communication), 2018, 000, Accepted.
7. A Robust Nanocomposite of Nitrogen Doped Reduced graphene Oxide and MnO2 Nanorods for High Performance Supercapacitors and Non-enzymatic Peroxide Sensors. Saraf. M., Natarajan, K. and Mobin, S. M. ACS Sustainable Chem. Eng., 2018, Accepted.
8. High yield graphene production arising from synergistic effect of inflated temperature and gelatin offers higher stability and cellular compatibility. Tiwari, P., Kaur, N., Sharma, V., and Mobin, S. M. Phys. Chem. Chem. Phys, 2018, Accepted.
9. Design and Synthesis of 1D-Polymeric Chain Based [(CH3NH3) 3Bi2Cl9] n Perovskite: A New Light Absorber Material for Lead Free Perovskite Solar Cells.Ahmad, K.; Ansari, S. N.; Natarajan, K.; Mobin, S. M. ACS App. Energy Mater, 2018 (Just Accepted).
10. Vacuum Mediated Single-Crystal-to-Single-Crystal (SCSC) Trans-formation in Na-MOFs: Rare to Novel Topology and Activation of Nitrogen in Triazole Moieties. Ansari. S., Verma, S. K., Garin, A. and Mobin, S. M. Cryst. Growth & Des., 2018,18, 1287-1292.
11. Preparation of Ru3(CO)8-pyridine-alcohol cluster and its use for selective catalytic transformation of primary to secondary amines. Singh. A., Shaikh M. Mobin and Mathur, P.Dalton Trans., 2018, 000, Accepted.
12. Full color emitting fluorescent carbon material as reversible pH sensor with multicolor live cell imaging. Sharma, V., Kaur, N., Tiwari, P. and Mobin, S. M. J Photochem Photobiol B., 2018, 182,1 37-145.
13. A highly selective and sensitive chemosensor for L−tryptophan by employing Schiff based Cu(II) complex. Saini, A., Saraf, M., Kumari, P. and Shaikh M. Mobin New J. Chem., 2018,42,3509-3518.
14. Enthralling Adsorption of Different Dye and Metal Contaminants from Aqueous Systems by Cobalt/cobalt Oxide Nanocomposites Derived from Single-source Molecular Precursors. Mohammed, A., Ansari, S. N., Choudhary, A., Ahmed, K., Rajak, R. and Shaikh M. Mobin Chemistry Select, 2018, 000, Accepted.
15. Facile oxidation of alcohols to carboxylic acids in basic water medium by employing ruthenium picolinate cluster as an efficient catalyst.Singh, A., Singh, S., Saini, A. K., Shaikh M. Mobin and Mathur, P.Appl. Organomet. Chem., 2018, 000, Accepted.
16. Facile synthesis of phase pure ZnAl2O4 nanoparticles for effective photocatalytic degradation of organic dyes. Choudhary, A., Mohammed, A. and Shaikh M. Mobin. Mater. Sci. Eng., B., 2018, 227, 136-144.
17. Construction of graphene oxide sheets based modified glassy carbon electrode (GO/GCE) for the highly sensitive detection of nitrobenzene. Ahmad, K., Mohammed, A., Ansari, S. N. and Shaikh M. Mobin Mater. Res. Express , 2018, Accepted,000.
18. A new multitalented azine ligand: elastic bending, single-crystal-to-single-crystal transformation and a fluorescence turn–on Al(III) sensor.Saini, A. K., Natarajan, K. and Shaikh M. Mobin. Chem. Commun., 2017, 53, 9870-9873.

19. Facile Access to Amides from Oxygenated or Unsaturated Organic Compounds by Metal Oxides Nanocatalysts Derived from Single-source Molecular Precursors. Mohammed, A., Chandra, P., Ghosh, T., Carraro, M. and Shaikh M. Mobin. Inorg. Chem., 2017, 56, 10596-10608.
20. Design and construction of ferrocene based inclined polycatenated Co-MOF for supercapacitor and dye adsorption applications.Rajak, R., Saraf, M., Mohammed, A. and Shaikh M. Mobin. J. Mater. Chem. A, 2017, 5, 17998-18011.
21. Small biomolecules sensor based on an innovative MoS2-rGO heterostructure modified electrode platform: A binder-free approach. Saraf, M., Natarajan, K., Saini, A. and Shaikh M. Mobin. Dalton Trans., 2017, 46, 15848-15858.
22. Visible Light Induced Water Splitting Based On A Novel -Fe2O3/CdS Heterostructure.Natarajan, K., Saraf, M. and Shaikh M. Mobin. ACS Omega, 2017, 2, 3447-3456.
23. Sustainable carbon-dots: Recent advances in green carbon dots for sensing and bioimaging. Sharma, V., Tiwari, P. and Shaikh M. Mobin. J. Mater. Chem. B., 2017, 5, 8904-8924. (Invited Review by the Journal)
24. Recent Advances in Single-Crystal-to-Single-Crystal Transformation at the Discrete Molecular Level.Choudhary, A., Mohammed, A. and Shaikh M. Mobin. Cryst. Growth & Des., 2017, 17, 2893-2910.
25. Hydrothermally grown a-MnO2 nanorods as highly efficient low cost counter-electrode material for dye-sensitized solar cells and electrochemical sensing applications.Ahmed, K., Mohammed, A. and Shaikh M. Mobin. Electrochim. Acta, 2017,252, 549-557.
26. Graphene oxide based planar heterojunction perovskite solar cell under ambient condition.Ahmed, K. and Shaikh M. Mobin. New J. Chem., 2017, 41, 14253-14258.
27. Multifunctional porous NiCo2O4 nanorods: sensitive enzymeless glucose detection and supercapacitor properties with impedance spectroscopic investigations. Saraf, M., Natarajan, K. and Shaikh M. Mobin. New J. Chem., 2017, 41, 9299-9313.
28. Ferrocene-substituted bis (ethynyl)-anthracene compounds as anticancer agents. Singh, A., Kumari, P., Raghuvanshi, A., Shaikh M. Mobin and Mathur, P. Appl. Organomet. Chem., 2017, e4071.
29. Microwave assisted fabrication of nanostructured reduced graphene oxide (rGO)/Fe2O3 composite as a promising next generation energy storage material. Saraf, M., Natarajan, K.; Shaikh M. Mobin. RSC Adv., 2017, 7, 309-317.
30. Binder Free Modification of Glassy Carbon Electrode by Employing Reduced Graphene Oxide/ZnO Composite for Voltammetric Determination of Certain Nitroaromatics. Mohammed, A., Ahmad, K., Rajak, R. and Shaikh M. Mobin. Electroanalysis, 2017, 29, 1-10.
31. Cytocompatible peroxidase mimic CuO: graphene nanosphere composite as colorimetric dual sensor for hydrogen peroxide and cholesterol with its logic gate implementation. Sharma, V. and Shaikh M. Mobin. Sens Actuators B Chem, 2017, 240, 338-348.

# 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
- Wavelets and Shearlets

## From the HoD's Desk

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

### Overview and Contributions:

The discipline of Mathematics of IIT Indore began in July 2009; introduced its Ph.D. programme in 2010; and M.Sc. programme in 2015. The faculty are well equipped to conduct research programmes in various areas of pure and applied Mathematics.

The discipline currently offers Ph.D. and M. Sc. programs in Mathematics and envisages other Master's programs in allied fields such as Statistics and Applied Computing and plans to start a B.Tech programme in 'Mathematics and Computing'. Provision can also be made for B.Tech. students to earn Minor in Mathematics. The discipline also encourages Bachelor's and Master's students in Science and Engineering to undertake summer internships and Ph.D. programs in Mathematics.

The discipline received VAJRA Faculty award of SERB. The discipline recently conducted three GIAN courses "Theory and Application of Wavelets and Framelets", "Generalized Iterative Methods for Nonlinear Differential Equations" and "Quasiconformal Mappings and their Applications" in December

2017- January 2018. An "International Conference On Machine Intelligence and Signal Processing" was organized in December 2017, and one CEP course "Differential Equations: Theory, Computation and Applications" in December 2018. The O Level-Mathematics Training and Talent Search Programme was organized in May-June 2017.

An "International Symposium on Computational Mathematics, Optimization, and Computational Intelligence (CMOCI 2017)" has been organized in July 2017. The "Madhava Mathematics" competition is held every year to promote Mathematics in India. Eminent mathematicians from around the world are frequently invited to deliver lectures in both pure and applied Mathematics.

**Introducing the Mathematics Faculty:**

- Dr. Sk. Safique Ahmad (HoD)
- Dr. Antony Vijesh
- Dr. Niraj Kumar Shukla
- Dr. Ashisha Kumar
- Dr. Vijay Kumar Sohani
- Dr. Sanjeev Singh
- Dr. Charitha Cherugondi
- Dr. Swadesh Kumar Sahoo
- Dr. Anand Parkash
- Dr. Md. Aquil Khan
- Dr. Ashok Kumar
- Dr. M. Tanveer
- Dr. Santanu Manna

**Discipline Research Areas:**

Current Mathematics faculty members and students are focusing on a wide range of research areas as follows:

- Algebra, Analysis,
- Differential equations,
- Special functions, Geometric function theory
- Rough Set Theory, Modal Logics, Co-algebra,
- Numerical Linear Algebra, Numerical Analysis, Quaternion Linear Algebra,
- Information Theory, Statistics, Probability,
- Wavelet Analysis, Machine Learning, Optimization and Wave Propagation.

**Facilities in Mathematics:**

We have one postgraduate computers lab that consists of the following:

- Around 25 computing terminals catering to the academic requirements of graduate students. All terminals offer Windows as well as Linux working environments. Computational packages such as MATHEMATICA and MATLAB are included as standard software.

**Collaboration with Foreign Universities/Institutes:**

University of Goettingen, Germany; University of Cincinnati, USA; Shantou University, China; Hunan Normal University, China; University of Eastern Finland, Finland; University of Oulu, Finland; University of Turku, Finland; California State University, Fullerton, USA; Yamaguchi University, Japan; Tohoku University, Japan; Central South University of Forestry and Technology, China; Institute of Mathematics, TU Berlin, Germany; Miami University, Oxford, Ohio USA; Illinois University, USA; University or Split, Croatia; California University, USA; Babes-Bolyai University, Romania; Obuda University, Hungary; Keele University, UK, University of Cambridge, UK; Fraunhofer SIT, Germany; NTU Singapore; University of Technology Sydney, Australia; CNRS, France.

**Collaboration with universities/institutes in India:**

IISc Bangalore, HRI Allahabad, TIFR CAM Bangalore, ISI Kolkata, ISI Chennai, IIT Kanpur, IIT Delhi, Delhi University, University of Allahabad, NIT Rourkela, National Brain Research Centre Gurgaon.

**Academic Events:**

- International Conference On Machine Intelligence and Signal Processing, Dec. 22-24, 2017.
- CEP-2017 on Differential Equations: Theory, Computation and Applications, Dec. 11-14, 2017.

- International Symposium on Computational Mathematics, Optimization and Computational Intelligence (CMOCI 2017), July 17-19, 2017.
- GIAN Program on Theory and Application of Wavelets and Framelets, Dec. 28, 2017-Jan. 04, 2018
- GIAN Program on Generalized Iterative Methods for Nonlinear Differential Equations, Dec. 18-22, 2017
- GIAN Program on Quasiconformal Mappings and their Applications, Dec 11-16, 2017
- MTTS-2017

**Student's Achievements:**

- Our Ph.D. graduates are pursuing Postdoc in India (HRI, IMSC, ISI) and abroad.
- M.Sc. graduates have qualified in national examinations including CSIR-NET, NBHM and GATE, and are pursuing Ph.D. at reputed institutions.

**Notable Achievements:**

- 8 ongoing and approved research projects worth approximately 2 Crores INR till March 31, 2018 from various Govt. funding agencies. Research projects have also been submitted to funding agencies.
- VAJRA Faculty award of SERB jointly with Prof Michel Broniatowski of UPMC, Paris, France.
- Faculty members have been actively collaborating with various institutes across the globe (Finland, China, France, Germany, Singapore, Canada, USA etc.)
- Faculty members are invited to various prominent international institutes as research visitors.

## Photographs of various events

GIAN Program 2017

MTTS 2017

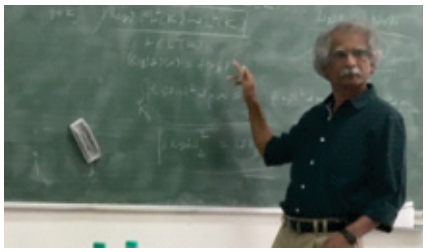
TU9-IITI Research Workshop 2018

## Photographs of eminent mathematicians delivering lectures at IIT Indore

Prof. Michel Broniatowski

Prof. R. Balasubramanian

Prof. Rajeeva L. Karandikar



Prof. S. Thangavelu

Prof. S. Kumaresan

Prof. S. Ponnusamy

## About Faculty:

Associate Professor
safique@iiti.ac.in

**Dr. Sk. Safique Ahmad** (Ph.D.: 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 German Fellowship and visited the Institut für Mathematik, Universität Berlin, Germany in 2nd February 2009 as a Post-Doctoral Fellow and then 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 lies inside Numerical Linear Algebra, Quaternion Linear Algebra and Operator Theory and its Applications, Inverse Eigenvalue problems, etc . For more on his research, please visit the website:
http://www.iiti.ac.in/people/~safique/

### Major Thrust Area of Research:

Numerical Linear Algebra, Quatrenionic Linear Algebra, Operator Theory and Applications

### Research Publications:

1. Localization theorems for matrices and bounds for the zeros of polynomials over a quaternion division algebra, S. S. Ahmad and I. Ali, Filomat , Vol. 32, pp. 553-573, 2018.

### Teaching Activities:

Dr. Ahmad taught the following courses for UG and PG students: Calculus, Linear Algebra, Differential Equations, Complex Analysis, Numerical Methods, Computational Techniques, Numerical Linear Algebra, Advanced Operator Theory, Analysis.

### Research Projects:

1. On inverse eigenvalue problems for structured matrix pencils Sponsoring Agency: Department of Science and Technology (DST), New Delhi, SERC, Under the scheme MATRICS Designation: Principal Investigator Sanctioned amount and duration: INR 6 Lakhs (2018-2020)
2. Perturbation analysis on singular Multi-parameter eigenvalueproblems with various Structures Sponsoring Agency: funded by SERB.

### Events Organized:

1. International Conference on Mathematical Modelling and Scientific Computing (ICMMSC) 19th-21st July 2018
2. "Modern Applications of Numerical Linear Algebra Methods" under GIAN funded by MHRD Govt. of India 27th August-5th July, 2018. of India during 26th Oct- 1st Nov, 2016
3. Big Data Stream Analytics under GIAN funded by MHRD Govt. of India during 26th Oct- 1st Nov, 2016

### Foreign Visit (recent):

1. Contributed talks in two American Mathematical Society (AMS) Conferences during September in 2017
2. Invited talk and chairing the session in 34th Ohio State-Denision Math Conference held in May 2018
3. A two-month visit to OSU, USA, sponsored through MATRIC Project during May-July, 2018
4. Contributed talk in International Congress of Mathematicians in 2018 held in Brazil during August 1-9

## About Faculty:

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 Ph.D. 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. For more information on his academic, research and other activities at IIT Indore, please visit: www.iiti.ac.in/~swadesh.

### Major Thrust Area of Research:

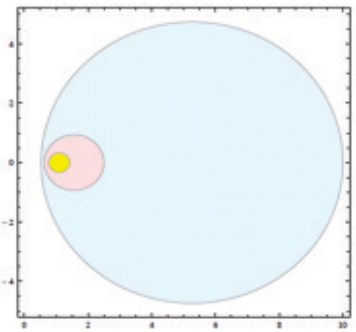
Geometric Function Theory. Current research interests include: Univalent Function Theory, Special Functions, Hyperbolic-type metrics, Quasiconformal mappings, Compactness and Spectral properties of complex integral operators, and role played by them in Mathematical Sciences.

### Teaching Activities:

He teaches several courses in Under-Graduate and Post-Graduate Mathematics at IIT Indore. In 2017-18, Complex Analysis, Topology, and Functional Analysis were taught by him.

### Selected Research Publications:

1. M. R. Mohapatra and S. K. Sahoo, A Gromov hyperbolic metric vs the hyperbolic and other related metrics, Comput. Methods Funct. Theory, 18 (2018), 473-493.
2. 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 (2018), 141-152.
3. R. Klen, M. R. Mohapatra, and S. K. Sahoo, Geometric properties of the Cassinian metric, Math. Nachr., 290 (2017), 1531-1543.
4. J. Chen, P. Li, S. K. Sahoo, and X. Wang, On the Lipschitz continuity of certain quasiregular mappings between smooth Jordan domains, Israel J. Math., 220 (2017), 453-478.



The Cassinian disks centred at a fixed point with different radii.

### Research Projects:

Geometry of hyperbolic type metrics and their application in analytic function theory, funded by NBHM, DAE. Duration: 2016 - 2019.

### Events Organized:

1. NTU-India Connect Program: International Symposium on Computational Mathematics, Optimization, and Computational Intelligence (CMOCI 2017), July 17-19, 2017.
2. GIAN course on Quasi conformal Mappings and their Applications, December 11-16, 2017 (International Speaker: Prof. Pekka Koskela, University of Jyvaskyla, Finland).

## About Faculty:

Associate Professor
vijesh@iiti.ac.in

**Dr. Antony Vijesh** (Ph.D.: 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.

### Major Thrust Area of Research:

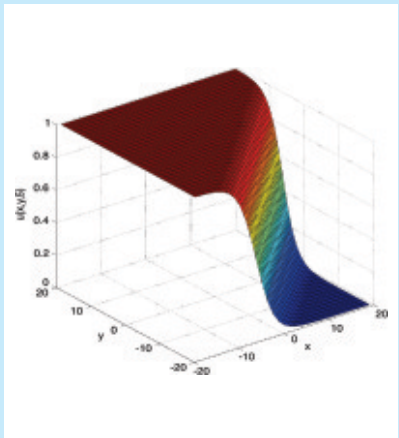
Currently, he is working on developing higher order compact finite difference method for nonlinear partial differential equation as well as for integro differential equation via monotone iteration.

### Teaching Activities:

Dr. Vijesh has taught the following courses for UG and PG students: advanced analysis, calculus, numerical linear algebra, numerical methods, ordinary differential equation and partial differential equations.

**Research Publications:**

1. K. Harish Kumar and V. A. Vijesh, Wavelet based iterative methods for a class of 2D-partial integro differential equations, Computers & mathematics with applications, 75(2018), 187—198.
2. G. Chandhini, Prashanthi and V.A. Vijesh, A radial basis function method for fractional Darboux problems, Engineering analysis with boundary elements, 86(2018), 1—18.
3. R. Roy, V.A. Vijesh and G. Chandhini, Iterative methods for a fractional order Volterra population model, to appear in Journal of integral equations and applications.



### Events Organized:

1. Organized a GIAN course entitled 'Generalized iterative methods for nonlinear differential equations' during Dec 18-22, 2017.

## About Faculty:

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 Ph.D. research at IIT Kanpur, he worked on Prime Submodules and Multiplication Modules under the supervision of Prof. A.K. Maloo. After submitting his Ph.D. 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.

Homepage: http://www.iiti.ac.in/people/~anandparkash/

**Major Thrust Area of Research:** Commutative Algebra

**Teaching Activities:** In the academic year 2017-18, Dr.Parkash taught Algebra-I and Algebra-II at IIT Indore. He is also an instructor in MTTS-2017.

**Events Organized:** Dr.Parkash is one of the organizers of 0-Level Mathematics Training and Talent Search (MTTS) programme held in IIT Indore during 29/05/17 to 24/06/17.

## About Faculty:

Assistant Professor
nirajshukla@iiti.ac.in

**Dr. Niraj Kumar Shukla** (Ph.D.: 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. He is currently working on the path connectivity of collection of all wavelets, and duality of frame wavelets on the space of square integrable as well as square summable.

**Major Thrust Area of Research:** Frame, Wavelets, and Harmonic Analysis

**Teaching Activities:** Wavelet Analysis, Calculus, Numerical Methods, Analysis-I, Linear Algebra and Ordinary Differential Equations, Topology

**Research Publications:**

1. Pairwise orthogonal frames generated by regular representations of LCA groups, Bull. Sci. Math., to appear. (with A. Gumber)
2. Finite dual g-framelet systems associated with an induced group action, Complex Anal. Oper. Theory, to appear. (with A. Gumber)
3. Generalized Nonuniform Multiresolution Analyses, Colloq. Math., 153(2018), 121-147. (with S. Mittal)
4. Super-wavelets on local fields of positive characteristics, Math. Nachr., 291(2018), 704-719. (with S.C. Maury)
5. Uncertainty Principle corresponding to an Orthonormal Wavelet System, Appl. Anal., 97(3)(2018), 486-498. (with A. Gumber)
6. Orthogonality of a pair of frames over locally compact abelian groups, J. Math. Anal. Appl., 458(2)(2018), 1344-1360. (with A. Gumber)
7. A Characterization of Nonuniform Multiwavelets Using Dimension Function, Results Math., 72(3)(2017), 1239–1255. (with S. Mittal and N.A.S. Atlouba) ·

**Research Projects:**

**Title:** A study of Shearlet frames and Shearlet transform

**Sponsoring Agency:** CSIR, New Delhi

**Sanctioned amount and duration:** INR 19 Lakhs approx. (2018-2021)

**Events Organized:**

1. Organized a GIAN course, 'Theory and Application of Wavelets and Framelets', 28 December 2017-04 January 2018.

## About Faculty:

Associate Professor
aquilk@iiti.ac.in

**Dr. Md. Aquil Khan** (Ph.D.: 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.

**Major Thrust Area of Research:** Modal Logic, Rough Set Theory

**Teaching Activities:** Dr. Khan taught the following courses for UG and PG students: ordinary differential equations, partial differential equations, complex analysis, linear algebra, discrete mathematics, mathematical logic, topology.

**Research Publications:**

Khan, M. A.: A Probabilistic Approach to Rough Set Theory with Modal Logic Perspective. Information Sciences, 406-407, 170-184. Elsevier.

**Research Projects:**

**Title:** Probabilistic and co-algebraic approaches to rough set theory

**Funding Agency:** Science and Engineering Research Board (SERB), New Delhi

**Membership:** Program Committee Member, The International Joint Conference on Rough Sets, Olsztyn, Poland Local Advisory Committee, International Conference on Machine Intelligence and signal processing, IIT Indore, India.

## About Faculty:

Assistant Professor
akumar@iiti.ac.in

**Dr. Ashisha Kumar** (Ph.D.: 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. Web page: http://iiti.ac.in/people/~akumar/

**Major Thrust Area of Research:** Harmonic Analysis

**Teaching Activities:** In the academic year 2017-18, Dr. Kumar taught Fourier Analysis on Euclidean Spaces, Linear Algebra and Functional Analysis

**Events Organized:** As a seminar coordinator of Discipline of Mathematics, Dr. Kumar has organized lectures of many eminent Mathematicians. He is a regional coordinator of national mathematics competition named after, an Indian Mathematician, Madhava (Madhava Mathematics Competition). Dr. Kumar is also one of the organizers of O-Level Mathematics Training and Talent Search (MTTS) programme held in IIT Indore during 29/05/17 to 24/06/17.

## About Faculty:

Assistant Professor
ashokm@iiti.ac.in

**M. Ashok Kumar** received his bachelor's and master's degrees in Mathematics from the Manonmaniam Sundaranar University, Tirunelveli, in 1999 and 2001 respectively. He qualified for the CSIR-UGC (NET) for JRF in 2008 and joined Ph.D. programme in the department of Electrical Communication Engineering, the Indian Institute of Science, Bangalore, under the supervision of Prof. Rajesh Sundaresan. He completed his Ph.D. in October 2014. Subsequently, he was a Visiting Scientist at the Stat-Math Unit of the Indian Statistical Institute, Bangalore from December 2014 to May 2015 and a post-doctoral fellow at Technion-Israel Institute of Technology from May 2015 to December 2015 under the mentorship of Prof. Igal Sason. He joined as Assistant Professor in the discipline of Mathematics at the Indian Institute of Technology, Indore since in January 2016.

### Major Thrust Area of Research:

Information Theory, Information Geometry, Generalized Estimation for Power-Law Models.

### Awards & Achievements:

Received VAJRA Faculty award of SERB jointly with Prof Michel Broniatowski of UPMC, Paris, France.

## About Faculty:

Assistant Professor
vsohani@iiti.ac.in

**Dr. Vijay Kumar Sohani** completed his Ph.D. 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.

Web page: http://iiti.ac.in/people/~vsohani/.

### Major Thrust Area of Research:

Harmonic Analysis and PDE

### Teaching Activities:

Dr. Vijay taught the following courses for UG and PG students: Calculus, Ordinary Differential Equation, Topology-I, Analysis-I, Analysis-II.

## About Faculty:

Assistant Professor
mtanveer@iiti.ac.in

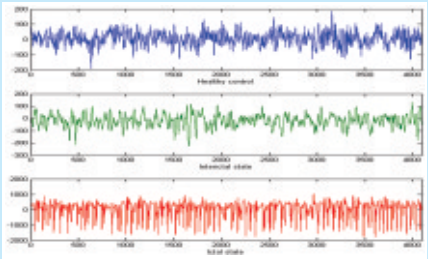
**Dr. M. Tanveer** is an Assistant Professor and Ramanujan Fellow. Previously, he was a Postdoctoral Research Fellow at the Rolls-Royce@NTU Corporate Lab of NTU, Singapore for one year. He received his Ph.D. degree in Computer Science from JNU, New Delhi. He has published in over 20 referred journal 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)].

**Major Thrust Area of Research:** Machine Learning, Optimization, Support Vector Machines

**Teaching Activities:** Operations Research, Linear Algebra, Numerical Methods, Computational Techniques

**Research Publications:**

1. B. Richhariya, M. Tanveer (2018), A robust fuzzy least squares twin support vector machine for class imbalance learning. Applied Soft Computing, Elsevier, 71:418-432. [SCI Indexed with Impact Factor: 3.907]
2. B. Richhariya, M. Tanveer (2018), EEG signal classification using universum support vector machine. Expert Systems with Applications, Elsevier, 106: 169-182. [SCI Indexed with Impact Factor: 3.928].



EEG Signal classification using universum SVM

**Events Organized:**

1. International Conference on Machine Intelligence and Signal Processing (MISP-2017) from December 22-25, 2017 held at IIT Indore.
2. NTU-India Connect Program: International Symposium on Computational Mathematics, Optimization, and Computational Intelligence (CMOCI 2017) during July 17-19, 2017.

MISP 2017

**Ongoing Research Projects:**

1. Classification and prediction of Alzheimer disease using multimodal imaging data Sponsoring Agency: SERB under Ramanujan Scheme, Designation: Principal Investigator, Sanctioned amount and duration: INR 89 Lakhs (2016-2021)
2. Optimization models and algorithms for non-parallel support vector machines, Sponsoring Agency: SERB under Early Career Research Award (ECRA) Scheme, Designation: Principal Investigator, Sanctioned amount and duration: INR 26 Lakhs (2017-2020)

3. Detection of human brain disorders using novel machine learning approaches, Sponsoring Agency: CSIR under Extra Mural Research (EMR), Scheme Designation: Principal Investigator, Period: 2017-2020, Sanctioned amount and duration: INR 24 Lakhs (2018-2021)
4. Development of novel machine learning algorithms for automated detection of seizure using EEG signals, Sponsoring Agency: DST under ICPS - Data Science Research Initiative Scheme, Role: Principal Investigator, Approved amount and duration: INR 15 Lakhs (2018-2021)

**Awards & Achievements:**

2018: IEEE Senior Member.
2018: IEEE Computational Intelligence Society Member.
2018: Special Session Chair of IEEE SSCI 2018 (Top ranked conference).
2018: Invited as Visiting Professor at UFMG, Brazil.
2018: Section Editor: Smart Science, Taylor & Francis (Scopus and ESCI).

NTU-INDIA Connect Program 2017

Research Group

## About Faculty:

Assistant Professor
snjvsngh@iiti.ac.in

**Dr. Sanjeev Singh** completed his school education from Ballia, Uttar Pradesh; B.Sc. from Ewing Christian College, Allahabad in 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 2011 and 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; a Postdoctoral Fellow at the Indian Statistical Institute Chennai Centre from December 2016 to June 2017 and a SERB - National Post Doctoral Fellow at IIT Indore from June 2017 to September 2017. His area of research is Special Functions, Differential Equation and Geometric Function Theory. He has studied Turan type inequalities for various special functions such as Struve functions, confluent hypergeometric functions of the second kind, Bessel functions etc. His recent studies include geometric properties of some special functions and distribution of zeros of these special functions.

**Major Thrust Area of Research:**

To study geometric properties, inequalities, and zeros of special functions

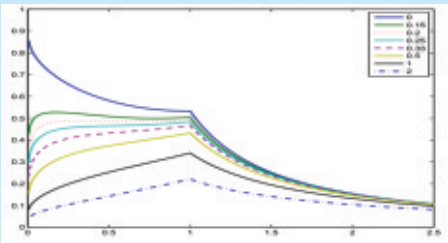
**Academic/Professional Activities:**

Reviewer: MathSciNet (American Mathematical Society)
Reviewer: Bulletin of the Malaysian Mathematical Sciences Society (Springer)
Reviewer: Scientiae Mathematicae Japonicae
Member: Ramanujan Mathematical Society

**Teaching Activities:**
MA 651 Numerical Analysis (M.Sc. Semester III), MA 105 Calculus (B.Tech. Semester I), MA 204 Numerical Methods (B.Tech. Semester IV).

**Research Publications:**

1. Geometric and monotonic properties of hyper-Bessel functions , Ramanujan Journal, (2018), To appear. (with I. Aktas, A. Baricz).



The graph of ln(x)Kn(x)/(1+|lnx|) for n= 0; 0.15; 0.2; 0.25; 0.33; 0.5; 1; 2 on [0,0.25]

## About Faculty:

Visiting
Assistant Professor
smanna@iiti.ac.in

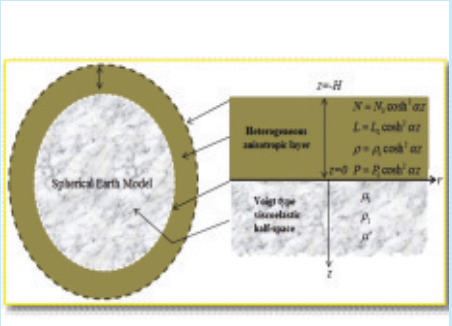
**Dr. Santanu Manna** did his B.Sc. in Mathematics (Honours) from the University of Calcutta; Master's in Mathematics & Computing from the Indian School of Mines, Dhanbad in 2011 and Ph.D. in Applied Mathematics from the Indian Institute of Technology (ISM), Dhanbad in 2015. After his Ph.D., Dr. Manna 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 in ICM 2018 from the International Mathematical Union. Homepage: http://iiti.ac.in/people/~smanna/

**Major Thrust Area of Research:** Differential Equations (Hyperbolic-PDE, Stability analysis, Simulation), Multi-parametric Modeling, Wave Propagation Aspects, Computational Geo-Science.

**Teaching Activities:** MA 204: Numerical Methods, MA 680: Computational Techniques, MA 105: Calculus-I, MA 203: Differential Equations-II, MA 651: Numerical Analysis.

**Research Publications:**

1. Manna, S., Kundu, S. and Misra, J.C., Analysis of torsional wave propagation in a heterogeneous anisotropic stratum over a Voigt viscoelastic half-space, International Journal of Geomechanics, (ASCE), 2018, vol. 18(6), pp.
2. Manna, S., Misra, J.C., Kundu, S. and Gupta, S. Surface wave propagation in an initially stressed heterogeneous medium having a sandy layer and a point source Geomechanics and Engineering (Techno-Press) Vol. 16(2), 169-176, 2018, SCI, IF: 1.818.



### Research Projects:

Surface Waves in Non-Locally Elastic Solids, submitted to SERB, DST under VAJRA, February 10, 2018 (Ref. No : 342018000063) with Prof. Julius Kaplunov (Under Consideration)

### Awards & Achievements:

1. ICM-2018 Open Arms Grant Award, from International Mathematical Union based on Research output, 2018

### Events Organized:

1. Convener (2017): Continuing Education Program on "Differential Equations: Theory computation and Applications" on 11-14th December 2017, IIT Indore. (http://bit.ly/2F8H4fQ)
2. Member (2017): International Conference on "Machine Intelligence and Signal Processing (MISP 2017)", Dec 22-24, 2017, IIT Indore, India. (http://misp.iiti.ac.in/)
3. Member (2018): International Symposium on "Water: Resources, Challenges & Sustainability" (WRCS), March 10, 2018, IIT Indore. (http://bit.ly/2H3MrcU).

## About Faculty:

Visiting
Assistant Professor
charithac@iiti.ac.in

**Dr. Charitha Cherugondi** (Ph.D.: 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 Ph.D. 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.

### Major Thrust Area of Research:

She has been trained in the theory of optimization in her doctoral studies with a focus on mathematical analysis of solution methods for general classes of optimization problems through reformulations. She pursued her postdoctoral work in analyzing the optimization models of Image denoising problems. She is currently working on regularization schemes for vector optimization problems and algorithmic framework for convex optimization problems restricted to specific structures.

### Teaching Activities:

Dr. Charitha has been involved in teaching the following courses at UG and PG levels: Operations Research, Calculus, Complex Analysis, Analysis I, Computational Techniques and the Ordinary Differential Equations.

# Discipline of Physics

The Physics discipline at IIT Indore, established in 2009 has matured into an active research and teaching community. The discipline offers two postgraduate academic programs, M.Sc. and Ph.D. 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 Ph.D. students. Many faculty members are also involved in interdisciplinary research areas extending to disciplines of Astronomy, Biosciencs 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

**Dr. Krushna R. Mavani** is working as a Professor in the Discipline of Physics. She joined IIT Indore in 2009 after completing her postdoctoral tenures of about 3.5 years in Osaka University, Japan and Kyoto University, Japan. She was awarded by 'Wakastayoshiki' research fund as Principal Investigator in her project in Kyoto University. Before this, she worked as a Research Fellow in Tata Institute of Fundamental Research (TIFR), Mumbai for about 3 years. In 2003, she completed her Ph.D. work from Saurashtra University, in major collaboration with TIFR, Mumbai. She also worked as a 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 Supercondcutor Thin Films.

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.

Presently she has three major research projects from the Departement of Science and Technology (DST) , Board of Research on Nuclear Sciences (BRNS) and Science and Engineering Research Board (SERB).

Presently her research group includes six Ph.D. students. Two Ph.D. and two M.Sc. students have been graduated under her guidance. Dr. Mavani has 58 publications till date. Dr. Mavani conducted a workshop on: 'Knowledge, Personality and Skill Development Activities for Aspiring Girl Students' at IIT Indore for three weeks from 21st May – 10th June 2018.

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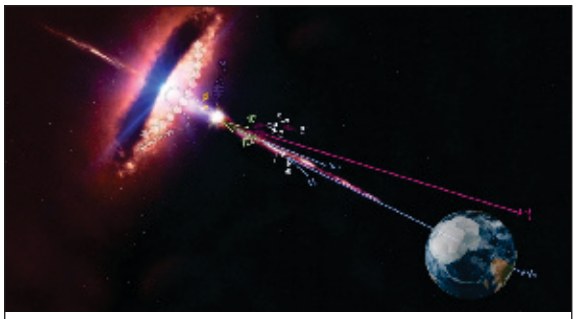
**Dr. Subhendu Rakshit**
Professor
rakshit@iiti.ac.in

**Dr. Shubhendu Rakshit** has done his Ph.D. from Calcutta University and was Visiting Scientist in TIFR, India, postdoctoral fellow at University of Dortmund, Germany; Saha Institute of Nuclear Physics, India; Technion UCniversity, Israel; and, Harish Chandra Research Institute, Allahabad.

The IceCube experiment located at the Antarctica is measuring high-energy neutrinos of more than 60 TeV coming from extra-galactic sources. Several observations have been made and a shape of the spectrum is gradually emerging. It is likely that many sources like Active Galactic Nuclei, Gamma Ray Bursts etc. contribute to these spectra. We have proposed that the neutrinos do get absorbed in the dark matter halos on their way to the Earth, so that the observed spectra are actually the absorption spectra due to interaction of the neutrinos with ultra-light bosonic dark matter of mass less than 1 eV. Such dark matter candidates can exist in the form of Bose-Einstein condensates and hence, are candidates for cold dark matter. So the entire observed relic density can be saturated by this kind of dark matter particles. Such dark matter candidates are interesting as they may help sort out issues related to structure formation. We have explored large classes of models that can give rise to such interactions between ultra-light bosonic dark matter and the neutrinos. It is a difficult exercise given the constraints coming from collider searches, cosmological constraints and electroweak precision experiments. For example, we have presented a renormalisable model where the interactions are mediated by a light Z' boson of mass 10 MeV.

After discovery of the Higgs boson, an important question to ask is how many of them do exist? While the Standard Model of particle has made a minimalistic choice of only one Higgs boson, the extended models predict more than one scalar boson that are being searched for in the collider experiments. We have

considered the next to minimal model, the two Higgs doublet model (2HDM). The failure to identify any such new Higgs below 500 GeV or so has raised an interesting possibility that the model may exist in the so-called alignment limit in which the heavier bosons are weakly coupled to the standard model particles. We have proposed a complete basis for six dimensional operators to 2HDM and found out the constraints on the corresponding Wilson coefficients of the bosonic operators interesting for Higgs physics. Subsequently, we have also checked the robustness of the alignment limit if the 2HDM, in presence of such operators. The results were published in the following two articles in the Journal of High Energy Physics.



Picture Courtesy: IceCube Collaboration

1) Alignment Limit in 2HDM: Robustness put to test By Siddhartha Karmakar, Subhendu Rakshit. JHEP 1809 (2018) 142.
2) Higher dimensional operators in 2HDM By Siddhartha Karmakar, Subhendu Rakshit. JHEP 1710 (2017) 048.

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

**Dr. Sarika Jalan** has done her Ph.D. 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 with graduating students

Complex Systems Lab @ IITI : The research at Complex Systems Lab guided by Dr. Jalan primarily explores into structural and dynamical behaviors of real-world complex systems where the underlying network can be expressed in multiplex framework. A layered representation of networks where each layer signify a different type of interaction between same pair of nodes, known as multiplex networks provide a realistic assumption of the real world complex systems. Our work includes impact of multiplexing on the behavior of second-order Kuramoto oscillators, impact of excitatory and inhibitory couplings in the dynamics of chimera state in a multiplex network. We also explored the localization of PEV in multiplex networks by single-layer rewiring. Two review articles on networks has been published. The details of the key works are as follows:

### I) Multiplexing induces explosive synchronization in kuramoto oscillators:

Explosive synchronization (ES) of coupled oscillators on networks is shown to be originated from the existence of correlation between natural frequencies of oscillators and degrees of corresponding nodes. Here, we demonstrate that ES is a generic feature of multiplex network of second-order Kuramoto oscillators and can exist in the absence of a frequency-degree correlation. We report that multiplexing of two networks having homogeneous degree distribution support the first-order transition in both the layers thereby facilitating ES. More interesting is the multiplexing of a layer bearing heterogeneous degree distribution with another layer bearing homogeneous degree distribution, which induces a first-order (ES) transition in the heterogeneous layer which was incapable of showing the same in isolation. Further, we report that such induced ES transition in the heterogeneous layer of multiplex networks can be controlled by varying inter- and intra-layer coupling strengths.

**II) Impact of inhibitory coupling on dynamical behavior of multiplex system:**

We investigate the impact of multiplexing of a layer having repulsively coupled oscillators on the occurrence of chimeras in the layer having attractively coupled identical oscillators. We report that there exists an enhancement in the appearance of the chimera state in one layer of the multiplex network in the presence of repulsive coupling in the other layer. Furthermore, we show that a small amount of inhibition or repulsive coupling in one layer is sufficient to yield the chimera state in another layer by destroying its synchronized behavior.

**III) Localization of multilayer networks by the optimized single-layer rewiring:**

We study localization properties of principal eigenvector (PEV) of multilayer networks. Starting with a multilayer network corresponding to a delocalized PEV, we rewire the network edges using an optimization technique such that the PEV of the rewired multilayer network becomes more localized. The framework allows us to scrutinize structural and spectral properties of the networks at various localization points during the rewiring process. We show that rewiring only one-layer is enough to attain a multilayer network having a highly localized PEV. Our investigation reveals that a single edge rewiring of the optimized multilayer network can lead to the complete de- localization of a highly localized PEV. This sensitivity in the localization behavior of PEV is accompanied by a pair of almost degenerate eigenvalues. Furthermore, analysis of multilayer networks constructed using real-world social and biological data show that the localization properties of these real-world multilayer networks are in good agreement with the simulation results for the model multilayer network.

**Total Publication: 17**

**Key Publications**

**Reviews Articles:**

1) Sarika Jalan and Camellia Sarkar. Complex Networks: an emerging branch of science. Physics News 47, 3-4 (2017).
2) Camellia Sarkar and Sarika Jalan, Spectral properties of complex networks. Chaos: An interdisciplinary journal of nonlinear science) 28 102101 (2018).

**Recent Publications (Selected):**

1) Ajay Deep Kachhvah and Sarika Jalan. Multiplexing induced explosive synchronization in Kuramoto oscillators with Inertia, EPL 119, 60005 (2017).
2) Sarika Jalan, Saptarshi Ghosh and Bibhabasu Patra. Is repulsion good for the health of chimeras?, Chaos 27, 101104 (Fast Track) (2017).
3) Sarika Jalan and Priodyuti Pradhan. Localization of multiplex networks by the optimized single-layer rewiring. Phys. Rev. E 97, 042314 (2018).
4) Saptarshi Ghosh, Sarika Jalan. Engineering chimera patterns in networks using heterogeneous delays, Chaos 28, 071103 (2018) (Fast Track) Selected as Editor's Pick Article.
5) Pramod Shinde, Camellia Sarkar and Sarika Jalan*. Codon based co-occurrence network motifs in human mitochondria. Sci. Rep. 8, 3060 (2018).

**Dr. Sarika Jalan was the main Organizer of following two GIAN Courses namely,**

1) Course on "Network science – from structure to dynamics" taken by Dr. Baruch Barzel. (August, 2018)
2) Course on "Explosive transitions in complex networks" taken by Dr. I. Leyva. (January, 2018)

**Dr. Sudeshna Chattopadhyay**
Associate Professor
sudeshna@iiti.ac.in

**Dr. Sudeshna Chattopadhyay** (Bandyopadhyay) is an Associate Professor in Discipline of Physics, Discipline of Metallurgy Engineering and Materials Science (adjunct faculty), and Discipline of Biosciences and Biomedical Engineering (adjunct faculty) at IIT Indore.

She is working in the field of atomic scale characterization of surface and interfaces of materials, atomic layer deposition, x-ray scattering, ellipsometry, energy research. In general, her research interest is in the study of surfaces and interfaces (solids, liquids, soft matter and nanomaterials, metal-polymer nanocomposites, nanostructured organic / inorganic ultra-thin films etc.) and structure-property correlation, Electrical Energy Storage specifically on Al and Li-ion battery application, and Renewable energy, exploring high efficiency photocatalyst, for $H_2$ production through water splitting and solar cell application, Biomedical Applications of Nanotechnology, Biomedical nano-chip for detection of pathogens (virus, bacteria), inflammatory and tumor cells and Bio-instrumentation.

Dr. Chattopadhyay has done her Ph.D. 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 (Sept 1, 2015 -date)

She has published in several high impact peer reviewed journals such as Physical Review Letters, Chemistry of Materials, Physical Review B, Macromolecules, Advanced Materials Interfaces etc and has US patent on electrode materials for Li-ion battery, and is a recipient of Deutscher Akademischer Austausch Dienst (DAAD) Faculty Award (2013).

Total number of research publications in 2017-2018 is 6. Few selected publications (in 2017-2018) are given below:

1. ''Binder-Free ZnO Cathode synthesized via ALD by Direct Growth of Hierarchical ZnO Nanostructure on Current Collector for High-Performance Rechargeable Aluminium-Ion Batteries''.
   Dipayan Pal, Aakash Mathur, Ajaib Singh, Srimanta Pakhira, Rinki Singh, and Sudeshna Chattopadhyay*, Chemistry Select, 3, 12512-12523 (2018)
2. "Structure and morphology of magnetron sputter deposited ultrathin ZnO films on confined polymeric template"
   Ajaib Singh, Susanne Schipmann, Aakash Mathur, Dipayan Pal, Amartya Sengupta, Uwe Klemradt, Sudeshna Chattopadhyay*, Applied Surface Science 414, 114 -123 (2017).
3. "Tunable Optical Properties in Atomic Layer Deposition grown ZnO Thin Films"
   Dipayan Pal, Aakash Mathur, Ajaib Singh, Jaya Singhal, Amartya Sengupta, Surjendu Dutta, Stefan Zollner, and Sudeshna Chattopadhyay*, Journal of Vacuum Science & Technology A 35, 01B108 (1-9) (2017)
4. "Effect of Substrates and Thickness on Optical Properties in Atomic Layer Deposition Grown ZnO Thin Films"
   Dipayan Pal, Jaya Singhal, Aakash Mathur, Ajaib Singh, Surjendu Dutta, Stefan Zollner, and Sudeshna Chattopadhyay*, Applied Surface Science, 421, 341-348, (2017).

**Continuing education program (CEP) and Invited Talk in International Conference/Workshop**

1. Organized / Conducted A Short Term Interdisciplinary Course on "Differential Equations: Theory, Computation and Applications" under Continuing Education Program (CEP) at IIT Indore, 11-14 December 2017, along with three other members.

2. Invited Talk in the "International Conference on Nano-materials for Energy Conversion and Storage Applications" (NECSA -2018), PDPU, Gandhinagar, January 29th - 31st, 2018.
3. Invited Talk in the "IIT Indore – TU9 Second Research Workshop", IIT Indore, 5-6 October 2017. Title: "Design and Characterization of Novel Materials for Energy Research and Nanoscale Devices."

The Research Group of
Dr. Sudeshna Chattopadhyay

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

**Dr. Rajesh Kumar** is an experimental solid state physicist. He completed his Ph.D. from IIT Delhi and was a post doctoral Scientist in 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. 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. The following are couple of recent important works from the group:

**Quantification of short-range order:** Amorphous materials are often said to have "short-range order" of crystallinity. This short-range is used very qualitatively and has little significance in understanding the nature of a material. A methodology has been proposed to quantify this crystallinity, similar to nanomaterials, using Raman spectroscopy. A theoretical line-shape, derived by considering the phonons under a confined system, appears to be explaining the observed Raman spectra from amorphous silicon. The line-shape is observed to be dependent on the abovementioned "short-range order" and hence can be used to quantify the same. Additionally a very simple relation between the order and the Raman peak position is reported. https://pubs.acs.org/doi/abs/10.1021/acs.analchem.8b01352

**Fabrication of Fast Electrochromic and field emission Devices:** A fast and stable power efficient electrochromic device has been designed and fabricated using hybrid materials by combining viologen (Organic) and metal oxide (inorganic) materials. The device shows superior properties as compared to metal oxide only electrochromic device. Certain modifications in materials make it to switch between multiple colors.

https://pubs.acs.org/doi/abs/10.1021/acsanm.8b00871

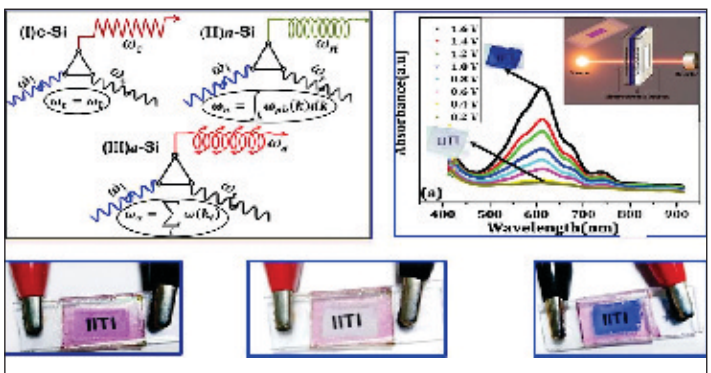


Figure: Raman scattering from crystalline, amorphous and nanocrystalline materials along with color switching from electrochromic device.

2. Selected publications (Total: >25):

- Priyanka Yogi, Manushree Tanwar, Shailendra K. Saxena, Suryakant Mishra, Devesh K.Pathak, Anjali Chaudhary, Pankaj R. Sagdeo and Rajesh Kumar, "Quantifying the short-range order in amorphous silicon by Raman scattering", Analytical Chem. 90, 8123(2018).
- Suryakant Mishra, Simran Lambora, Priyanka Yogi, Pankaj R. Sagdeo, and Rajesh Kumar "Organic Nanostructures on Inorganic Ones: An Efficient Electrochromic Display by Design", ACS Appl. Nano Mater. 01, 3715 (2018).
- Suryakant Mishra, Priyanka Yogi, P.R. Sagdeo & Rajesh Kumar, "$TiO_2Co_3O_4$ CoreShell Nanorods: Bifunctional Role in Better Energy Storage and Electrochromism"ACS Appl.Energy Mater. 01, 790 (2018).
- Shailendra K. Saxena, P. Yogi, Suryakant Mishra, Hari Mohan Rai, Vikash Mishra, Kamal Warshi, Swarup Roy, P Mondal, Pankaj Ramesh Sagdeo and Rajesh Kumar, "Amplification or Cancellation of Fano Resonance and Quantum Confinement Induced Asymmetries in Raman Line-Shapes", Phys. Chem. Chem. Phys. 19, pp-31788, (2017)
- Suryakant Mishra, Priyanka Yogi, Shailendra K. Saxena, J. Jayabalan, Prakash Behera, P.R. Sagdeo, Rajesh Kumar, "Field emission enhancement in ultrathin nano-thorn covered NiO nano-petals", J. Mater. Chem. C, vol. 5, pp-9611, 2017

3. Appointed as Associate Editor of journal "Advances in Materials Processing and Technology (Taylor & Francis)"

Scan the QR code for more details:

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

**Dr. Pankaj R. Sagdeo** has done his Ph.D. from UGC-DAE CSR Indore and held positions of Officer/Coordinaator in 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.

Dr. Sagdeo is using optical spectroscopy, x-ray scattering data, Raman/IR spectroscopy and density functional theory at ambient and non-ambient temperature to study address some of the fundamental problems related to the highly correlated electron systems. The direct correlation of the band gap and the electronic disorder near band-edge on the physical properties such as conductivity, dielectric behavior etc. is being established. Using the said spectroscopic techniques Dr. Sagdeo and his research group demonstrated the potentials of optical spectroscopy to investigate 1) the relaxation in pure BaTiO3 near phase transition 2) to study the defect state below fundamental edge and 3) searching the signature of non-stoichiometry in d5 transition metal based oxides etc. The correlation between the optical band gap with that of structural parameters, the correlation between band gap, electronic disorder, width of d-d transition and electron phonon coupling is recently established in several perovskite based oxide systems. Using temperature dependent optical spectroscopies Dr. Sagdeo demonstrated the potential of optical spectroscopy to find the frequency of phonon strongly coupled with lattice which helps to predict the crystallographic structure after phase transition and the disappearance of phonon mode at the phase transition in polar and non-polar dielectric and semiconductors materials. The temperature dependent optical, structural and density functional analysis investigations on of Mott-Hubbard insulators and

charge transfer insulators is successfully used to obtain the values of on-site columbic repulsion and charge transfer parameter which are very crucial for highly correlated electron system. These are some of the cutting edge information on the highly correlated electron systems.

Some of the recent important publications are (in 2017-2018 the Group of Dr. Sagdeo have published around 20 research papers in international peer reviewed Journals):

1) Electronic and optical properties of BaTiO3 across tetragonal to cubic phase transition: An experimental and theoretical investigation: Journal of Applied Physics 122, 065105 (2017).
2) Strain control of Urbach energy in Cr-doped PrFeO3: Appl. Phys. A: 123, 576 (2017).
3) Importance of frequency dependent magnetoresistance measurements in analysing the intrinsicality of magnetodielectric effect: A case study: Journal of Applied Physics 122, 054103 (2017).

Dr. Sagdeo with students at IIT Madras for EESTER-2018.

4) Diffuse reflectance spectroscopy: An effective tool to probe the defect states in wide band gap semiconducting materials: Materials Science in Semiconductor Processing 86, 151 (2018).
5) Possible origin of ferromagnetism in antiferromagnetic orthorhombic-YFeO3: A first-principles study: Ceramics International 44, 13507 (2018).

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

**Dr. Preeti Bhobe** has done her Ph.D. 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.

Specialization: X-ray Absorption Fine Structure (XAFS), Photoemission Spectroscopy (PES), and Magnetism.

**Research Interests:** Study of Crystal and Electronic Structure of Materials forms the underlying theme of our research activity. We employ advanced experimental probes like XAFS, XMCD, and PES to investigate and understand a variety of properties and phenomena in solids. The solids we study can be broadly classified into the following areas:

- Strongly Correlated Electronic Systems; Unusual Magnetism across Metal-Insulator transitions
- Magnetic Shape Memory Alloys
- Half-metals and Semiconducting Materials
- Transparent Conducting Oxides
- Thermoelectric Materials

**Publications:** Journal articles = 31
Conferences (peer reviewed) = 17
Talks at Scientific Meetings = 10
Total Citations = 448
h-index = 14

**Selected journal publications in 2017 – 18:**

**Referred Journals:**

1. S. Chaudhuri, P. A. Bhobe, and A. K. Nigam
   "Unraveling the physical properties and superparamagnetism in anti-site disorder controlled $Fe_2TiSn$"
   J. Phys.: Condens. Matter. In press (2018)
   DOI: 10.1088/1361-648X/aaf0c7

2. Gowthamaraju S, U. P. Deshpande, Alfa Sharma, P. M. Shirage, P. A. Bhobe
   "Impact of different morphological structures on physical properties of nano-structured SnSe"
   J. Phys. Chem. C. Vol. 122, 13182−13192 (2018)
   DOI: 10.1021/acs.jpcc.8b03797

3. Tamalika Samanta, A. Das, A. K. Nigam, P. A. Bhobe
   "Reentrant cluster glass and stability of ferromagnetism in $Ga_2MnCo$ Heusler alloy "
   Phys. Rev. B Vol. 97, 184421 (2018)
   DOI: 10.1103/PhysRevB.97.184421
   (This is the first paper from the Condensed Matter Physics Group to be published in the journal of Phys. Rev. B – regarded very highly in this field)

4. S. Chaudhuri, P. A. Bhobe, and A. K. Nigam
   "Possible half-metallicity and variable range hopping transport in Sb-substituted $Fe_2TiSn$ Heusler alloys"
   J. Phys.: Condens. Matter Vol. 30, 015703 (2018)
   DOI: 10.1088/1361-648X/aa9c10

5. M. K. Majee, P. A. Bhobe, U. P. Deshpande, and A. K. Nigam
   "Local crystal structure and physical properties change of p-type transparent conducting oxide: $CuCrO_2$ upon Ti-substitution
   J. Appl. Phys. Vol. 122, 225111 (2017)
   DOI: 10.1063/1.5003965

6. P. Suchismita Behera, Dhirendra Kumar, V. G. Sathe, and P. A. Bhobe "Influence of local structural distortions on magnetism and spin-phonon coupling of multiferroic spinel chalcogenide"
   J. Appl. Phys. Vol. 121, 243905 (2017)
   DOI: 10.1063/1.4990292

7. Preeti A. Bhobe
   "Peek into the world of materials using thermopower and XAFS as investigative probes"
   Current Science, Vol. 112, No. 7, 1402 (2017)
   (Invited review article in the special issue on Women Scientists of India)

8. Suman Kushwahaa, Karthikayini M. P., Guanxiong Wang, Sudip Mandal, Preeti. A. Bhobe, Vijay K. Ramani, K. R. Priolkar, Kothandaraman Ramanujam
   "A non-platium counter electrode, MnNx/C, for dye-sensitized solar cell applications"
   Appl. Surf. Sci. Vol. 418, 179-185 (2017)
   DOI: 10.1016/j.apsusc.2016.12.140

9. M. P. Karthikayini, Guanxiong Wang, P. A. Bhobe, Anjaiah Sheelam, Vijay K. Ramani, K. R. Priolkar, R. K. Raman
   "Effect of Protonated Amine molecules on the Oxygen Reduction Reaction on Metal-Nitrogen-Carbon Based Catalysts"
   Electrocatalysis, Vol. 8, 74-85 (2017)
   DOI: 10.1007/s12678-016-0341-y

## Awards and Honors

1. Awarded the "Indo-U.S. Fellowship for Women in STEMM (WISTEMM) Women Overseas Fellowship 2018" supported by the Department of Science and Technology (DST), Govt. of India and implemented by the Indo-U.S. Science & Technology Forum (IUSSTF) to conduct research work at Texas A & M University, Texas, U.S.A.
2. Served as a member of National Level Expert Committee constituted by Chairman, ISRO and Secretary, Dept. of Space, Govt. of India to review the development of classified project of national importance.
3. Invited to write a review article in the special issue of Current Science dedicated to women scientists of the country.

## Externally Funded Research Projects undertaken as a Faculty in IIT Indore:

| SN | Title | Cost (INR) | Duration | Role | Funding Agency |
|---|---|---|---|---|---|
| 1 | New thermoelectric materials design based on early transition metal compounds | Rs. 45,77,007/- | Three years (Oct 2013 to Oct 2016) | Principal Investigator | DST, India |
| 2 | Crystal structure and magnetic properties correlation in Multiferroic Spinel Chalcogenides | Rs. 13,91,200/- | Three years (Dec 2013 to Dec 2016) | Principal Investigator | CSIR, India |
| 3. | Half-Metallic Heusler Alloys for Spintronics Applications | Rs. 50, 00, 000/- | Three years (Ongoing) Starting in 2018 | Principal Investigator | CSIR, India |

## Current Group Members:

1. **Mithun Kumar Majee**
   Thesis Title : "Structural aspects of Thermoelectric Oxides"
   Period : December 2014 – till date
   Publications : 1 journal article, 2 conference proceedings.

2. **Sayan Chaudhuri**
   Thesis Title : "Electronic properties of Fe-Ti-Sn Heusler alloys"
   Period : December 2014 – till date
   Publications : 1 journal article, 1 conference proceedings.

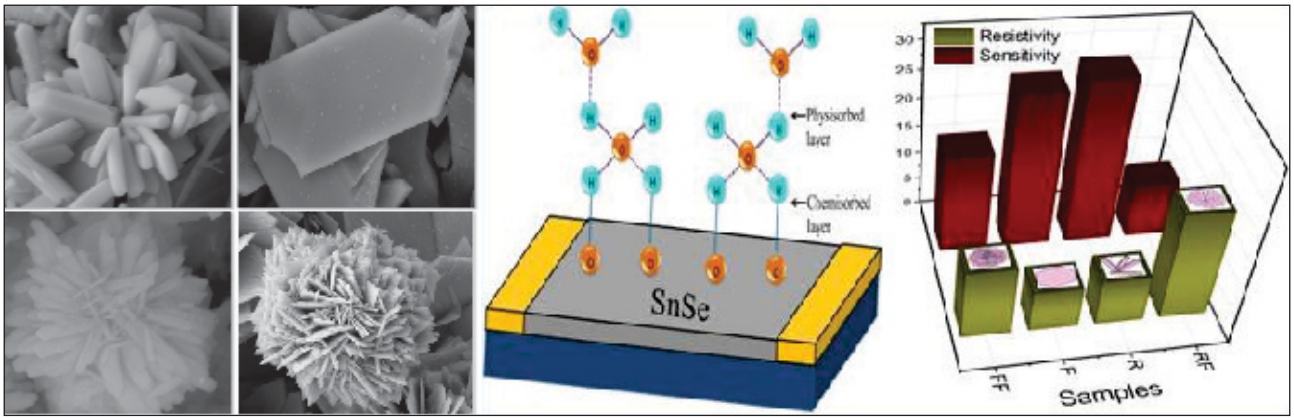
3. **Gowthamraju S**
   Thesis Title : "Thermoelectric properties of Tin Selenides"
   Period : June 2015 – till date
   Publications : 1 journal article, 2 conference proceedings.

4. **Tamalika Samanta**
   Thesis Title : "Magneto-structural aspects of Ga-Mn-Co Heusler alloys"
   Period : December 2016 – till date
   Publications : 1 journal article, 1 conference proceedings.

## Research Activity in 2017-18:

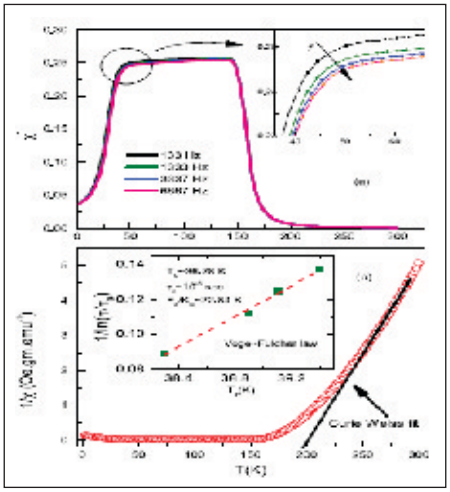
Currently, our work focuses on the design of novel materials relevant for technological applications in the field of thermoelectrics and spintronics.

- **Thermoelectrics:** We studied the impact of different morphological structures on the physical properties of nanostructured SnSe, a thermoelectric material. By controlling the growth parameters in a hydrothermal reaction process, we obtained different morphologies of SnSe like rods, flowers, flakes etc and studied the impact of changing morphology on the properties like electrical resistivity, Optical spectroscopy and sensing capabilities of SnSe. Our work reveals the morphology driven application of a given material that serves to assist the miniaturizing technology for multifunction materials.

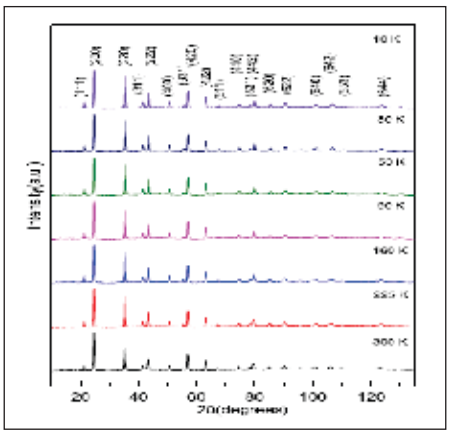



- **Spintronics:**

(a) Fe-Ti-Sn alloy is a neutral full Heusler system containing 24 valence electrons, thus non-magnetic in nature. Electronic structure wise, it is semimetal with a small pseudo gap at Fermi level, hence theoretically predicted to have zero spin polarization. However, intrinsic presence of strong antisite disorder between Fe and Ti, changes the ground state magnetic and transport properties of the system. We have found that the antisite disorder can be controlled by substituting element with higher electronegativity at Sn site and thus revealing a half-metallic ground state in such compositions.



(b) Mn-Co-Ga Heusler alloys We study an unusual variety of Heusler alloy, $Ga_2MnCo$ which has the '$Z_2XY$' form, unlike the standard Heusler form of $X_2YZ$. It is found that such a composition maintains the $L2_1$ structural form but displays a variety of exotic magnetic ground states including spin glass state, itinerant ferromagnetism, magnetic shape memory effects, etc. We elucidate the magnetic structure of such composition and attempt to understand the impact of its magnetic ground state on other physical properties.



Neutron diffraction pattern of $Ga_2MnCo$ structure and spin glass characterization of the magnetic ground state of $Ga_2MnCo$.

**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 Ph.D. 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.

Dr. Sen has his collaborators in USA, Taiwan, Japan, and India. Apart from scientific research, his group trains interns from high school, B.Tech/B.Sc., M.Tech/M.Sc. levels.

The SMART lab is basically a simple synthesis lab where high purity complex materials are synthesized which are structurally designed to produce multiferroic properties. Such facilities present in-house are some very basic characterization techniques like a synthesis lab, a XRay Diffractometer and some transport property measurement facilities. The group maintains strong connections with RRCAT, UGC-DAE Indore and other research institutes in India.

### *List of Publications as follows:*

| SN | Name of Authors | Title of the research paper | Journal & Publication details | Year | Impact Factor 2018 |
|---|---|---|---|---|---|
| 1 | Anita, AK Yadav, N Khatun, S Kumar, CM Tseng, S Biring, S Sen | Size and strain dependent anatase to rutile phase transition in TiO2 due to Si incorporation | Journal of Materials Science: Materials in Electronics 28 (24), 19017-19024 | September 2017 | 2.324 |
| 2 | N Khatun, P Rajput, D Bhattacharya, SN Jha, S Biring, S Sen | Anatase to rutile phase transition promoted by vanadium substitution in TiO2: A structural, vibrational and optoelectronic study | Ceramics International 43 (16), 14128-14134 | November2017 | 3.057 |
| 3 | S Kumar, AK Yadav, S Sen | Sol–gel synthesis and characterization of a new four-layer K0. 5Gd0. 5Bi4Ti4O15Aurivillius phase | Journal of Materials Science: Materials in Electronics 28 (16), 12332-12341 | May 2017 | 2.324 |
| 4 | T Srivastava, G Bajpai, N Tiwari, D Bhattacharya, SN Jha, S Kumar, S Biring, S Sen | Opto-electronic properties of Zn(1-x)VxO: Green emission enhancement due to V4+ state | Journal of Applied Physics 122 (2), 025106 | July 2017 | 2.176 |
| 5 | G Bajpai, T Srivastava, M Nasir, S Tiwari, S Bajpai, EG Rini, S Biring, S.Sen | A comprehensive theoretical and experimental study on structural and mechanical properties of Si doped ZnO | Scripta Materialia 135, 1-4 | July 2017 | 4.163 |
| 6 | T Srivastava, A Sadanandan, G Bajpai, S Tiwari, R Amin, M Nasir, S Sen | $Zn_1$−x$Si_x$O: Improved optical transmission and electrical conductivity | Ceramics International 43 (7), 5668-5673 | May 2017 | 3.057 |
| 7 | AK Yadav, P Rajput, O Alshammari, M Khan, G Kumar, S Kumar, S Sen | Structural distortion, ferroelectricity and ferromagnetism in Pb (Ti1− xFex)O3 | Journal of Alloys and Compounds 701, 619-625 | April 2017 | 3.779 |
| 8 | CC Lee, CJ Shih, G Kumar, S Biring, S Sen, SW Liu | Highly efficient exciplex organic light-emitting devices employing a sputtered indium-tin oxide electrode with nano-pinhole morphology | Journal of Materials Chemistry C 5 (46), 12050-12056 | October 2017 | 5.976 |

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|---|---|---|---|---|---|
| 9 | M Nasir, N Patra, MA Ahmed, DK Shukla, S Kumar, D Bhattacharya, S Sen, SW Liu | Role of compensating Li/Fe incorporation in Cu 0.945 Fe 0.055− x Li x O: structural, vibrational and magnetic properties | RSC Advances 7 (51), 31970-31979 | June 2017 | 2.936 |
| 10 | AK Yadav, S Kumar, A Panchwanee, VR Reddy, PM Shirage, S Biring, S. Sen | Structural and ferroelectric properties of perovskite $Pb_{(1-x)}(K_{0.5}Sm_{0.5})_xTiO_3$ ceramics | RSC Advances 7 (63), 39434-39442 | August 2017 | 2.936 |
| 11 | T Srivastava, G Bajpai, G Rathore, SW Liu, S Biring, S Sen | Vanadium substitution: A simple and economic way to improve UV sensing in ZnO | Journal of Applied Physics 123 (16), 161407 | March 2018 | 2.176 |
| 12 | AK Yadav, A Verma, S Kumar, V Srihari, AK Sinha, VR Reddy, SW Liu, S Biring, S Sen | Investigation of La and Al substitution on the spontaneous polarization and lattice dynamics of the Pb(1-x)LaxTi(1-x)AlxO3 ceramics | Journal of Applied Physics 123 (12), 124102 | March 2018 | 2.176 |
| 13 | T Pareek, B Singh, S Dwivedi, AK Yadav, S Sen, P Kumar, S Kumar | Ionic conduction and vibrational characteristics of Al3+ modified monoclinic LiZr2(PO4)3 | Electrochimica Acta 263, 533-543 | February 2018 | 5.116 |
| 14 | G Bajpai, T Srivastava, F Husian, S Kumar, S Biring, S Sen | Enhanced red emission from Fe/Si co-doped ZnO nano-particles | Scripta Materialia 144, 27-30 | February 2018 | 4.163 |
| 15 | CJ Shih, CC Lee, YH Chen, S Biring, G Kumar, TH Yeh, S Sen, SW Liu, S Biring, S Sen | Exciplex-Forming Cohost for High Efficiency and High Stability Phosphorescent Organic Light-Emitting Diodes | ACS applied materials & interfaces 10 (2), 2151-2157 | December 2017 | 8.097 |
| 16 | M Nasir, R Islam, MA Ahmed, S Ayaz, G Kumar, S Kumar, CL Prajapat, S Biring, S Sen | Cu1–xFexO: hopping transport and ferromagnetism | Royal Society open science 4 (9), 170339 | September 2017 | - |

***Conference Proceedings:***

**April 2017 – March 2018**

| | | | | |
|---|---|---|---|---|
| 1 | S Tiwari, N Balasubramanian, S Biring, S Sen | Synthesis, structure and characterization of Co doped CeO2 nanoparticles | 2018 | IOP Conference Series: Materials Science and Engineering 396 (1), 012035 |
| 2 | S Tiwari, N Balasubramanian, S Biring, S Sen | Investigation of structural, optical and electronic properties of (Co, Ni) codoped CeO2 nanoparticles | 2018 | IOP Conference Series: Materials Science and Engineering 390 (1), 012001 |
| 3 | S Tiwari, N Balasubramanian, S Biring, S Sen | Effect of Co doping on structural and mechanical properties of CeO2 | 2018 | AIP Conference Proceedings 1966 (1), 020037 |
| 4 | R Amin, P Mishra, N Khatun, S Ayaz, T Srivastava, S Sen | Effect of titanium on the structural and optical property of NiO nano powders | 2018 | AIP Conference Proceedings 1953 (1), 030129 |
| 5 | M Nasir, A Kandasami, S Sen | Structural and dielectric characteristics of double perovskite La2(NiFe)1/2MnO6 | 2018 | AIP Conference Proceedings 1953 (1), 050076 |
| 6 | N Khatun, R Amin, Anita, S Sen | Effect of V-Nd co-doping on phase transformation and grain growth process of $TiO_2$ | 2018 | AIP Conference Proceedings 1953 (1), 040028 |

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|---|---|---|---|---|
| 7 | M Nasir, S Ayaz, S Kumar, A Kandasami, S Sen | Dielectric relaxation behavior in La1.80Y0.20NiMnO6 double pervoskite | 2018 | AIP Conference Proceedings 1942 (1), 110029 |
| 8 | M Kumar, AK Yadav, Anita, S Sen, S Kumar | Lithium ion conduction in sol-gel synthesized LiZr2(PO4)3 polymorphs | 2018 | AIP Conference Proceedings 1942 (1), 140026 |
| 9 | A Verma, AK Yadav, S Kumar, S Sen | Lead free dielectric ceramic with stable relative permittivity of 0.90(Na0.50Bi0.50Ti)O3-0.10AgNbO3 | 2018 | AIP Conference Proceedings 1942 (1), 030024 |
| 10 | N Khatun, S Sen | Effect of Vanadium doping on dielectric properties of $TiO_2$ | 2018 | Bulletin of the American Physical Society |
| 11 | T Srivastava, G Bajpai, S Sen | Suppression and enhancement of deep level emission of ZnO on Si4+ & V5+ substitution | 2018 | Journal of Physics: Conference Series 987 (1), 012024 |
| 12 | CC Lee, YH Li, G Kumar, S Sen, S Hiring, SW Liu | Highly efficient blue organic light-emitting diodes employing exciplex host | 2017 | Active-Matrix Flatpanel Displays and Devices (AM-FPD), 2017 24th |
| 13 | S Sen, A Gupta, DM Phase, R Gupta | Influence of preparation methods on the optical and electronic properties of Cr-doped $TiO_2$ thin films | 2017 | AIP Conference Proceedings 1832 (1), 080074 |
| 14 | G Bajpai, T Srivastava, P Shirage, S Sen | Influence of Si incorporation on mechanical properties of ZnO particles | 2017 | AIP Conference Proceedings 1832 (1), 050156 |

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

**Dr. Manavendra Mahato** has done his Ph.D. 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. If they are related to field theories using the gauge/gravity conjecture, they are related to thermalization of perturbations in the field theory. These modes for a class of nh-stu black holes were calculated for flat horizon topology and were numerically computed for spherical horizon topology. A number of properties of quasinormal modes such as their correlation with temperature, size of black holes, etc. were also explored. (M. Mahato and Ajay Pratap Singh, "Quasinormal modes in nh-stu black holes", accepted in European Physics Journal C ).

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

**Dr. Ankhi Roy** has done her Ph.D. 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.

### 1. Data Analysis in heavy flavour sector in ALICE experiment:-

The heavy flavours are produced in the initial stages of the collisions via initial hard scattering due to their large masses. Therefore, the measurement of heavy-flavor production cross sections in proton-proton (pp) collisions at the LHC serves as a sensitive test for Quantum Chromodynamics, the well-established theory of strong interactions. Measurement of these heavy flavours in pp collisions act as reference to the corresponding measurements in the nucleus-nucleus collisions where thermally equilibrated strongly interacting matter consisting of quarks and gluons so called QGP (Quark Gluon Plasma) is supposed to be formed. As heavy flavour decays semileptonically, so they can be measured by measuring the electrons via semielectronic decay channels. Preliminary spectra of production cross section of heavy flavor hadron decay electrons is obtained by subtracting dominating contributions from the photonic background. Photonic electron tagging method was used to measure electrons from the heavy flavour hadron decays in pp collisions at 7 TeV at LHC using ALICE experiment. Moreover,they have also started the new analysis of the measurement of the electrons from the beauty hadron decays using DCA (Distance of Closest Approach) template method at 5 TeV energy. In this analysis, the DCA distribution of the electrons from the different sources of the electrons is prepared using the MC to subtract it from the DCA distribution of the inclusive electrons obtained from the data.

### 2. Simulation of the MUCH detector in CBM experiment:-

The construction of Compressed Baryonic Matter (CBM) experiment at Facility for Antiproton and Ion Research (FAIR) in Darmstadt is going on. The aim of CBM research program is to explore the QCD phase diagram in the region of high baryon densities at moderate temperature using high energy nucleus-nucleus collisions. This includes the study of the equation-of-state of nuclear matter at neutron star core densities, and the search for phase transitions, chiral symmetry restoration, and exotic forms of (strange) QCD matter. The CBM detector is designed to measure the collective behavior of hadrons, together with rare diagnostic probes such as multi-strange hyperons, charmed particles and vector mesons decaying into lepton pairs with unprecedented precision and statistics. In order to achieve the required precision, the measurements will be performed at reaction rates up to 10 MHz. Due to such high luminosity, it becomes very important to study about data handling capacity of the detectors used in the CBM experiment and Muon Chamber (MUCH) is one of the important detector, developed by the Indian scientists. So we are trying to see its data-handling rate by simulating detector performance of the MUCH Detector.

### 3. Publications:-


1. "Electrons from heavy-flavour hadron decays at mid-rapidity and low transverse momenta in pp collisions at √s = 7 TeV and √s = 5.02 TeV" (Analysis Note) : Sudhir P. Rode, IIT Indore https://aliceinfo.cern.ch/Notes/node/782.
2. Preliminary Physics Summary: "Measurements of low-pT electrons from semileptonic heavy-flavour hadron decays at mid-rapidity in pp collisions at √s=7 TeV" (public note) : Sudhir P. Rode, IIT Indore https://cds.cern.ch/record/2317185?ln=en.
3. "Kinetic freeze-out conditions in nuclear collisions with 2A -158A GeV beam energy within a non-boost-invariant blast-wave model", S. P. Rode, P. P. Bhaduri, A. Jaiswal and A. Roy, Phys. Rev. C 98, no. 2, 024907 (2018) [arXiv:1805.11463 [nucl-th]].
4. "Differential elliptic flow of charged hadrons at FAIR SIS100", S. P. Rode, A. Roy and P. P. Bhaduri, DAE Symp. Nucl. Phys. 62, 892 (2017).
5. A.Goswami for the WASA-at-COSY Collaboration (2017), Electromagnetic Transition Form Factor of the η Meson with WASA-at-COSY, EPJ Web of Conferences Vol. 130. Available online: DOI: https://doi.org/10.1051/
6. A.Goswami for the WASA-at-COSY Collaboration (2017), Towards the Electromagnetic Transition Form Factor of the η Meson with WASA-at-COSY, JPS Conf. Proc.13, 020032. Available online: DOI: https://doi.org/10.7566/JPSCP.

### Activities :

Dr. Ralf Averbeck from GSI, Darmstadt, Germany had visited our lab from 21/09/2018 to 29/09/2018. Dr. Averbeck's visit is part of our ongoing DST-DAAD project "Leptons from heavy-flavour hadron decays at the LHC". We had a very fruitful discussion about the project. He also presented a seminar "Heavy-ion collisions at ultra-relativistic energies - A unique QCD laboratory" for our MSc students.

Dr. Ankhi with Group Members

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

**Dr Raghunath Sahoo** has done his Ph.D. from the Institute of Physics, Bhubaneswar and was Postdoctoral fellow in Subatech, France, INFN fellow in INFN Padova, Italy and Visiting Scientist in University of Cape Town, South Africa.

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. They have the glory of the highest number of analysis notes and journal publications compared to any research group in high energy physics in India. The active research done in the group at the frontier of high-energy physics both on the phenomenology of Quark-Gluon Plasma (QGP) and the experimental endeavours at the world's largest laboratory, CERN, Geneva has brought many laurels in 2017-18. Mr. Sushanta Tripathy, a PhD student in this group has got the Quark Matter-2018, Venice, Italy best poster flash talk award, which was selected among 389 posters presented in this highest conference in the field. He was awarded with the DST international travel support for the same. Dhananjaya Thakur, another PhD student working in ALICE for the study of J/psi production in proton+proton collisions, has been awarded DST international travel support to attend Hard Probes conference in Aix-Les-Bains, Savoie, France and also 37th edition of the Joliot-Curie International School held at La Grande Motte, France. Dr. Sahoo has been selected for the National Organizing Committees of DAE-High Energy Physics and Nuclear Physics Symposia-2018, which is a clear visibility of the outstanding work done in the group. He was an invited speaker in DAE-Nuclear Physics symposium held at Thapar University, Patiala-2017 and also WPCF conference held in NIKHEF, Amsterdams.

For the popularization of science, especially to bring the high energy frontiers to the undergraduate students, Dr. Sahoo has delivered colloquia and public lectures in various places which include: The Millennium School, Indore; IIT Bhubaneswar; OUAT, Bhubaneswar; IIST, Indore; BITS-Pilani Hyderabad ; TEQUIP program of MHRD for teacher's training. In addition, he was an invited speaker in the National School on Nuclear Reactions, held at IUAC, New Delhi during December 2017.

### List of Publications:

1. "Non-Extensive Statistics in Free-Electron Metals and Thermal Effective Mass."
   Arvind Khuntia, Gayatri Sahu, Raghunath Sahoo, D.P. Mahapatra and Niranjan Barik, arXiv:1809.08096, (Physica A: Under Review).
2. "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: Under Review).

3. ''Multiplicity Dependence of J/ψ Production and QCD Dynamics in p+p Collisions at s√ = 13 TeV''.
   Suman Deb, Dhananjaya Thakur, Sudipan De, and Raghunath Sahoo, arXiv:1808.01841 (Phys. Rev. D: Under Review).
4. "Radial Flow and Differential Freeze-out in Proton-Proton Collisions at s√=7 TeV at the LHC" at the LHC." Arvind Khuntia, Himanshu Sharma, Swatantra Kumar Tiwari, Raghunath Sahoo, and Jean Cleymans, arXiv:1808.02383 (Eur. Phys. J. A: Under Review).
5. "Predictions for azimuthal anisotropy in Xe+Xe collisions at √sNN = 5.44 TeV using a multiphase transport model."
   Sushanta Tripathy, Sudipan De, Mohammed Younus, and Raghunath Sahoo, arXiv:1804.10906 (Phys. Rev. C: Under Review).
6. "Limiting Fragmentation in High Energy Nuclear Collisions in the LHC Era."
   Pragati Sahoo, Pooja Pareek, Swatantra Kumar Tiwari, and Raghunath Sahoo, arXiv:1803.05155 (Eur. Phys. J. A: Under Review).
7. "Elliptic flow of hadrons via quark coalescence mechanism using Boltzmann transport equation for Pb+Pb collision at √sNN =2.76 TeV."
   Mohammed Younus, Sushanta Tripathy, Swatantra Kumar Tiwari, and Raghunath Sahoo, arXiv:1803.01578 (Phys. Rev. C: Under Review).
8. "Effective-energy universality approach describing total multiplicity centrality dependence in heavy-ion collisions."
   Edward K. Sarkisyan-Grinbaum, Aditya Nath Mishra, Raghunath Sahoo, and Alexander S. Sakharov, arXiv:1803.01428 (Phys. Rev. D: Under Review).
9. "Dissipative Properties and Isothermal Compressibility of Hot and Dense Hadron Gas using Non-extensive Statistics."
   Nilotpal Kakati, Swatantra K. Tiwari, Sushanta Tripathy, and Raghunath Sahoo, arXiv:1709.06352 (Phys. Rev. D: Under Review).
10. "Beam Energy Dependence of Thermodynamic and Transport Properties of Strongly Interacting Matter in a Color String Percolation Approach at the Relativistic Heavy Ion Collider."
    Pragati Sahoo, Swatantra Tiwari, Sudipan De, Raghunath Sahoo, Rolf P. Scharenberg, and Brijesh K. Srivastava, arXiv:1708.06689 (Eur. Phys. J. C: Under Review).
11. "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) [Impact Factor: 4.643].
12. "Energy and Centrality Dependent Study of Deconfinement Phase Transition in a Color String Percolation Approach at RHIC Energies."
    Pragati Sahoo, Sudipan De, Swatantra Kumar Tiwari, and Raghunath Sahoo, arXiv:1803.08280, Eur. Phys. J. A 54, 136 (2018) [Impact Factor: 2.373].
13. "Role of Multiparton Interactions on J/ψ 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) [Impact Factor: 4.643].
14. "Elliptic Flow in Pb+Pb Collisions at √sNN = 2.76 TeV at the LHC Using Boltzmann Transport Equation with Non-extensive Statistics."
    Sushanta Tripathy, Swatantra Kumar Tiwari, Mohammed Younus, and Raghunath Sahoo, arXiv:1709.06354, Eur. Phys. J. A 54, 38 (2018) [Impact Factor: 2.373].
15. "Transverse Energy per Charged Particle in Heavy-Ion Collisions: Role of Collective Flow."
    Swatantra Tiwari and Raghunath Sahoo, arXiv:1701.03323, Eur. Phys. J. A 54, 39 (2018) [Impact Factor: 2.373].

16. "Transverse Momentum Spectra and Nuclear Modification Factor using Boltzmann Transport Equation with Flow in Pb+Pb collisions at √sNN = 2.76 TeV."

    Sushanta Tripathy, Arvind Khuntia, Swatantra Kumar Tiwari, and Raghunath Sahoo, arXiv:1703.02416, Eur. Phys. J. A 53, 99 (2017) [Impact Factor: 2.373].

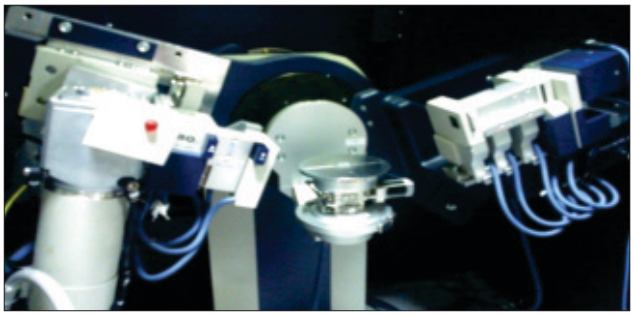
17. "Multiplicity Dependence of Non-extensive Parameters for Strange and Multi-Strange Particles in Proton-Proton Collisions at √s = 7 TeV at the LHC."

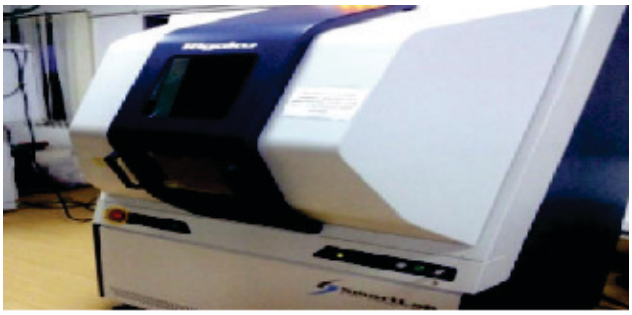
    Arvind Khuntia, Sushanta Tripathy, Raghunath Sahoo, and Jean Cleymans, arXiv:1702.06885, Eur. Phys. A 53, 103 (2017) [Impact Factor: 2.373].

18. "Estimation of stopped protons at energies relevant for a beam energy scan at the BNL Relativistic Heavy Ion Collider."

    Dhananjaya Thakur, Sunil Jakhar, Prakhar Garg and Raghunath Sahoo, arXiv:1611.05078, Phys. Rev. C 95, 044903 (2017) [Impact Factor: 3.308].

## Research Highlight of the Year



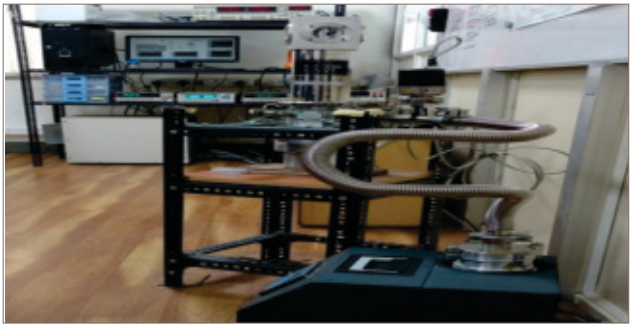


Rigaku SmartLab, Automated Multipurpose x-ray Diffractometer, is an x-ray diffraction system (including thin film analysis system) equipped with a high-accuracy theta-theta goniometer featuring a horizontal sample mount. X-ray diffraction is a versatile and non-destructive technique for characterizing the crystalline samples including nano material. It reveals detailed information about phase identification and crystal structure of natural and engineered materials.

Pulse Layer deposition set up:

Pulse layer deposition set up is an advanced research facility at IIT Indore used to fabricate thin films

X-ray Absorption (XAS) for the measurement of XANES and EXAFS: (Part of SIC)



Electrical resistivity measurement:
Electrical Resistivity and Thermopower measurement (15K-400K), home- made setup developed as the part of DST-SERB project.

### Key functions of Xanes and EXAFS are

- Element Specific: K edges of all elements from Ti to Cu can be measured.
- Samples: Crystallinity is not required -- amorphous, nano, soils, films
- Valence Probe: Gives chemical state and formal valence of selected element
- Local Structure: bond -distance and number of near-neighbor atoms around selected element

Equipment: TFS 200, BENEQ: Atomic Layer Deposition (ALD), as a thin film coating method.

Energy storage laboratory: Battery research

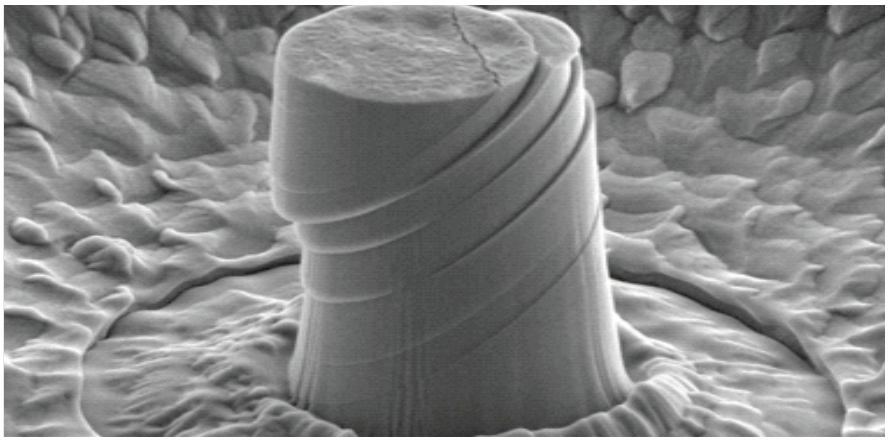
Glove box for battery research: Mbraun UniLab

### Notable achievements of the Physics Discipline in 2018

Physics faculty with Master's students

1. Dr. Rajesh Kumar appointed as Associate Editor of journal "Advances in Materials Processing and Technology (Taylor & Francis)"
2. Mr. Vikash Mishra, a Ph.D. student working under the guidance of Dr. Sagdeo has been awarded best poster prize for his work entitled "Experimental and theoretical Investigation of Optical Spectroscopy on BaTiO3", at International conference on systems and process in physics, chemistry and biology (ICSPPCB 2018) held at the Department of physics, Assam University, Silchar.
3. Dr. Preeti Bhobe was awarded the "Indo-U.S. Fellowship for Women in STEMM (WISTEMM) Women Overseas Fellowship program 2018" supported by the Indo-U.S. Science & Technology Forum (IUSSTF), to carry out research work at Texas A &M University, USA.
4. Mr. Siddhartha Karmakar attended the prestigious Cargese International Summer School 2018 - Mass: From the Higgs to Cosmology, held at Institut d'Etudes Scientifiques de Cargese, France from 9-21 July 2018.
5. Dr. Subhendu Rakshit was awarded with a DST-DAAD bilateral collaboration project entitled "Flavour physics and dark matter: Reconnecting the dots" with TU-Dortmund, Germany.
6. Mr. Sushanta Tripathy, a Ph.D. student in Dr. Sahoo's group, has received the Quark Matter-2018, Venice, Italy best poster flash talk award, which was selected among 389 posters presented in this highest conference in the field.

# 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

Materials continue to play a vital role in almost every technological advancement since the beginning of civilization. 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 faculty from the disciplines of Chemistry, Physics, Biosciences & Biomedical Engineering, Mechanical Engineering, and Electrical Engineering, and one adjunct faculty 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.

Since its inception, the discipline's faculty members have received competitive research grants worth over INR 6.5 cores from various funding agencies and have published about 260 research articles in reputed peer-reviewed journals. The details of externally funded projects and published research articles in the year 2017-2018 are provided in the report. The discipline faculty members have been bestowed with several accolades and achievements, and some of them have been elected as Visiting Faculty in renowned universities in Japan, Taiwan, China, and France.

The discipline offers several courses at undergraduate and graduate levels. Besides Ph.D. program, there are currently two M. Tech programs (Materials Science & Engineering and Metallurgy Engineering) and an undergraduate program. Two M.Tech. batches have graduated and 5 Ph.D. students have completed their Ph.D. and more than 50 PhD students working. Currently, there more than 10 different labs dedicated to different areas of teaching and research in Metallurgy and Materials Science which include Mechanics of Materials, Physical Metallurgy, Metal forming, Solidification, Welding, Corrosion, Polymers, Materials for devices, Composites, and Mechatronics & Instrumentation.

The discipline curriculum has a special emphasis on "hands-on" training on various techniques used for materials characterization, and significant attention is given to the laboratory component of teaching. Undergraduate students are also encouraged to get familiar with the modern processing techniques through part-time research projects in various research labs in the discipline itself or through industrial internships. The vision of the discipline is to train students who will be the future industry leaders as well as get global recognition for excellence in materials education and research.

MEMS Faculty members

## Discipline Research Areas

- Nanostructured Materials for Energy Generation, Storage and Electronic Devices
- Superconductors Single Crystal Growth and Understanding the Basic Mechanism
- Humidity and Gas Sensor
- Supercapacitors and Solar Cells (Including Pervoskite type)
- Photocatalysis ( Hydrogen generation and storage: Materials and mechanism)
- Biosensors ( Metal Oxide and Polymer based)
- Piezoelectric Devices: Construction and Testing
- 1D/2D Metal-Oxide nanostructures for engineering applications
- Polymers for energy applications
- Nano-hetero-architectures and Core-shell nanostructures
- Energy conversion/storage devices fabrication
- Resistive Switching devices
- Field emission displays and electrochromic smart windows
- Photoluminescence
- Design and Synthesis of multifunctional CHIRAL METALLOGELS (Inorganic Gels) with an objective of conductance, morphological and photo-physical importance
- Synthesis of superabsorbent materials
- Charge transfer and Aggregation Induced Emission
- Structural materials Chemistry based on chiral ligands
- Mechanical behavior of materials
- High strain rate deformation
- Deformation behavior at small length scales

- Indentation mechanics
- hysical Metallurgy
- Heat treatment of Metals and Alloys
- Surface Engineering: Surface Alloying, Surface Deformation
- Microstructure-Properties correlations
- Nanomaterials
- Structure-Property Correlations in High Entropy Alloys
- Corrosion Engineering
- Lightweight alloys for automotive and aerospace applications
- Phase transformation
- Mechanical Metallurgy
- Joining of Materials
- Fatigue and fracture
- Solidification: Experiments and Simulation
- Processing-Structure-Property correlation in multicomponent/high entropy alloys
- Material design for high temperature applications
- Phase equilibria: Materials for the future
- 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
- Photo- and Electro-catalysts for Hydrogen Evolution Reactions (HERs)
- Metal carbonyl clusters and their applications
- 3d-4f metal chalcogenide nanostructured optoelectronic materials
- Crystallographic texture and grain boundary
- Physical Metallurgy of Steel
- Fracture mechanics and Micro-mechanism
- Computational Material Science
- Materials and manufacturing
- Process-structure-property relationships in metals
- Lightweight components for transport applications
- Casting of light metals (Al and Mg), casting defects, casting simulation and experimental studies
- Deformation processing including extrusion, rolling, forming etc, deformation mechanisms
- Electron back scattered diffraction, in-situ deformation studies, crystallographic texture
- Solid Electrolytes for Lithium Batteries
- Cathode Materials for Li/Na ion Batteries
- Lead-free Piezoelectric Materials
- Solid State Ionics
- Dielectric & Electrochemical Impedance Spectroscopy
- Theoretical and Computational Material Science, Nanomaterial Science and Engineering, Defects in Materials, Single Wall and Multi Wall Carbon Nanotubes (CNT), Graphene and 2D Materials Engineering
- Gas Storage, Gas Separation and Gas Adsorption in Metal-Organic Frameworks (MOFs) and Covalent Organic Frameworks (COFs), , and Their Possible Applications
- 2D, 3D and Bulk Structure Materials and Their Applications, Alkali-ion Battery, Novel Batteries Technology, Materials for Renewable Energy Materials
- Transition Metal Dichalcogenides (TMDs), H2 and O2 Evolution Reactions (HER and OER), O2 and CO2 Reduction Reactions and New Catalysts for HER, OER and ORR
- Drug Delivery in MOF Materials and Bio-compatibility of MOFs, Chemical Reactions, Computational Chemistry and Polymerization Reactions

### Discipline Notable Achievements

- Award for Excellence in Teaching, IIT Indore, India, 2016 (Dr. P. Shirage)
- Ramanujan Fellowship, SERB- DST, Govt. of India – 2 awardees (Drs. P. Shirage and S. Pakhira)

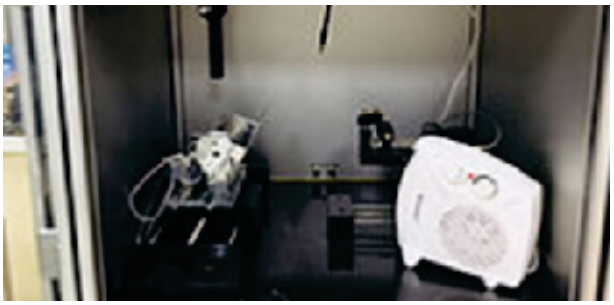
- Early Career Research Award from SERB, Gov. of India – 2 awardees (Drs. Sunil Kumar and Ajay Kushwaha)
- DST-INSPIRE Faculty Award, Govt. of India – 5 awardees (Drs. M. Dubey, R. Devan, A. Ghosh, A. Kushwaha, Sunil Kumar)
- Young Scientist Award, International Academy of Physical Sciences, Allahabad, India- 2017 (Dr. M. Dubey)
- Visiting Fellowship from Nagoya Technological Institute, Nagoya, Japan 2018 (Dr. P. Shirage)
- Visiting Fellowship from National Institute of Advanced Industrial Science and Technology(AIST), Tsukuba, Japan, Japan 2018 (Dr. P. Shirage)
- Overseas expert in Belt and Road project, China (Dr. K. Eswara Prasad)
- Visiting faculty, CAMP Nano, Center for Mechanical Behavior of Materials, Xian Jiaotong University, China (Dr. K. Eswara Prasad)
- Visiting Scientist, Laboratory for Mechanics-Solids-Structures-Materials, Centrale Supelec, Paris (Dr. K. Eswara Prasad)
- Editor, 'Chinese Journal of Physics' Elsevier publishers. (Dr. Rupesh Devan)

### 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

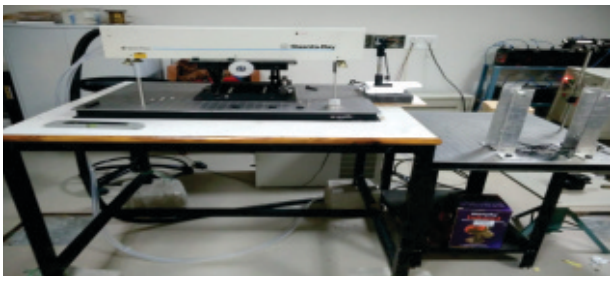


Electros pining

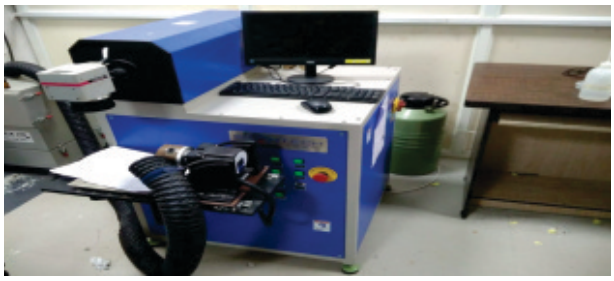
Rotary Evaporator

High Temperature Oven

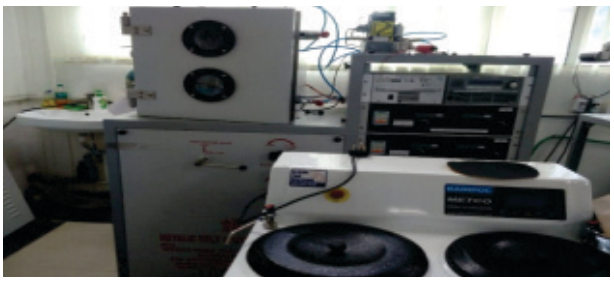
Ultra Senicator



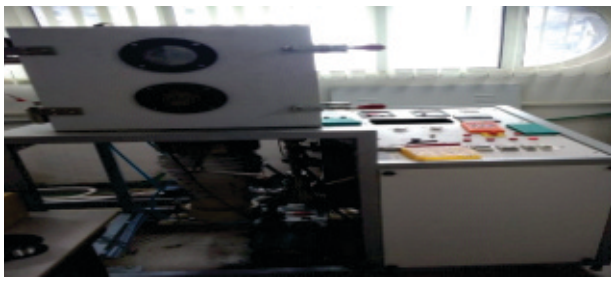
Nd:YAG Laser



Continuous Fibre Laser

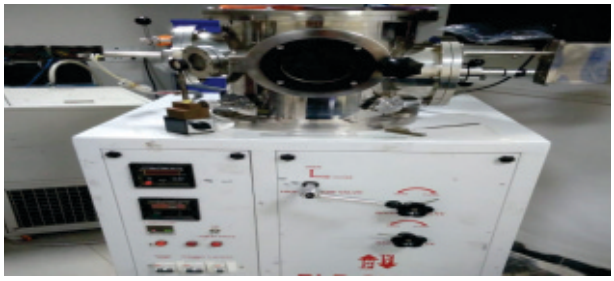


DC + RF Sputtering



Flash Evaporation

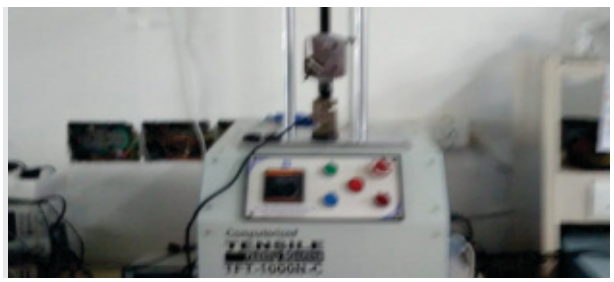
Arc Melting



Pulsed Laser Deposition

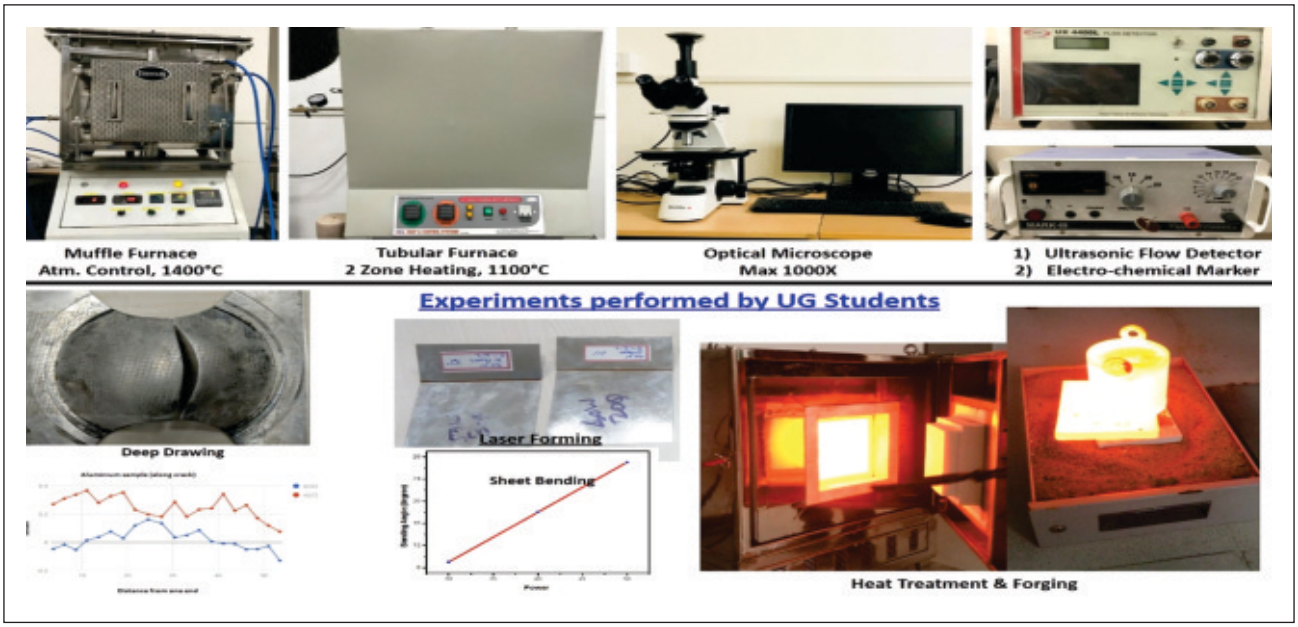
GMAW based Wire Arc Additive Manufacturing

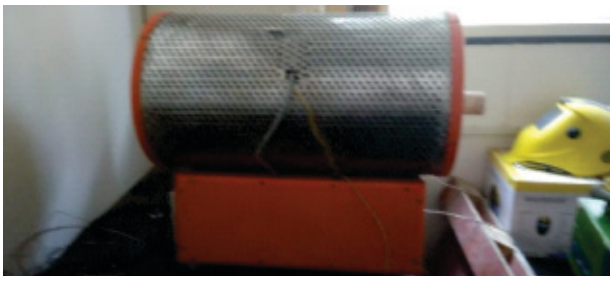
Optical Microscope



Straining Setup for SMA

Thermal Evaporation



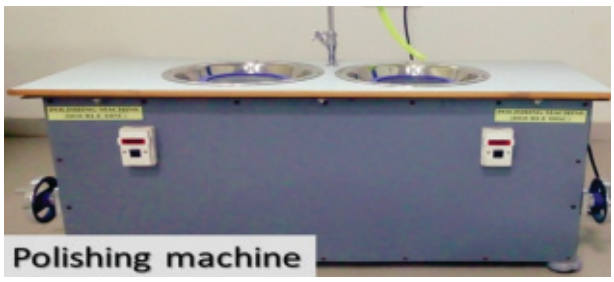



Tube Furnace

Polishing Machine

## Specimen preparation equipment

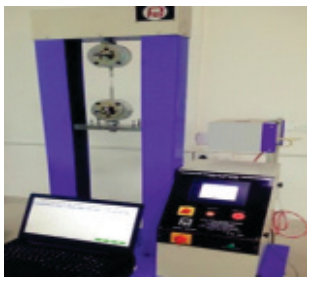
High speed saw




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 Shirage** (Ph.D: Shivaji University, India; Postdoc Scientist: 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); Lecturer: Rajaram College, Kolhapur (Maharashtra Govt.) (2003-2004) works on superconductors, synthesis and single crystal growth; advanced functional materials, thin films, nanostructured materials for energy harvesting and storage, sensors, etc. His fundamental contribution to science is the inverse isotope effect on the transition temperature of (Ba,K)Fe2As2 superconductor, which is a historic finding in high-Tc superconductivity. He has invented and synthesized innumerous superconductors.

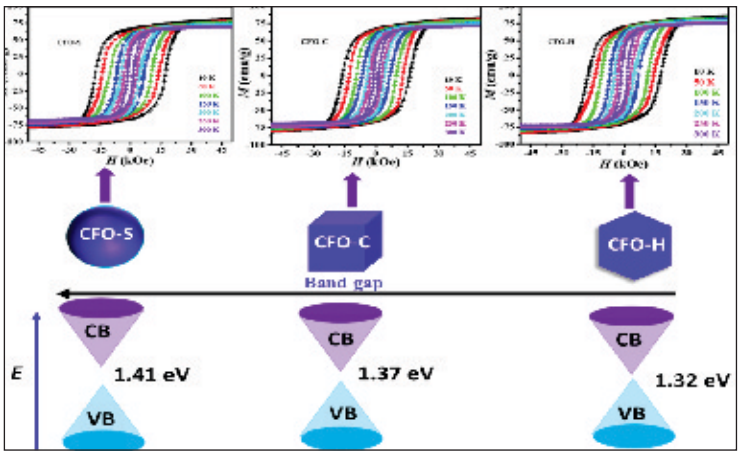


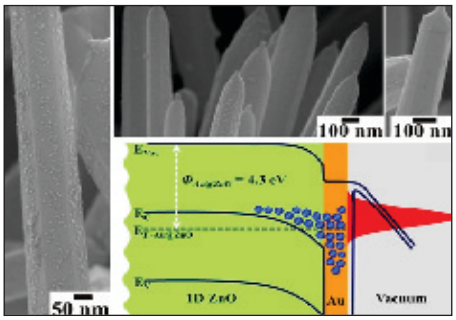

Fig. Morphology dependence of the magnetic and optical properties of cobalt ferrite

Advanced functional materials are the materials whose physical and chemical properties are sensitive to a change in the environment such as temperature, pressure, electric field, magnetic field, optical wavelength, adsorbed gas molecules and the pH value. The functional materials utilize the native properties and functions of their own to achieve an intelligent action. Few materials belong to magnetism, energy storage functions, ferroelectricity, piezoelectricity, etc.

Dr. Shirage has contributed in the basic and applied science branch of science by synthesizing and studying new superconductors, nano-materials, topological insulators, single crystals growth, etc. for basic studies and for energy applications. He developed a facile technique for growing nano-materials by avoiding toxic chemicals and sophisticated instrumentation. He demonstrated that porous carbon can be utilized as superior materials for supercapacitors. Dr. Shirage is an expert in high pressure high temperature synthesis of novel advanced functional materials and basic properties studies, he contributed fundamental finding of inverse isotope effect on *Tc* of (Ba,K)Fe2As2 superconductor, also invented few new materials and origin of room temperature ferromagnetism in ZnO. One of the thrust areas of his research is flexible solar cell fabrication with high efficiency. He also works on developing a facile technique for the growth of nanomaterials including single layer graphene and their applications in energy generation and storage. Under his guidance 3 Ph.D. students and 8 master students completed their thesis work. He is guiding 2 postdocs, 9 Ph. D. students and 4 master students at present. He has published more than 55 research papers from IIT Indore in internationally reputed journals in last three years. He is one of the leaders in growing large single crystals of varieties of functional materials. More details can be found at http://iiti.ac.in/people/~pmshirage/

**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. He is handing externally funded research projects from DST (Department of Science and Technology) and UGC-DAE CSR (UGC-DAE Consortium for Scientific Research). This year, he co-coordinated two GIAN (Global Initiative of Academic Networks) projects funds from MHRD.




He is the recipient of the INSPIRE Faculty award (2013) from DST (Department of Science and Technology). Recently, he has received "Excellent," grade for INSPIRE Research Project from DST. He is also serving as Editor for Chinese Journal of Physics (Elsevier).

Precisely controlled dimensions of nanostructures and their decoration are found influencing to exhibit unexpected physical properties, such as tailoring of work function, energy band alignment, and energy barrier formation, etc. Therefore, interface engineering is imperative in determining the performance in the fabrication of energy storage/conversion and display devices. Recently, his group has developed nano-hetero-architectures of metal nanoparticles decorated 1D nanostructures for fabrication of displays. Further, they are putting efforts to employ them in energy storage/conversion devices. Last year, he delivered invited talks on his research activities in the Global Photovoltaic Conference (GPVC-2018, S. Korea) and International Conference on Applied Science (ICAS-2018, Taiwan). His research group includes 4 research scholars and 2 M.Tech students at IIT Indore, and has published 10 research articles this year.

Follow the link: https://rupesh76.wixsite.com/rupesh to know more details about the research activities of Dr. Rupesh's research group.

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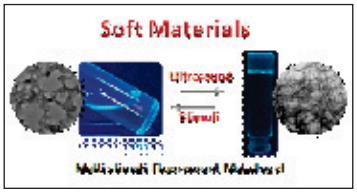
**Dr. Mrigendra Dubey**
Assistant Professor
mdubey@iiti.ac.in

**Dr. Mrigendra Dubey** Ph.D: Indian Institute of Technology Guwahati

**Research Interest:** 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. In the present era, gels are directly applicable in human daily routine life like medicine, cosmetics, electronic devices, tissue engineering etc. The direct applications as well as interesting chemistry of gels further motivated to establish soft materials research laboratory for the synthesis of chiral Metallogels. Now the question that arises is, why chiral and inorganic with gel? 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 behavior. Thus, 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.

Doctoral Students: Mr. C. Mahendar & Mr. Siddhartha Suman, Webpage: https://drdubey.wixsite.com/iiti

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

**Dr. Eswara Prasad Korimilli** earned his ME and Ph.D. 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 laboratory of Mechanics-solids-structures-materials, Centrale Supelec, France 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. 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. His work has been published in highly reputed journals and has attracted 950 citations with a Hirsch-index of 12. Currently his group consists of 3 doctoral students (Vaibhav Kathavate, Tulika Dixit and Abhinav Sharma) and one M. Tech student (Mohit Deshpande).

Webpage: https://sites.google.com/view/eswarprasad/home

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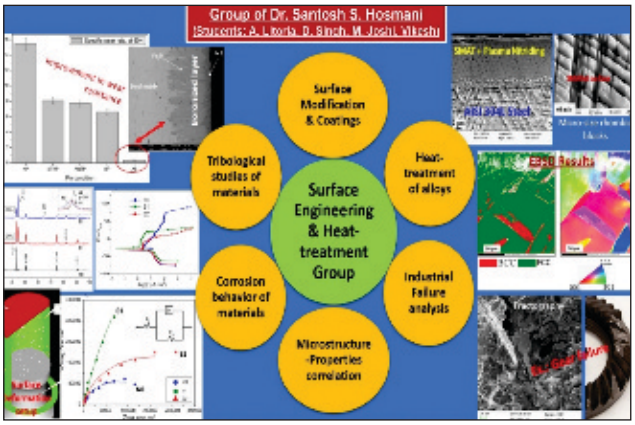
**Dr. Santosh S. Hosmani**
Assistant Professor
sshosmani@iiti.ac.in

**Dr. Santosh S. Hosmani** PhD: Max-Planck-Institute, Stuttgart, Germany

Post-Doc.: Max-Planck-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. In the past, he has guided 1 PhD, 14 M.Tech., and 8 B.Tech. theses. Currently, his group has 2 PhD, 1 JRF, and 1 M.Tech. students. He has more than 30 publications in international, national journals and conference-proceedings. He has written a book on 'An Introduction to Surface Alloying of Metals', published by Springer. He is also a co-author of one book-chapter, which is published by CRC Press. He recently got EMR research grant (Rs. 50.86 Lakhs) from DST-SERB for 3 years (starting from March 2018) on the project titled "Wear Behavior and Microstructural Studies of Surface Mechanical Attrition Treated (SMAT) and Post-Treated Stainless Steels".

About research activities: There are various engineering applications where surface must perform a job different from the bulk of a component. On many occasions, just by altering 1–2 % of the total thickness of the components, the properties enhance their performance considerably. The list of applications requiring the manipulation of surface properties is unlimited, especially, in the field of automobile, petrochemical, food processing, nuclear, etc. His group is currently working on the novel and promising approach of sever plastic deformation (SPD) of surfaces to manipulate the surface microstructure and the properties. The group also focusses on the scientific aspects of surface-alloying and coatings.

Research Group Website: https://sites.google.com/site/santoshhosa/home

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

**Dr. Vinod Kumar**

PhD: Indian Institute of Technology Kanpur (2012)

**Research Areas:**

- Nanomaterials
- Structure-Property Correlations in High Entropy Alloys
- Corrosion Engineering
- Lightweight alloys for automotive and aerospace applications
- Phase transformation

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

**Dr. Jayaprakash Murugesan** did his M.S. (by research, Oct 2005) and Ph.D. (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. Dr. Murugesan has published 22 research papers in peer-reviewed journals and 42 research papers in International and National Conference Proceedings.

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 Ph.D. students for their thesis work.

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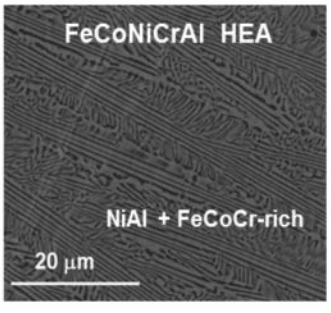
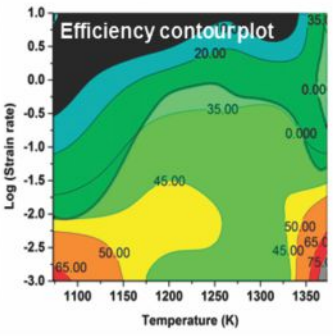
**Dr. Sumanta Samal**
Assistant Professor
sumanta@iiti.ac.in

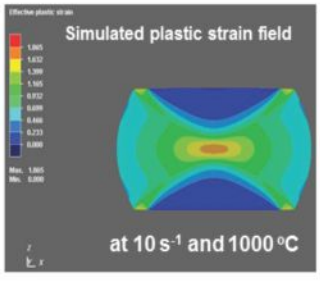
**Dr. Sumanta Samal** earned his doctorate from the department of Materials Science and Engineering, Indian Institute of Technology Kanpur in 2014, followed by three years of Post-Doctoral research experience in the Department of Metallurgical and Materials Engineering at the Indian Institute of Technology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

Current Ph.D. Students: Reliance Jain, Sandeep Jain, Priyanka Sahu




M.Tech. Student: Avi Jain

Webpage: http://people.iiti.ac.in/~sumanta/index.html

**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 Enginering, 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

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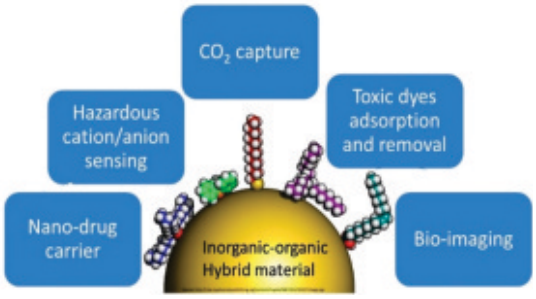
**Dr. Dhirendra Kumar Rai**
Assistant Professor
dkrai@iiti.ac.in

**Dr. Dhirendra Kumar Rai**

Ph.D.: Indian Institute of Technology Bombay




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 (for example, drug delivery by Silica nanoparticle, bio-imaging, bio-sensor, cancer cell detection, heavy metal ions detection in a biological system) and environmental remediation (for example, CO2 separation/adsorption, toxic dye adsorption and removal, hazardous cations/anions detection and removal from water).

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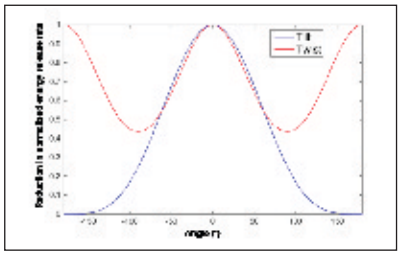
**Dr. Abhijit Ghosh**
Assistant Professor
aghosh@iiti.ac.in

**Dr. Abhijit Ghosh** (Ph.D.: 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. He has published several manuscripts in reputed journals such as International Journal of Plasticity, Scripta Materialia, Materials and Design etc. Presently his group is working on a DST funded sponsored project on the texture development and abnormal grain growth in high Si electrical steel. His research areas include:

- Crystallographic texture and grain boundary
- Fracture mechanics and Micro-mechanism
- Physical Metallurgy of Steel
- Computational Materials Science

Doctoral Student: Mr. Vipul Jain

Google scholar profile: https://scholar.google.co.in/citations?user=P9nZOBsAAAAJ&hl=en

**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)

**Research Interests:**

- Materials and manufacturing
- Process-structure-property relationships in metals
- Lightweight components for transport applications
- Casting of light metals (Al and Mg), casting defects, casting simulation and experimental studies
- Deformation processing including extrusion, rolling, forming etc, deformation mechanisms
- Electron back scattered diffraction, in-situ deformation studies, crystallographic texture

Dr. Borkar works in the area of lightweight materials Mg and Al with focus on processing-structure-property relationships. 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 focused on the product development by investigation of alloy-design-process-properties.

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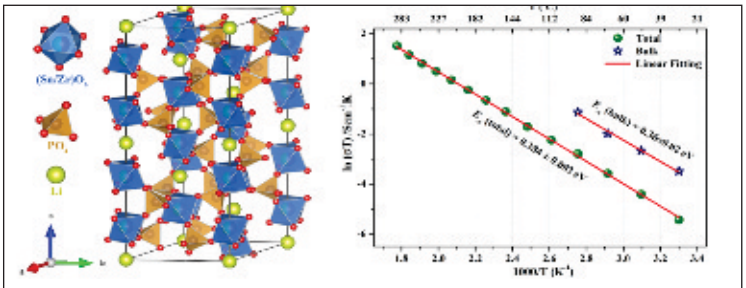
**Dr. Sunil Kumar**
INSPIRE Faculty
sunil@iiti.ac.in

**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.

The research group led by Dr. Sunil Kumar is focusing on the development of solid electrolytes as a means to have safer, cheaper, and better performing electrochemical energy storage systems. In this regard, they have systematically investigated $LiZr_{2-x}Sn_x(PO_4)_3$ solid-solution for crystal structure, ionic conductivity, and electrochemical properties; and certain compositions showed excellent $Li^+$ conductivity ~ 0.01 $\Omega^{-1}m^{-1}$ which is in the range of values reported for state-of-the-art phosphate and oxide electrolytes.

Aside, lead-free materials with good piezoelectric coefficient $d_{33}$ were rationally designed by shifting the rhombohedral-tetragonal polymorphic phase boundary near room-temperature. The high Curie temperature ~ 380 °C makes such materials attractive for piezoelectric devices operating at high temperatures.



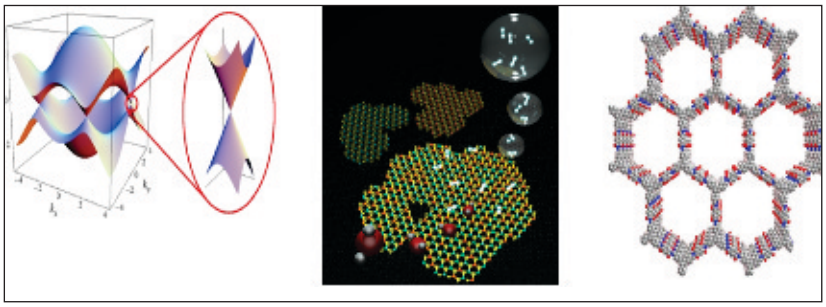
Crystal structure and Arrhenius behavior of ionic conductivity of LZSP ceramics

Dr. Kumar is supervising 2 Ph.D. students for their doctoral thesis work at present and has successfully guided one postgraduate student for his M. Tech. thesis work. At IIT Indore, Dr. Kumar has published more than 30 research articles in reputed peer-reviewed journals and conference proceedings. More details about his research interest and research group can be found at: http://iiti.ac.in/people/~sunil/

**Dr. Srimanta Pakhira**

Ramanujan Fellow
spakhira@iiti.ac.in

Hybrid porous materials such as metal–organic frameworks (MOFs) or porous coordination polymers (PCPs) or constructed by various kind of organic linkers with metal cations, have a promising and potential applications of various field of science, such as gas storage, gas separation, gas adsorption, physisorption, selective gas separation, heterogeneous catalysis, solar cell, radical polymerization reactions in the MOFs or PCPs channels, controlling the tacticity and polymerization, more recently biomedicine, nanotechnology and drug delivery. In the last decade, a large number of MOFs containing various organic ligands were synthesized experimentally and studied theoretically as well as computationally. Additionally, scientists are always still researching and finding ways to design MOFs to target specific properties. Moreover, systematic functionalization of MOFs by introducing various substituents onto the component organic ligand, i.e. changing the ligand benzene groups, or the rotational groups, has been performed to regulate the radical polymerization of methyl methacrylate (MMA) in the nano-channels. The important advantages of these kinds of MOFs are very low weight, high pore volumes, fast adsorption–desorption kinetics, large surface and tunable pore, and easy refueling. These would be sufficient for technological applications.



To construct the pristine COFs, we first used graphene sheets and formed graphene bilayer (BLG) structure. The first row transition metal atoms (TM = Sc - Zn) were intercalated between two graphene layers and formed a new type of 2D layer structure and 3D bulk structure material noted as BLG-TM and bulk-BLG-TM. Using first-principles dispersion-corrected DFT techniques, we have designed 20 new materials in-silico by intercalating first row transition metals (TMs) with BLG, i.e. 10 layered structure and 10 bulk crystal structures of TM intercalated in BLG. Our present DFT-D calculations found the Dirac Cone at the band structure of the 2D BLG-V material and we showed how the Dirac points moved. This work opens up new avenues for the efficient production of two-dimensional and three-dimensional carbon-based intercalated materials with promising future applications in nanomaterial science. This article has just been published in high impact international journal, The Journal of Physical Chemistry C 122, 2018, pp 4768–4782. In parallel, we continued one work to study the modulating electrocatalysis on graphene heterostructures which have an important role in alkali-ion battery and the findings were published high impact international journal, ACS Nano 12, 2018, pp. 2980-2990, Impact Factor: 13.942.

## Adjunct Faculty Member of MEMS

**Dr. Vilas G. Pol**
Professor
vpol@purdue.edu

**Associated Department:** School of Chemical Engineering, Purdue University, USA

**Research Areas:**

- Synthesis of novel carbon architectures for energy storage applications
- Fabrication of high-capacity Lithium-ion anode materials
- Exploration of innovative electrochemical cell geometries with great mechanical, flexible, and lightweight properties
- Design of nano and micro-structuring processes to advance electrode materials and electrolytes for lithium-sulfur, lithium-oxygen, and sodium-ion battery systems

More details about Prof. Pol research group can be found at: https://engineering.purdue.edu/ViPER/index.html

**List of Ph.D. Completed from discipline of Metallurgy Engineering and Materials Science**

| S.No | Name of Student | Name of Supervisor(s) |
|---|---|---|
| 1 | Dr.Tulika Srivastava | Dr. Somaditya Sen, Dr. Parasharam M. Shirage |
| 2 | Dr. Arun Kumar Yadav | Dr. Somaditya Sen, Dr. Parasharam M. Shirage |
| 3 | Mr. Ashish Kumar Shukla | Dr. I. A. Palani, Dr. M. Anbarusu |
| 4 | Mr. Gaurav Bajpai | Dr. Somaditya Sen, Dr. Parasharam M. Shirage |
| 5 | Ms. Nandini Patra | Dr. I. A. Palani, Dr. Vipul Singh |

*MEMS Ph.D. Students*

*MEMS M. Tech. Students*

## Appendix A: Projects

| Project No. | Project Title | Funding Agency | Grant Amount (in Lakhs) |
|---|---|---|---|
| P1. | Promotion of Environmental Friendly Plasma Nitriding / Nitrocarburizing Process for wear and Corrosion Resistance of Industrial Components | SERB-DST | 95.84 |
| P2. | Solid Electrolytes for All Solid State Rechargeable Lithium Batteries | SERB-DST | 86.00 |
| P3. | Development of the technique for the growth of metal oxide Nano-porous materials for supercapacitors applications | CSIR | 23.55 |
| P4. | Wet-chemical approach to fabricate visible-near infrared light harvesting photoelectrodes | SERB-DST | 85.00 |
| P5. | Compositionally and Micro structurally Engineering Lead-Free Ceramics for Piezoelectric Applications | SERB-DST | 46.37 |
| P6. | Innovation in Science Pursuit for Inspired Research (INSPIRE) | SERB-DST | 35.00 |
| P7. | Role of Boron passivated 1D NiO nanostructures in the next generation change/energy | UGC-DAE | 2.46 |
| P8. | Fabrication of efficient Organic-Inorganic Hybrid Heterojunction Solar cells (OIHSCs) containing Lead Free Perovskite Compound and Polymeric Hole Conductors | SERB-DST | 19.20 |
| P9. | Synthesis and environmental degradation study of aluminium-chromium-copper-manganese-iron-tungsten based high entropy alloy for high temperature application | BRNS | 17.65 |
| P10. | Self- Powered wearable /non- wearable metal oxide triboelectric gas sensors | SERB-DST | 19.20 |

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| P11. | Construction of Porous Metal-Organic Frameworks (MOFs) & Covalent- Organic Frameworks (COFs) and Its Applications | SERB-DST | 89.00 |
| P12. | Novel Homochiral Metal-Organic Framework for Chiral, Achiral molecules inclusion and Reversible Gas Storage Applications | SERB-DST | 35.00 |
| P13. | Conducting Polymer Nanocomposites (CPC) for Selective and Sensitive Sensors Detection of Explosives array | SERB-DST | 19.20 |
| P14. | Wear Behavior and Microstructural Studies of Surface Mechanical Attrition Treated (SMAT) and Post-Treated Stainless Steels | SERB-DST | 50.85 |
| P15. | Development of Cold Rolled Grain Oriented Electrical Steel with High Si content | SERB-DST | 35.00 |
| P16. | Lead Free Inorganic Halide Perovskite Nanostructure for Solution-Processable Photovoltaic Cell | SERB-DST | 31.35 |

## Appendix B: Publications


1) Amit Kumar Rana, Yogendra Kumar, P. Rajput, S. N. Jha, D. Bhattacharyya, Parasharam Shirage, "Search for Origin of Room Temperature Ferromagnetism in Ni doped ZnO", ACS Applied Materials and Interfaces 9 (2017) 7691-7700. (IF = 8.097)
2) Prateek Bhojane, Lichchhavi Sinha, Rupesh S Devan, Parasharam M Shirage, "Mesoporous layered hexagonal platelets of Co 3 O 4 nanoparticles with (111) facets for battery applications: high performance and ultra-high rate capability", Nanoscale, 10(2018) 1779-1787. (IF = 7.367)
3) Sonal Mittal, J. Lee, Y. Ohshita, Parasharam M Shirage, "Effect of preparative parameters on Pervoskite solar cell stability", Nanoscale (2018) Accepted. (IF = 7.367)
4) Alfa Sharma, Yogendra Kumar, Kushal M azumder, Amit Kumar Rana, Parasharam M Shirage, "Controlled $Zn_{1-x}Ni_xO$ nanostructures for an excellent humidity sensor and plausible sensing mechanism", New Journal of Chemistry, 2018. (IF = 3.269 ).
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12) Prateek Bhojane, Alfa Sharma, Manojit Pusty, Yogendra Kumar, Somaditya Sen and Parasharam Shirage, "Synthesis of Ammonia-Assisted Porous Nickel Ferrite (NiFe2O4) Nanostructures as a

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# School of Humanities and Social Sciences

### Research Thrust/Facility

- Digital Humanities
- Economics of Innovation
- Human Factors & Applied Cognition (HFAC)
- Quality Point Average (QPA)
- Sustainability Studies

### Application Areas

- Agricultural Economics, IP Rights & Patenting
- Automative User Interface (UI), Human Computer Interaction (HCI) & Interactive Systems
- Business History
- Moral Philosophy & Political Philosophy
- Publishing, Music Studies, Media Studies & Linguistic Variation
- Water Governance

## From the HoD's Desk

**Dr. Sanjram P. Khanganba**
Associate Professor
hosh@iiti.ac.in

The School of Humanities and Social Sciences is a multi disciplinary establishment. At present, it comprises of six disciplines- Economics, English, History, Philosophy, Psychology, and Sociology. The school is currently upgrading its facilities with modern state-of-the-art laboratories. Its academic program is both broad and in-depth, covering a broad discursive field; social-centric issues, technically oriented fields and creative specialties (thus aiming at incorporating anthropology, political science, human services, human sciences, arts, media, music studies, design, and allied fields). We look forward to expanding our academic diversity by engaging motivated and talented individuals who are willing to embark on a challenging research career.

# Faculty Profiles in School of Humanities and Social Sciences

- Dr. Akshaya Kumar,
  *Assistant Professor (Discipline of Sociology)*
- Dr. Ananya Ghoshal,
  *Assistant Professor (Discipline of English)*
- Dr. Ashok Kumar Mocherla,
  *Assistant Professor (Discipline of Sociology)*
- Dr. C. Upendra,
  *Associate Professor (Discipline of Philosophy)*
- Dr. Neeraj Mishra,
  *Assistant Professor (Discipline of Sociology)*
- Dr. Nirmala Menon,
  *Associate Professor (Discipline of English)*
- Dr. Pritee Sharma,
  *Associate Professor (Discipline of Economics)*
- Dr. Ruchi Sharma,
  *Associate Professor (Discipline of Economics)*
- Dr. Sanjram P. Khanganba,
  *Associate Professor (Discipline of Psychology)*
- Dr. Shomik Dasgupta,
  *Assistant Professor (Discipline of History)*
- Dr. Usha Udaar,
  *Assistant Professor (Discipline of English)*

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.

**About the School:** The School of Humanities and Social Sciences has a strong Ph.D. student group (comprising of 22 students at present). We emphasize on providing students the much-needed experiences that will 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. Faculty members currently teach a full range of courses from introductory classes to advanced electives for U.G. and P.G. students.

## Research Areas

- Moral and Political Philosophy
- Philosophy and Literature
- Translation Studies and Digital Humanities
- Postcolonial Literature and Theory, Globalization Studies,
- Critical and Cultural Theory
- IPR, Patent Policy, and Technology Transfer
- Agricultural Economics & Development Economics
- Medical and Healthcare Human Factors, Transport Human Factors, Performance, Community Systems, Interactive Systems
- Water Resource Governance and River Basin Management
- Indian Cinema and Comparative Media Studies
- Ethnic and Religious Minorities of India, Faith Healing, Pentecostalism, and Public Health
- Intellectual History Governance, Local Administration and State in Modern India
- Economic, Social and Business History
- Literature and Other Arts (Interrelations between Literature and Music), Ekphrasis
- Literature and the Anthropocene (Environmental Humanities)
- Linguistic Variation, Indo-Aryan Languages, Case and Agreement
- Art as Performance

**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. Attending to most of these issues, he is now finishing a manuscript provisionally entitled *Provincializing Bollywood: Bhojpuri Cinema in the Comparative Media Crucible.*

He finished his B. Tech in Materials and Metallurgical Engineering from IIT Kanpur, M.A. in Arts and Aesthetics from Jawaharlal Nehru University, and Ph.D. in Film and Television Studies on *Screen Studentship* from *Screen,* the Film Studies journal, at 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.

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**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 and Music Studies, Narratives of the Anthropocene, Performance Studies, Digital Humanities and Visual Culture. Her research also intersect with graphics, poetry, photography, and filmmaking in relation to the discourses of emerging media technologies.

Ananya has presented her research at various universities in India and abroad and has published several journal articles and book chapters. She also mentors Fulbright aspirants and graduate students with USIEF and Education USA. Before coming to IIT Indore, Ananya was an Academic Fellow at the Forum on Contemporary Theory & Balvant Parekh Centre for General Semantics and Other Human Sciences, Baroda. Her latest publication is –*An Anthropocene Primer.* This Primer, edited by Jason M. Kelly and Fiona P. McDonald is an innovative open access, open peer review publication that guides learners through the complex concepts and debates related to the Anthropocene. It emerged from the "Anthropology of the Anthropocene: Structures, Theories, Practices" workshop hosted by the IUPUI Arts and Humanities Institute, Indianapolis which Ananya was a part of. The goal of this workshop was to explore interdisciplinary questions about Anthropology's role in the Anthropocene. Version 1.0 of *An Anthropocene Primer* was made available for open peer review from October 23, 2017, through February 1, 2018. Since it went live, the platform received more than 3,500 unique visitors. This open peer review allowed users to contribute to and engage with fellow readers and the authors. In response to the

http://anthropoceneprimer.org/

comments received, the editors are now developing the Primer for two versions: print and open access-book with Indiana University Press. Proceeds from Version 2.0 of *An Anthropocene Primer* will be used to fund open access translations and support environmental charities.

*An Anthropocene Primer* has been shortlisted in the EU for the 2018 "Best Climate Solutions Award" with the Centre Euro-Mediterraneosui Cambiamenti Climatici (CMCC) in the category of "Education and Media."

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**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 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'. He is presently working on a major research project (2017 -2019), sponsored by ICSSR (Indian Council of Social Science Research), 'Democratization of Indian Christianity: Dalit Christian Liberation Movement in Contemporary India'.

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**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. Currently, he is an Associate Professor of Philosophy in the School of Humanities & Social Sciences at IIT Indore. Upendra's research interests vary from Moral Philosophy to Political Philosophy to Phenomenology with a specific focus on radical philosophy. Combining these three, he investigates the possibility of social revolutions. His teaching interests are in epistemology, history of ideas, philosophy of film, and war history. For the last one year, Upendra has worked on two specific themes in philosophy: [1] Political Philosophy – with a specific focus on the ever presence of the utopian imagination and the eternal wait for an emancipated society. The question dealt with was – 'was political utopia via socialism a misadventure? [2] Philosophy of Biology – the focus was on the philosophical relevance of the Darwinian understanding of life and evolution, drawing motivation from the Gaia hypothesis – conceiving the Earth as a super-organism. The work focused on three important principles – immanence, mechanism, and organism. It focused on the possible defense of metaphysics that is usually a futile exercise for both biologists and philosophers of science. Currently, he is working on the enigma of radical social transformation through the idea of Guy Debord's *The Society of the Spectacle.*

**Dr. Neeraj Mishra**
Assistant Professor
Sociology
nmishra@iiti.ac.in

**Dr. Neeraj Mishra** is an Assistant Professor in Sociology. He has received his Ph.D. from the University of Bonn, Germany and his Postdoc from the University of Amsterdam. Dr. Mishra's research interests include Sociology of Development, Environmental Sociology, and Politics of Water Governance. Some of the ongoing projects in his research group include:

- River Basin Governance in Western India: A Technographic Analysis of River Kshipra and her Tributaries in Madhya Pradesh;
- Understanding Water Conflicts in Narmada River Basin: A Sociological Analysis of Omkareshwar Dam Project in MP, India.
- Water Management in the Forts of Medieval India: Case Study of Mandu Town in MP. (Supported by ICSSR, New Delhi: 2017-2019)

Homepage: http://sociology.iiti.ac.in/people.php

At IIT Indore, Dr. Mishra has taught the courses listed below:

HS-205: Classical Sociology, HS-302: Environmental Sociology, HS-482: Introduction to International Development Studies, HS-616: Advanced Sociological Theories, HS-600: Qualitative Research Methodology

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**Dr. Nirmala Menon**
Associate Professor
English
nmenon@iiti.ac.in

**Dr. Nirmala Menon** leads the Digital Humanities and Publishing Research Group at the Indian Institute of Technology (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). She has published in numerous international journals and speaks, writes and publishes on postcolonial studies, digital humanities, and scholarly publishing. She directs Ph.D. students in their projects and runs DH projects from the research lab at IIT Indore. Her primary area of research is Digital Humanities, Postcolonial Literature, and Theory. Her focus is on the comparative study of twentieth- century postcolonial literatures in English, Hindi and other languages. Gender studies, Globalization and Translation studies are additional areas of research. Her interests are multilingual but also interdisciplinary; her research examines how literatures from different non-Western languages influence and can redefine and reframe postcolonial theoretical concepts. She 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 The Literary Encyclopedia. She is one of the Board members of Ubiquity Press, a consortium of Open Access university presses globally. Prof. Menon 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. ·

### The Digital Humanities and Publishing Research Group:

The Digital Humanities and Publishing Research Group at IIT Indore is a vibrant place of creative ideas that fuels our research agendas and projects. We are interested in interdisciplinary research that investigates and examines the intersections between technology and the humanities to understand the myriad ways in which technology is transforming and is transformed in the digital age. The group is especially committed to developing a research hub that foster collaboration across disciplines from Humanities, Computer Science and allied disciplines. Their 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 and so on. The DH research group 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 and a visiting Fulbright scholar in her team.

DH Research Group

**Achievements for the Year:**

1. Hosted Fulbright Scholar Ms. Melissa Delury, from CUNY, NY
2. Two Research Scholars have submitted their Thesis and one Research Scholar has been awarded the Ph.D. in the 6th Convocation.
3. Won an Australian Grant and was a visiting Research Fellow at Edith Cowan University, Australia
4. Ms. Wati Longkumer was awarded the Zubaan Saskawa Research Grant for Young Scholars for her work on Women Writers of the North East.
5. Ms. Shaifali Arora won the travel bursary to attend the DH2018 conference at the University of Montreal, Canada.
6. Keynote speaker for two national and two international Digital Humanities conferences.
7. Invited speaker for Academia Europaea's Knowledge Hub Series on "New Frontiers in Humanities Research".
8. Co-PI for the Samagra Documentation project in partnership with UNICEF, India.
9. Co-founded DHAI (Digital Humanities Alliance of India) and organized the inaugural DHAI Conference in collaboration with IIM Indore in June 2018.

Prof. Paul Arthur inaugurating the DHAI Conference at IIM Indore

Prof. Paul Arthur delivering the keynote address at the DHAI Conference

**Select Publications:**

- 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.
- T., Shanmugapriya, Andy Campbell and Nirmala Menon. "THANNER KUHAI 'The Water Cave' – A VR Poetry Experience" *Digimag,* 2018, pp. 20–26. ISSN Code: 2037-2256. Available at: <http://www.digicult.it/wp-content/uploads/digimag78.pdf>.
- T., Shanmugapriya, and Nirmala Menon. "Locating New Literary Practices in Indian Digital Spaces." MATLIT: Materialities of Literature, [S.l.], v. 6, n. 1, p. 159-174, Aug. 2018. ISSN 2182-8830. DOI : 10.14195/2182-8830_6-1_11.
- 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.
- Menon, Nirmala and Shanmugapriya T. "Digital humanities in India: Pedagogy, Publishing and Practices." *in Exploring Digital Humanities in India* edited by Nidhi Kalra and Maya Dodd. Routledge 2018. (Book Chapter, forthcoming)
- Arora, Shaifali, and Nirmala Menon. "The 'Reproductive' Body: Dis/locating Identities in the film Parched". *Asian Journal of English Studies,* vol. 6, no. 3, 2017.

**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 Ph.D. 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. She has also worked on the stakeholder issues, resilience building, adaptive capacity aspects of climate change; and land and forest degradation from urban and rural poor's perspectives. Her work pertain to governance, efficiency, and policy in the Indian context. Her research group includes Ph.D. 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.

### Key Achievements:

### Research Assignment:

"Process Documentation of Samagra Portal" as a joint project between IIT Indore and UNICEF Bhopal, for Government of Madhya Pradesh.

### Invitations:

1. Expert in Energy Security Analysis at "The Energy Workshop," at EPFL, Lausanne, Switzerland during July 05-07, 2017.
2. Panel discussant and speaker at the Earth System Governance International Project meeting at University of Lund, Lund, Sweden during October 31-November 03, 2017.
3. Keynote Speaker on Economic Policy at International Workshop on Nutrition Sensitive Agriculture held at Bhopal during May 14-15, 2018.

### Research Publications:

Joshi, S., and Sharma, P., (2018) Energy, Economic Growth and Energy Transitions: Exploring the interlinkages for Indian Economy, Journal of Emerging Technologies and Innovative Research, Vol 5(8) Publisher: IJ Publication DOI:http://doi.one/10.1729/Journal.18162

Joshi, S., and Sharma, P., (2018) Green growth & Trade restrictions: Assessing socio economic impacts of local content requirements in Indian solar policy, Journal of Developing Areas (Status: Accepted, details of publication awaited). Publisher: Tennessee State University College of Business.

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.

### Chapters in Books:

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

Sharma, P. and K. Singh (2018) Sustainable Development: Dimensions, Intersections and Knowledge Platform. In: *Sustainability: Fundamentals and Applications,* John Wiley and Sons Limited.

**Dr. Ruchi Sharma**
Associate Professor
Economics
ruchi@iiti.ac.in

**Dr. Ruchi Sharma** (Ph.D.: 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.

She is currently working on a project sponsored by ICSSR to study knowledge spillovers from foreign firms using patent citation data. She has organized two GIAN courses. The details of the course organized during April'17 to March'18 are:

1. Economics of Science, Technology, and Innovation: Empirical Approaches and Randomized Control Trials (RCTs) from 10-14 January 2018 with Dr. Ina Ganguli from the University of Massachusetts Amherst.

**Journal Articles Publications during April'17 to March'18:**

- Sharma, Ruchi, A. Paswan, S. Kumar and M. Dhanora, 2018. Impact of Patent Policy Changes on R&D Expenditure by Industries in India. *Journal of World Intellectual Property* 21(1-2): 52-69.
- Khachoo, Qayoom and Ruchi Sharma. 2017. FDI Entry and R&D Behaviour of Incumbents: Evidence from India. *Journal of Economic Studies*. 44 (3): 380-399.

  http://www.emeraldinsight.com/doi/full/10.1108/JES-10-2015-0188
- Lenka, S. K. & Ruchi Sharma. 2017. Does financial inclusion spur economic growth in India? *The Journal of Developing Areas*. 51 (3): 215-228.

  https://muse.jhu.edu/article/662349

**Journal Articles Accepted during April'17 to March'18 (but published later):**

- 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.
- 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.

**Publications in Conference Proceedings during April'17 to March'18:**

- Sharma Ruchi. 2018. FDI Policy Brief: R&D, Patenting and Spillovers. FDI: Issues and Policy, held at IIT Bombay on February 24 2018.

Dhanora, Madan and Ruchi Sharma. 2017. Innovation and competition in Indian medium and high technology industries. 12th Annual International Conference on Changing Paradigms in Technology, Trade and Development organized by Forum for Global Knowledge Sharing (FGKS), held at Nabakrushna Choudhury Centre for Development Studies (NCDS), Bhubaneswar from November 10-12, 2017. Available at http://fgks.in/index.php/conference-papers

**Student Achievements:**

Aparna Sharma, scholar from the research group, was selected for 4 months internship at National Cheng University, Taiwan.

**Ph.D. Students who defended their thesis during April'17 to March'18:**

1. Sanjaya K. Lenka 2. Ab. Qayoom Kachoo

**Dr. Sanjram P. Khanganba**

Associate Professor
Psychology
sanjrampk@iiti.ac.in

**Dr. Sanjram P. Khanganba** 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 P.G. students with diverse academic background under the aegis of 'Focused 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' focusing on technological systems in the pursuit of technological innovation, improvement, and optimal utilization of human capabilities. He performs advanced experimental studies often involving the development of experimental paradigms in order to examine aspects of Attention, Articulatory Rehearsal Mechanism of Working Memory, Human Errors, Human Multitasking, Mental Rotation, Auditory Cognition and Movement, and Visuo-spatial Cognition. His research at 'Human Factors & Applied Cognition Lab (HFAC Lab)' concentrates on broad domains of- Automotive and Transport Human Factors, Medical and Healthcare Human Factors, Smart Environments and Systems, Virtual/Augmented Reality, Human Performance, Community Systems, Media, and User Experience. 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.

**Automotive Human Factors Research, Human Factors & Applied Cognition Lab**
**Gaze Behavior and Driving Errors During Distracted Driving**

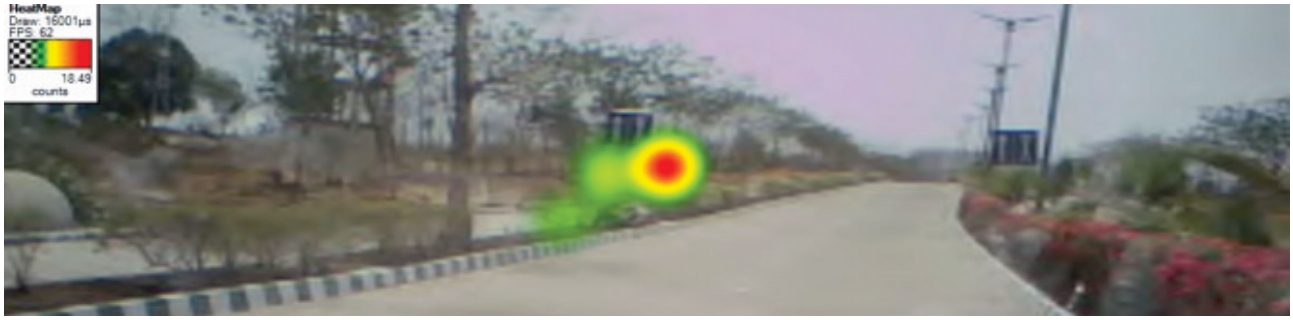



Fig. Heatmaps (gaze behavior) during distracted driving

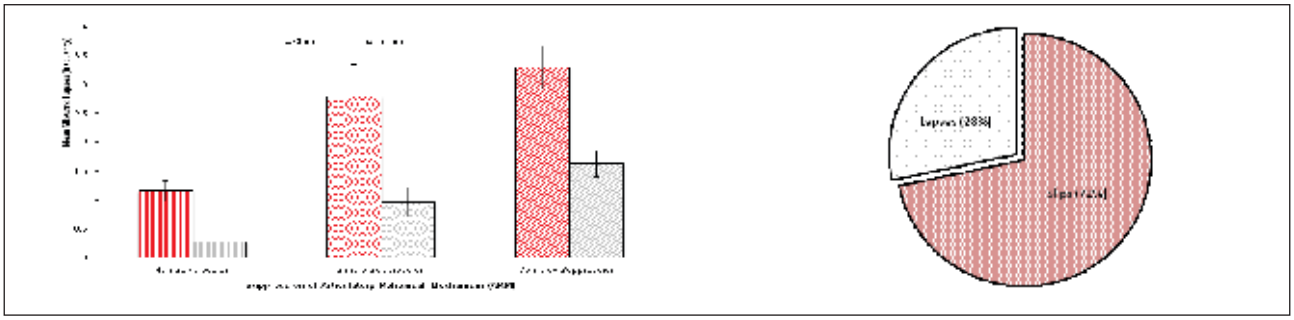


Fig. Slips and Lapses at three levels of suppression of ARM

Fig. The proportion of slips and lapses in overall driving error

## Highlights

- Substantial increase in suppression of Articulatory Rehearsal Mechanism (ARM) reduces, fixation duration and counts.
- Drivers paid visits to target visual information even when there is no fixation.
- Suppressed ARM increases vulnerability to errors.
- Slips have a higher contribution to overall driving errors as compared to lapses.

Distracted driving is a major safety and security concern all over the world. For the last one and half decade, the problem of distracted driving has worsened as more information, and entertainment technologies find their way in the vehicles. India is committed to reducing the on-road casualties by 50% by 2020 as per the Brasilia declaration, which is a faraway dream to chase because the no. of casualties instead of decreasing is showing an upward trend, i.e., 133938 deaths on Indian roads in 2010 and 150785 in 2016. In this context the Human Factors & Applied Cognition Lab (IITI) conducted an experiment in a naturalistic driving environment to investigate the effect of distraction on visual behavior and driving performance. The researchers found that distracted drivers looked at signboards for very short periods of time when compared to attentive drivers. Consequently, distracted drivers committed more driving errors. The reason is that our memory has 'Articulatory Rehearsal Mechanism' which converts visual information into verbal sounds and rehearses the verbal information until the task is accomplished. In the case of a distracted driver, the function of Articulatory Rehearsal Mechanism is suppressed, and it is not in a position to rehearse the information. In other words, performing the distracting task consumed the cognitive resources of the drivers due to which they were not able to pay a substantial amount of attention to direction signboards.

Najar, S., and Sanjram P. K. (2018). "Gaze Behavior and Human Error in Distracted Driving: Unlocking the Complexity of Articulatory Rehearsal Mechanism", Transportation Research Part F: Psychology and Behaviour. https://doi.org/10.1016/j.trf.2018.08.005 (Elsevier, supported by International Association of Applied Psychology).

**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 B.A. from St. Stephen's College, Delhi in History (Hons.); his M.A. in Medieval Indian History from Jawaharlal Nehru University (JNU); and, Ph.D. from King's College, the University of London. He is currently working on the publication of a full-length book based on his Ph.D. thesis on the political thought of Rammohun Roy.

**Dr. Usha Udaar**
Assistant Professor
English (Linguistics)
ushaudaar@iiti.ac.in

**Dr. Usha Udaar** is an Assistant Professor. She works on the syntax of natural languages, especially the languages of Western Indo-Aryan region in India. Her research work is mainly concerned with individual and interrelated phenomena with a focus on linguistic variation where she explores systematic differences between languages and dialects within the theoretical framework of generative grammar. Her book, *Syntax and Structures: Exploring South Asian Languages* (2017), co- edited with Reena Ashem and Gurmeet Kaur has been published by Cambridge Scholars Publishing, UK.

# 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.

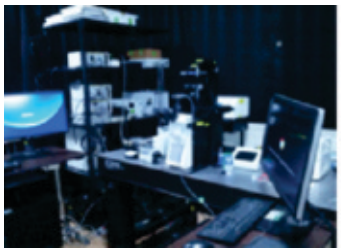
IIT Indore is recognized for its science and technology research and offers many opportunities for interdisciplinary collaborations and involvement with various departments and research centres including the disciplines of Computer Science and Engineering, Electrical Engineering, Mechanical Engineering, Physics, Chemistry, Mathematics, Humanities, and Social Sciences. Biosciences and Biomedical research will be one of the thrust areas at IIT Indore.

## Facilities

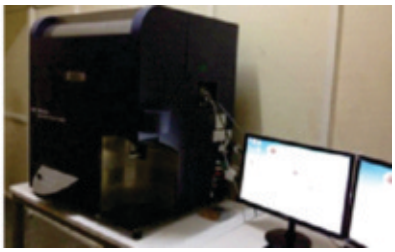
IIT Indore has many unique state-of-the-art laboratories in Chemistry, Physics and other Engineering departments. Such laboratories are also being built for Biosciences and Biomedical Engineering research. Additionally, the faculty, postdoctoral fellows, research scholars, and staff have access to the 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, $LN_2$ 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 Ph.D. program with 55 students in different areas of modern biology. Furthermore, 19 research projects are currently in progress.

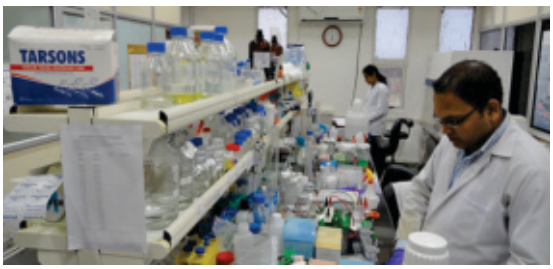
## Key Research Areas

- 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

## Notable Achievements

### General Achievements:

- Published about 26 research papers in reputed international journals.
- Two day International symposium was organized on the topic "Emerging Areas in Biosciences and Biomedical Technologies" from January 5-6, 2018.
- Ms. Mena Asha Krishnan working under the supervision of Dr. Chelvam Venkatesh awarded Science and Engineering Research Board (SERB) Overseas Visiting Doctoral Fellowship to work with Prof. Kavita Shah at Purdue University on Cancer Therapeutics for a year.
- Mr. Md. Fulbabu Sk from Dr. Parimal Kar's lab has received second prize in the poster presentation category at "ICMMSC 2018", July 2018.
- Ms. Mena Asha Krishnana, a Ph.D. student, working under the supervision of Dr. Venkatesh Chelvam, awarded Commonwealth Split Site Fellowship to work at Loughborough University, the UK with Prof. Paul Roach for studies in Cancer Diagnostics for a year.
- Short Term Course organized on "Advanced Biological and Chemical Understanding of Disease Diagnostics and Therapeutics" May 22 - 24, 2018.
- "International Symposium organized on Water: Resources, Challenges & Sustainability (WRCS)" from March 10, 2018.
- Ms. Atreyee Ghosh from Dr. Kiran Bala's lab awarded a scholarship from EPCO (Environmental Planning and Coordination Organization) as part of the Ph.D. Scholarship Program on Climate Change.
- Ms. Mansi Srivastava from Dr. Mirza's lab has received best oral presentation award at the 44th annual conference of the Indian Immunology Society (IIS) "IMMUNOCON 2017", December 2017.



## 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 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.

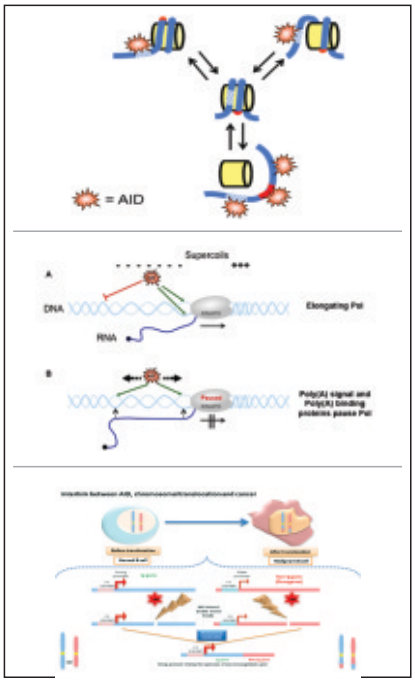
### Grant received:

Title: Flourimetric biosensor for detection and quantification of insecticides and pesticides using recombinant organophos phorous hydrolase expressed in E. coli.
Agency: Department of Biotechnology, Govt. of India
Co-PI: Dr. Abhijeet Joshi

### Publications:

Choudhary M, Tamrakar A, Singh AK, Jain M, Jaiswal A and Kodgire P, AID Biology: A Pathological and Clinical Perspective, International Reviews of Immunology, vol. 37(1), pp. 37-56, 2018

Bhattacharya A, Bhowmik S, Singh AK, Kodgire P, Das A and Mukherjee T, Direct Evidence of Intrinsic Blue Fluorescence from Oligomeric Interfaces of Human Serum Albumin, Langmuir, vol. 33(40), pp. 10606-10615, 2017.



**Dr. Sharad Gupta**

Assistant Professor
shgupta@iiti.ac.in

**Dr. Sharad Gupta** (Ph.D.: 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.

The main focus of Dr. Gupta's research is the development of optical techniques for biomedical applications, bio-nanotechnology and biomaterials. Currently, he is working on a project that studies the mechanism of small peptide interaction with plasma membrane. In this work, the effect of cholesterol on interaction of small peptide with plasma membrane is also studied. To understand this mechanism he uses optical interferometric techniques. It has been found that inclusion of cholesterol in plasma membrane makes membranes more resilient towards the cytolytic action of this small peptide. In addition,

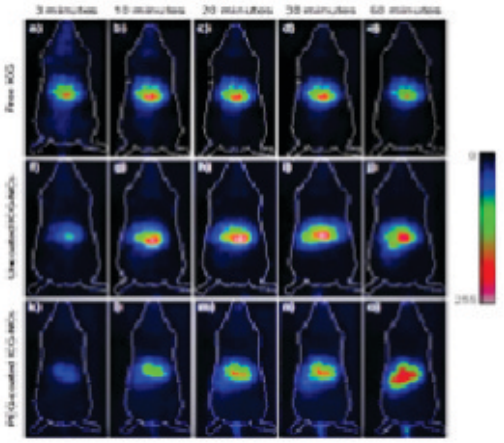
he is developing a nanotechnology based approach for near infrared (NIR) biomedical imaging for disease diagnosis. In this project, he is developing biocompatible and biodegradable nanoparticles that will bring the NIR chromophore such as Indocyanine green (ICG) to a target location to diagnose the abnormality inside the tissues.

**Publications:**

1. Gorey, A., Biswas, D., Kumari, A., Gupta, S., Sharma, N., Chen, G. C. K., and Vasudevan, S., "Application of continuous wave photoacoustic sensing to red blood cell morphology," Accepted in Lasers in Medical Science, 2018. DOI: 10.1007/s10103-018-2621-7
2. Bisnoi, S., Tiwari, R., Gupta, S., Byrareddy, S. N., and Nayak, D., "Oncotargeting by vesicular stomatitis virus (VSV): Advances in cancer therapy," Viruses, 10(2), 90, 2018

**Patents:**

1. "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.
2. "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.



**Approved Grants:**

1. DST Nano Mission project: Development of a vesicular stomatitis virus (VSV) glycoprotein based virus-like nanoparticles (VLP) platform for targeted drug d delivery.

   PI: Debasis Nayak, Sharad Gupta (BSBE, IIT Indore)

   Co-PI. Shanti Senapati, ILS Bhubaneswar
2. DBT Grant: Development of a Chikungunya candidate vaccine in Vesicular Stomatitis Virus (VSV) gene delivery platform

   PI. Sujatha Sunil, ICGEB, New Delhi

   PI: Debasis Nayak, Sharad Gupta (BSBE, IIT Indore)

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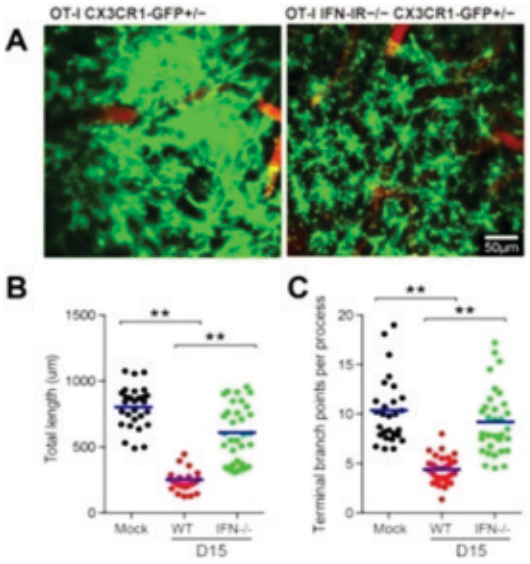
**Dr. Debasis Nayak**
Assistant Professor
nayakdn@iiti.ac.in

**Dr. Debasis Nayak** (Ph.D., 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. The immediate interest of the group is to generate




candidate vaccines against arboviruses such as Chikungunya, Dengue fever and the recently emerged Zika virus infection. In this direction, the group has secured funding from DBT which would support candidate vaccine development against the Chikungunya virus. This multi-institute project titled Development of a Chikungunya candidate vaccine in Vesicular Stomatitis Virus (VSV) gene delivery platform is being jointly developed in collaboration with Dr. Sujatha Sunil, ICGEB, New Delhi.

The group is engaged in collaborating with faculty in the field of Signal Processing, Synthetic chemistry, Photo-acoustics, and Nanotechnology, etc. In this endeavor, they have developed a research program and our activities are now funded by DBT, SERB, DST Nano Mission, etc. The grant "Development of a portable acoustic sensor based canine pregnancy detection system and biomarker-based canine pregnancy test kit" is an example of translational research in the field of assisted reproductive technology.

As this research work is translatable the group is highly motivated to make an impact on academia and academic entrepreneurship. The initial work in reproductive biotechnology combined with nanotechnology has resulted in a collaborative industrial grant, Biotechnology Ignition Grant (BIG) sponsored by the Dept. of Biotechnology.

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.

**Approved Grants:**

I. DST Project Title: High Confidence Cyber-Physical Systems HiConCyPhy
   PI: Gourinath Banda (IITI)
   Co-PIs: Debasis Nayak (IITI), KV Srinivas (IIT BHU), Krishna Chaitanya (IIIT Sri City)
II. SERB Core Research Grant: 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 PI: Srivathsan Vasudevan (EE, IIT Indore)
   Co-PI. Debasis Nayak (BSBE, IIT Indore)
III. DST Nano Mission project: Development of a vesicular stomatitis virus (VSV) glycoprotein based virus-like nanoparticles (VLP) platform for targeted drug d delivery
   PI: Debasis Nayak, Sharad Gupta (BSBE, IIT Indore)
   Co-PI. Shanti Senapati, ILS Bhubaneswar
IV. DBT Grant: Development of a Chikungunya candidate vaccine in Vesicular Stomatitis Virus (VSV) gene delivery platform
   PI. Sujatha Sunil, ICGEB, New Delhi
   PI: Debasis Nayak, Sharad Gupta (BSBE, IIT Indore)

**Publications:**

I. Urata S, Kenyon E, Nayak D, Cubitt B, Kurosaki Y, Yasuda J, Juan C, and McGavern DB. 2018. BST-2 controls T cell proliferation and exhaustion by shaping the early distribution of a persistent viral infection. PLOS Pathogens. PLOS Pathogens 14 (7), e1007172.
II. Mishra A and Nayak D. 2018 Innate immune response of the central nervous system to cytopathic virus infection. J. Neuro Immu Pharmaco. 13, S58-S58

III. Bishnoi S, Tiwari R., Gupta S, Byrareddy SN and Nayak D. 2018 Once targeting by Vesicular Stomatitis Virus (VSV): Advances in Cancer Therapy. Viruses 2018, 10(2), 90.

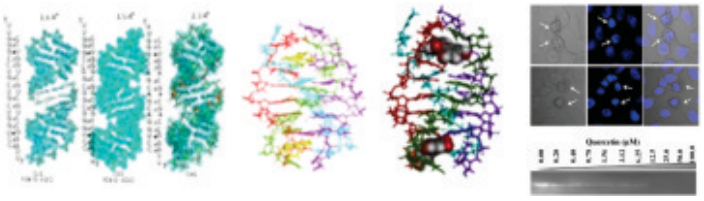
IV. Adhikari C, Mishra A, Nayak D, and Chakraborty A. 2018. Drug delivery system composed of mesoporous silica and hollow mesoporous silica nanospheres for chemotherapeutic drug delivery. Journal of Drug Delivery Science and Technology. 45 (2018) 303–314.

V. Das M, Kumar Kundu B, Tiwari R, Mandal P, Nayak D, Ganguly R, Mukhopadhyay S. 2018. Investigation on chemical protease, nuclease and catecholase activity of two copper complexes with flexidentate Schiff base ligands. Inorganica Chim Acta 469:111–122.

**Dr. Amit Kumar**
Associate Professor
amitk@iiti.ac.in

**Dr. Amit Kumar** (Ph.D.: IIT Roorkee, India; Postdoctoral Research Associate: The Scripps Research Institute, U.S.A.; Postdoctoral Fellow: SUNY Buffalo, U.S.A) Research Area: Structure Biology, Neurobiology, Chemical Biology, Target Identification, and Drug discovery.

Figure: Crystal structure that has been refined of a model duplex of r(CUG)exp in Myotonic dystrophy Type I, r(CGG)exp in Fragile X-associated tremor ataxia/ Fragile X syndrome and r(CAG)exp in Huntington's Disease (HD) and Spino Cerebellar Ataxia (SCAs). (Centre) NMR based structure is showing the G-quadruplex DNA complexed with the lead small molecule. (Right) Effect of Quercetin on cancer cell lines and DNA replication.



Dr. Kumar's group members conduct research on cancer, neurological disorders and other various diseases caused by bacteria and viruses by using libraries of bioactive small molecule/ligands that can target a variety of toxic DNA/RNAs at the molecular level. In many cases, not only do they directly use the information contained in the RNA motif-ligand database but also utilize similarity searching and virtual screening to rationally optimize the initial leads into potently bioactive small molecules. Further, rational design of small molecules and structural studies of these small molecules in complex with their DNA/RNA targets are done. These studies enable a better understanding of molecular and atomic level interactions that drive association of complexes and rationally design improved small molecules that target RNA.

**Important Publications:**

- Kalra, P, Mishra S K.; Kaur S.; Prasad, H, P.; Amit Kumar ; Sharma, T. K; Tyagi J. S, G-quadruplex forming DNA aptamers inhibit DNA-binding function of HupB (Rv2986c) and Mycobacterium tuberculosis entry into host cells., Mol Ther Nucleic Acids. 2018 Dec 7; 13: 99–109.
- A. Dhiman, K. Tripathi, S. Haldar, S. K. Mishra, N. Sharma, A. Bansal, A. S. Ethayathulla, Y. Ahmad, Amit Kumar , T. K. Sharma, J. S. Tyagi , Generation and application of DNA aptamers against HspX for accurate diagnosis of Tuberculous meningitis, Tuberculosis.,2018 Vol 112, Pages 27–36
- S. K. Mishra, N. Jain, U. Shankar, A. Tawani, A. Mishra , Amit Kumar, SMMDB: Database for small molecule modulators as therapeutics in neurological diseases, Database, Database (Oxford). 2018; 2018: bay082.
- N. Thakur, B. Sharma, S. Bishnoi, S.K. Mishra, D. Nayak, Amit Kumar, T.K. Sarma, Multifunctional Inosine Monophosphate Coordinated Metal-Organic Hydrogel: Multi-stimuli Responsiveness, Self-healing Properties and Separation of Water from Organic Solvents, ACS Sustainable Chem. Eng., vol. 6(7), pp. 8659–8671, 2018

- H. Kaur, J.G. Bruno, Amit Kumar, T.K. Sharma, Aptamers in the therapeutics and diagnostics pipelines, Theranostics, vol. 8(15), pp. 4016-403, 2018
- S.R. Bhagwat, K. Hajela and Amit Kumar, Proteolysis to Identify Protease Substrates: Cleave to Decipher, Proteomics, vol. 18, article 13, 2018
- Khan Eshan; Tawani, Arpita; Mishra, Kumar Subodh; Verma, Arun; Upadhyay, Arun; Kumar, Mohit; Sandhir, Rajat; Mishra, Amit; and Kumar, Amit, Myricetin targeting CAG repeat RNA ameliorates pathophysiology of Huntington's disease (HD) and Spino Cerebellar Ataxias (SCAs), ACS Chemical Biology, , vol. 13 (1), pp. 180-188, 2018
- Vibhuti Joshi, Arun Upadhyay, Amit Kumar, Amit Mishra, Gp78 E3 Ubiquitin Ligase: Essential Functions and Contributions In Proteostasis., Frontiers in Cellular Neuroscience, vol. 11, article 259, 2017

**Funding:**

- DST-EMR: DST/EMR/003897- (2017-2020)- Recognition of Human G-quadruplex Structure by natural product Piperine and its derivatives for mechanistic insight of its anticancer activity- Ongoing (INR 53 Lakhs)

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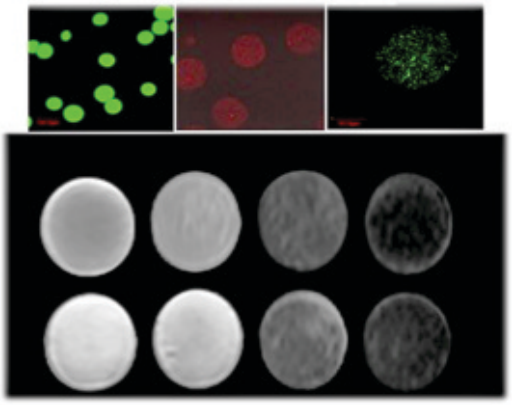
**Dr. Abhijeet B. Joshi**

INSPIRE Faculty
abhijeet.joshi@iiti.ac.in

**Dr. Abhijeet B. Joshi** (Ph.D.: IIT Bombay, Lecturer: NIPER-Ahmedabad, IYBA Fellow: IIT Bombay) works in the field of Biomedical Engineering; specifically, biosensor development, drug delivery, diagnostics, and theranostics. He has received several awards from national and international agencies such as TR-35 Award India, INAE-Innovative student project award, Dr. Gargi Vishnoi Memorial Best Ph.D. Thesis Award, Gandhian Young Technological Innovation (GYTI) Award etc.

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 using conventional methods of drug delivery. Using these nano/microcarriers he plans to improve the therapeutic efficacy of disease treatment by localizing, targeting and reducing the adverse effects.

In an example study, Dr. Joshi's group has developed combined capabilities of biosensing, drug delivery and imaging materials for glucose biosensing, anti-inflammatory agent delivery and MRI imaging using magnetic nanoparticles. Dr. Joshi's group aims to translate these biomaterial matrices into point of care systems that can be used in resource poor settings.



**Publications:**

1. Gaurav Pandey, Rashmi Chaudhari, Vinod Kumar Gupta, Abhijeet Joshi, Multifunctional nano-carriers as theranostic systems for targeting cancer, "Molecular Medicines for Cancer: Concepts and Applications of Nanotechnology"., 2018
2. Abhijeet Joshi, Jaspreet Kaur, Rajiv Kulkarni, Rashmi Chaudhari, In-vitro And Ex-vivo Evaluation of Raloxifene Hydrochloride Delivery Using Nano-transfersome Based Formulations, Journal of Drug Delivery Science and Technology, 2018

3. Sandipkumar A. Patel, Nrupa G. Patel, Abhijeet B. Joshi, Controlled-release domperidone pellets compressed into fast disintegrating tablets forming a multiple-unit pellet system (MUPS), Journal of Drug Delivery Science and Technology, 2018
4. Abhijeet Joshi, Rahul Dev Jayant, Ajeet Kaushik, Sneham Tiwari, Rashmi Chaudhari, Rohit Srivastava, Madhavan Nair, Nanogels for Gene Delivery, Nanogels for Biomedical Application, 2017
5. Joshi Abhijeet, Chaudhari R, and Srivastava R, pH and Urea Estimation in Urine Samples using Single Fluorophore and Ratiometric Fluorescent Biosensors, Nature Scientific Reports, vol. 7, pp. 5840, 2017

**Project Grants:**

1. Multi-analyte nano-engineered Quantum dot based flourescent biosensors for clinical quantification of biomarkers in diabetes related kidney diseases
2. Flourimetric biosensor for detection and quantification of insecticides and pesticides using recombinant organo-phosphorus hydrolase expressed in E. Coli

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**Dr. Parimal Kar**
Assistant Professor
parimal@iiti.ac.in

**Dr. Parimal Kar**

Understanding hypertension at the molecular level via multiscale simulations

Hypertension is a common chronic disorder that leads to stroke, myocardial infarction, renal failure, and congestive heart failure. Genetic approaches have demonstrated that mutation in many genes regulate renal salt reabsorption and causes variation in the blood pressure. The discovery of renal With No Lysine kinase (WNK) offers new insight into sodium, potassium, blood pressure regulations and body fluid homeostasis. It has been found that mutations in WNK lead to Pseudohypoaldosteronism type II (PHAII), also known as Gordons syndrome. Autophosphorylation at $Ser^{382}$ of activation loop makes WNK1 kinase active. Herein, via molecular dynamics simulations, the effect of phosphorylation on the structure and dynamics of the kinase in the unphosphorylated (uWNK) and phosphorylated (pWNK) complexes with its ligand (WNK463) have been studied.

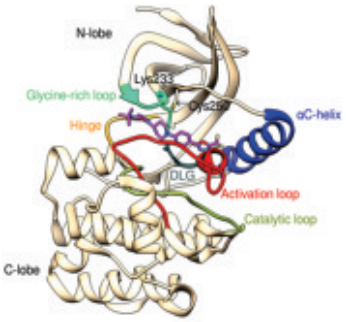
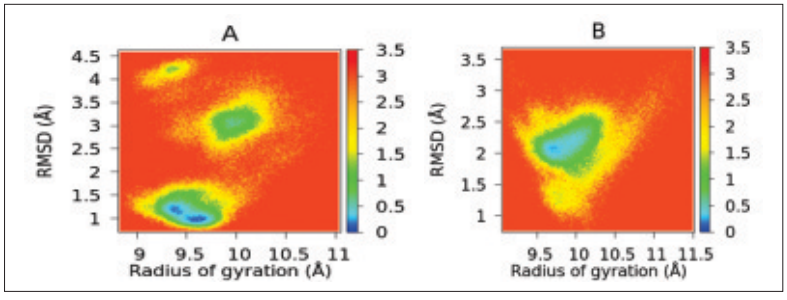



Fig 1: Free energy landscape as a function of $C_\alpha$ RMSD of activation loop and its radius of gyration ($R_g$) from the MD simulations of uWNK (A) and pWNK (B)

Our simulations reveal that the phosphorylation at $Ser^{382}$ significantly stabilizes the highly flexible activation loop. The pattern of the basin on free energy landscape shows multiple dispersed basin in uWNK and a broader and stable global minimum in pWNK. This suggests the structural disparity among the complexes and uWNK has no preferred conformation selection compare to pWNK.

Next, we have investigated the binding of the inhibitor WNK463 to the kinase (uWNK and pWNK) using the MM-PBSA scheme. We have observed a slightly favorable binding free energy in pWNK compared to uWNK due to lesser unfavorable desolvation polar energy and entropy contributions. In both cases, the binding is favored by the intermolecular electrostatics interactions and Van der Waals interactions. However, the complex formation is mainly driven by the Van der Waals interactions.



**Publications:**

- 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. 13, 5753-5765 (2017).

**Grants:**

- Title: Investigating conformational dynamics of N-glycans and the effect of glycosylation on the structure and dynamics of Hepatitis Virus C glycoproteins via molecular dynamics simulations
  Role: PI Agency: DST-SERB (ECR/2017/000010)

**Awards:**

- Early Career Research Award

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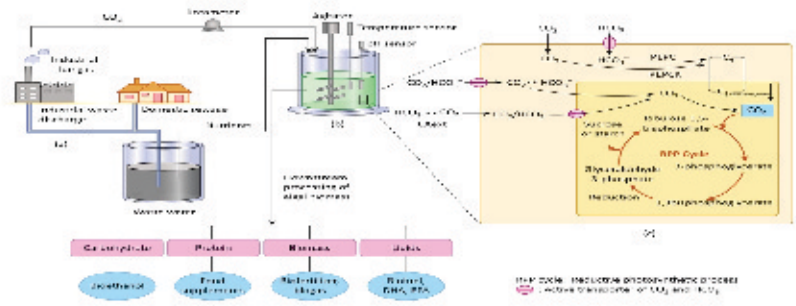
**Dr. Kiran Bala**
Assistant Professor
kiranb@iiti.ac.in

In Biofuels Research lab., we have 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.



(Atreyee Ghosh and Kiran Bala 2017, Carbon concentration in algae: Reducing CO2 from exhaust gas, Trends in Biotechnology, 35 (9), 806-808.)

Following this idea the researchers are exploring various strategies for maximizing lipid content, increasing the rate of cell growth, identifying superior chemical inducers, utilizing metabolic engineering and genomics as well as developing simple and efficient bioreactor systems and raceway ponds, suitable harvesting, lighting, extraction and refinery systems. Optimization of various growth parameters, effects of other pollutants present in wastewater, cost effective algae harvesting and oil extraction technology, mass cultivation in open ponds/ photobioreactors, molecular level studies to understand the mechanism, etc. are some of the major objectives of our research team. All these efforts would help in the identification of alternative renewable source of energy which can maintain environmental and economic sustainability.

**Publications:**

1. Sangwan, P., Sharma, K., Celin, M., Kiran, B., 2018, Maintenance, Conservation, and Regulation of Microbial Resources for Defense Applications, Microbial Resource Conservation, 54, ISBN: 978-3-319-96970-1.
2. Anand V and Kiran B. 2017, Algal Biodiesel: Challenges and Outcomes. Austin Environ Sci. 2017; 2(1): 1016. ISSN: 2573-3605.
3. Ghosh, A., Kiran, B., 2017, Carbon concentration in algae: Reducing CO2 from exhaust gas, Trends in Biotechnology, 35 (9), 806-808.
4. Nisha, R., Kiran, B., Kaushik, A., Kaushik, C.P., 2017, Bioremediation of salt-affected soils using cyanobacteria in terms of physical structure, nutrient status, and microbial activity, International Journal of Environmental Science and Technology, 15(3), 1-10.

5. Kiran, B., Pathak, K., Kumar, R., Deshmukh, D., 2017, Phycoremediation: An eco-friendly approach to solve water pollution problems, In: Microbial Reservoirs edited by Kalia, V.C., Kumar, P., Vol. 1, 3-28.
6. Anand, V., Ghosh, A., Shingdilwar, S., Kumar, R., Kiran, B., 2017, FAME production and fatty acid profiling of microalgae for biodiesel production, Phycologia, 56 (4), 8.
7. Rani, N., Kaushik, A., Sagar, A., Kiran, B., 2017, Halophilism in some indigenous strains of Nostoc from aridisols of Hisar, India, Phycologia, 56 (4), 156.
8. Anand, V., Kiran, B., 2017, Comparison of direct and indirect transesterification for FAME profiling in Chlorococcum sp., Phycologia, 56 (4), 8.

**Approved Grants:**

1. MoES, Delhi funded project, "Innovative and efficient algae based system to reduce carbon dioxide emissions: A possible remedy to climate change " (May, 2018).
2. SERB, Delhi funded project, "An innovative approach for development of an efficient and integrated algae bioenergy production system using biosynthesized nanoparticles" (Feb, 2018).
3. DBT funded project, "Demonstration of sustainable algal biomass production in outdoor environment for cost-effective biofuel production" (March, 2017).

**Awards & Achievements:**

1. SERB Early Career Research Award 2018.
2. Received funding from DBT, Delhi for project entitled "Demonstration of sustainable algal biomass production in outdoor environment for cost-effective biofuel production".
3. International Travel Support by DST, Delhi to attend 11th International Phycological Congress, held at Szczecin, Poland from 13th-19th August, 2017.
4. Hosted Prof. Eric D. van Hullebusch from IHE-Delft, Netherlands under GIAN (Global Initiatives of Academic Networks) program from 5th – 9th March, 2018 to IIT Indore for lectures.
5. Ph. D. student, Ms. Atreyee Ghosh has been awarded the scholarship from EPCO (Environmental Planning and Coordination Organization) as part of the Ph.D. Scholarship Program on Climate Change.
6. Ph. D. student, Mr. Vishal Anand attended a short-term training course on "Advanced Research Technique on Genomics, Proteomics, and Bioinformatics" at NFMC(DBT Centre), Tiruchirappalli (TN) from 7th to 21st November 2017.

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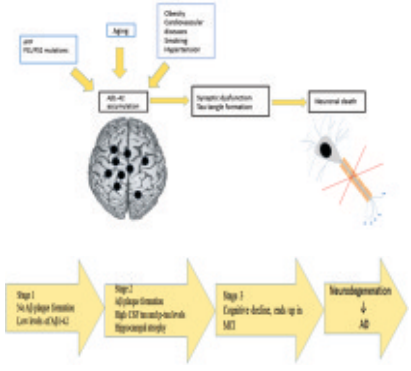
**Dr. Hem Chandra Jha**
Assistant Professor
HoD
hemcjha@iiti.ac.in

Epstein-Barr virus (EBV), also known as Human herpesvirus-4 (HHV4), belongs to Herpesviridae family. EBV popularly known as a tumour virus is associated with Burkitt's lymphoma, gastric carcinoma (GC), nasopharyngeal carcinoma (NPC), etc. Moreover, clinical studies support the association of EBV with neurological disorders like multiple sclerosis and Alzheimer's disease and autoimmune disorders like rheumatoid arthritis. How EBV being an oncogenic virus facilitates complications in the central nervous system, and how it is re-activated in the presence of parasites namely Plasmodium. Therefore, to discover and explain the research aims at finding how EBV with or without bacterial combination or parasites can trigger various chronic diseases.



Factors affecting the accumulation of Aβ1-42 and stages leading to neurodegenerative AD.

*Helicobacter pylori (H. pylori)* is one of the causative agent associated with Gastric Carcinoma. Reports have suggested the involvement of EBV in GC. The studies show report that *H. pylori* and EBV together lead to aggressive GC and drug resistance. We have isolated new strains of *H.pylori* from patients with stomach related disorders. Further, the reports indicate that the growth pattern and infection efficiency of the isolated strains are

different from earlier reported strains. This study will help in dealing with the disease in strain specific manner.

EBV is widely known to manipulate the host immune system and brain microenvironment thereby causing to various neurodegenerative disorders. EBV usually resides in the host B-lymphocytes asymptomatically. It is critically important to study the interaction of immune cells ability to cross the blood brain barrier thereby affecting the normal brain functions. The effect of EBV on brain microenvironment is being investigated with respect to various glial and neural cells. Further, the effect of the virus on early biomarkers for neuronal disorders like MS, AD, and PD is under investigation. The study is performed at cell line, transcriptome, and proteome level.

The research has successfully standardised the invitro Malaria culture. Secondly, as the current scientific literature reports suggest that malarial infection results in EBV reactivation. In this context, process of demonstrating the phenomenon of EBV reactivation through plasmodium infection is being studied.

**Publications (April 2017 to March 2018)**

1- Lang F, Sun Z, Pei Y, Singh RK, Jha HC., Robertson ES. Shugoshin 1 is dislocated by KSHV-encoded LANA inducing aneuploidy. PLoS Pathogen, 2018;14(9):e1007253.

2- Singh, R. K., Lang, F., Pei, Y., Jha, HC., & Robertson, E. S. (2018). Metabolic reprogramming of Kaposi's sarcoma associated herpes virus infected B-cells in hypoxia. PLoS pathogens, 14(5), e1007062.

3- Pandey, S., Jha, HC., Shukla, S. K., Shirley, M. K., & Robertson, E. S. (2018). Epigenetic Regulation of Tumor Suppressors by Helicobacter pylori Enhances EBV-Induced Proliferation of Gastric Epithelial Cells. mBio, 9(2), e00649-18.

4- Singh S, Jha HC*. Optical Imaging with Signal Processing for Non-Invasive Diagnosis in Gastric Cancer: Nonlinear Optical Microscopy Modalities. Advances in Intelligent Systems and Computing. Springer Nature Singapore Pte Ltd. 2018, 748; 609-620. *Corresponding Author.

5- 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.

6- Sonkar C, Jha HC*. Diagnosis of tumorigenesis and cancer. Advances in Intelligent Systems and Computing. Springer Nature Singapore Pte Ltd. 2018, 748; 633-643. *Corresponding Author.

7- 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. *Corresponding Author.

**Grants:**

1. CSIR Grant (2017-2020).
2. IIT Indore- CEERI Pilani grants (2017-2018).

**Awards received :**

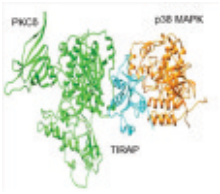
1. Tiwari D, Jhakhmola S, Jha HC. Epstein Barr Virus as an inducer of neurodegeneration. Poster presentation in International Conference, "Emerging Areas in Biosciences and Biomedical Engineering (eBBT) 2018 organized by Indian Institute of Technology, Indore from January 5-6, 2018. Received Best Poster Award.

**Other achievements:**

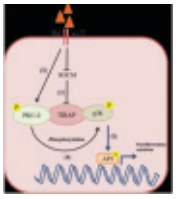
1. Organizing committee member- Industry Academia Conclave 2017 organized at IIT Indore on October 2017.
2. Host Faculty: GIAN- 10 day course on, "How next generation sequencing untying the knot in viral pathogenesis", Oct 22 -Nov 1, 2017.
3. Program Chair- International Conference on Machine Intelligence and Signal Processing December 22-24, 2017 at IIT Indore.
4. Organizing committee member- International conference entitled "Emerging Areas in Biosciences and Biomedical Technologies" (eBBT) Jan 5-6, 2018 at IIT Indore.
5. Organizing committee member- International Conference entitled "Water: Resources, Challenges & Sustainability".

**Dr. Mirza Baig**
Assistant Professor
msb@iiti.ac.in

**Dr. Mirza Baig** received his Ph.D. 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. Currently, he is a Scientist (RLF) at the Centre for Bioscience and Bioengineering. Dr. Baig's research focuses on the role of macrophages in the initiation, progression, and resolution of inflammatory processes. His work is recognized through various international and national awards, including the prestigious DBT- Ramalingaswami Fellowship Award, DST-Ramanujan Fellowship Award, Mirus Research Award, FEBS pre-doctoral award, eCheminfo Award, EMBL International Ph.D. Fellow Award. Dr. Baig has received multiple external funding from different Government bodies including DBT, DST, and CSIR. He has published several research articles in PubMed indexed, peer-reviewed international Journals. He has delivered talks and also presented many posters and papers, in different National and International Conferences.



Heterotrimer complex of PKCδ-TIRAP-P38 in inflammation


Heterotrimer complex of PKCδ-TIRAP-p38 mediated inflammatory response in macrophages

### Publications:

1. Baig MS, Anjali Roy, Uzma Saqib, Sajjan Rajput, Mansi Srivastava, Adnan Naim, Dongfang Liu, Rohit Saluja, Syed M. Faisal, Qiuwei Pan, Gajanan N. Darwhekar, Rajkumar Savai. Repurposing Thioridazine (TDZ) as an anti-inflammatory agent. Scientific report. 12471, 2018.
2. Srivastava M, Baig MS. NOS1 mediates AP1 nuclear translocation and inflammatory response. Biomed Pharmacother. 2018 Mar 29;102:839-847.
3. Adnan N, Qiuwei P, Baig MS. Matrix Metalloproteinases (MMPs) in Liver Diseases. Journal of Clinical and Experimental Hepatology. 2017. 7 (4): 367-372. 11.
4. Baig MS, Dongfang Liu, Kannan Muthu, Anjali Roy, Uzma Saqib, Adnan Naim, Syed M.Faisal, Mansi Srivastava, Rohit Saluja. Heterotrimeric complex of p38 MAPK, PKCδ, and TIRAP is required for AP1 mediated inflammatory response. International Immunopharmacology. 2017.48:211-218.
5. Uzma Saqib, Sutripta Sarkar, Kyoungho Suk, Owais Mohammad, Rajkumar Savai, Baig MS. Phytochemicals as Modulators of M1-M2 Macrophages in Inflammation. Oncotarget 2018; 9:17937-17950.
6. U. Saqib Baig MS. Identifying the inhibition of TIR proteins involved in TLR signalling as an anti-inflammatory strategy, SAR and QSAR in Environmental Research. 2018, 29;4:295-318.

### Grants:

Funding Agency: Science & Engineering Research Board (SERB), Department of Science and Technology.
Funding Amount: INR 51 Lakh, PI: Dr. Mirza Saqib Baig

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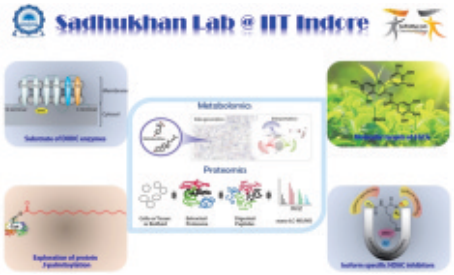
**Dr. Sushabhan Sadhukhan**
Assistant Professor
sushabhan@iiti.ac.in

**Dr. Sadhukhan** directs a young interdisciplinary research group. The lab is interested in deciphering the role of various protein post-translational modifications (PTMs) in physiological and pathological conditions. To date, more than 300 different types of PTMs have been identified, and almost all are correlated with various human diseases including cardiac diseases, diabetes, cancer, and neurodegenerative disorders. Therefore, an in-depth understanding on how and when those PTMs occur is crucial not only for gaining a perception of broad biological processes but also for developing therapeutics for many life-threatening diseases. The lab integrates aspects of chemical synthesis, enzymology, metabolomics and proteomics along with cellular and animal models. The work on uncovering the mechanism of action of

various phytochemicals such as epigallocatechin-3-gallate (EGCG), curcumin, etc. is also progressing. The long-term goal is to develop novel therapeutics (e.g. target-specific small molecules) for the treatment of human diseases.




**Publications:**

1. Indranil De, Sushabhan Sadhukhan*. Emerging Roles of DHHC-mediated Protein S-palmitoylation in Physiological and Pathophysiological Context. Euro. J. Cell Biol. 2018, 97, 319-338. (featured on the journal cover)
2. Nicole A. Spiegelman, Ian R. Price, Hui Jing, Miao Wang, Min Yang, Ji Cao, Jun Young Hong, Xiaoyu Zhang, Pornpun Aramsangtienchai, Sushabhan Sadhukhan, and Hening Lin. Direct Comparison of SIRT2 Inhibitors: Potency, Specificity, Activity-Dependent Inhibition, and On-target Anticancer Activities. ChemMedChem. 2018, 13, 1890-1894.

**Approved Grants:**

1. Identification of the substrates of DHHC palmitoyl acyltransferases by rational design of trifunctional probe and exploration of protein S-palmitoylation; Department of Science & Technology (DST), Govt.of India-ECR-SERB, (2018- 2021).

**Awards:**

1. Early Career Research Award from Department of Science & Technology (DST), Govt. of India, 2018.

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**Dr. Avinash Sonawane**
Associate Professor
asonawane@iiti.ac.in

Tuberculosis, caused by *Mycobacterium tuberculosis* (Mtb), is a serious human disease that infects one-third of the world's population and kills more than 1.5 million people every year. The main reason for problems in curbing Mtb infection are emergence of multidrug-resistant strains, lack of potent multi-target drugs, inadequate vaccine, and the pathogen's ability to avoid elimination by strong host immune responses. The laboratory of Dr. Sonawane studies the molecular, genetic and immunological basis for mycobacterial pathogenesis and its interaction with host cells.

**Research areas**

**I. Mycobacterium Glycobiology**

*Mycobacterium tuberculosis* (Mtb) glycoproteins play a critical role in host-pathogen interactions, antigenicity, and virulence determination, and are, therefore, considered as potential drug and vaccine targets. The cell wall of Mtb dominate sugars and lipids. The recent *In-silico* analysis has predicted more than 200 glycoproteins and glycolipoproteins in Mtb cell wall. Using multilectin glyco-catch system, the group has identified several novel Mtb glycoproteins and glycolipoproteins. Now, the researchers are trying to investigate the role of these glycoconjugates in host-pathogen interactions and modulation of host innate and adaptive immune responses using mice and zebra fish infection models. Some of these proteins were found to be highly antigenic in nature. The group is also exploring them as potential drug and vaccine candidates.

**II. Role of bone marrow stem cells in tuberculosis pathogenesis**: Mtb evolved with a plethora of evasion strategies against host immune responses. It is well established that alveolar macrophages are the primary infection sites for Mtb. However, recent studies have shown that Mtb can also infect and reside in bone marrow stem cells and use them as a safe niche to evade host immune responses. The group is investigating 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.

**III. Host cell epigenomics**: One of the prominent mechanisms employed by pathogenic bacteria to facilitate its survival in host cells involves the induction of epigenetic modifications in the host DNA, histones and RNA. Mtb is known to induce several transcriptional activation and repression epigenetic changes to promote its replication, propagation, and protection from host immune responses. However, very little is known about the dynamics and mechanisms of epigenetic changes during Mtb infection. Here, the group study the molecular mechanisms of epigenetic modifications during Mtb infection and the effect of these modifications on macrophage, stem cells, and T-cell immune functions.

**IV. Drug Delivery:** Over the decades, several anti-TB drugs have been developed. However, due to the emergence of multidrug-resistant (MDR), extremely drug-resistant (XDR) and totally drug-resistant (TDR) Mtb strains most of these drugs have become ineffective. Moreover, Mtb is an intracellular pathogen equipped with a lipid rich cell wall. As a result, most anti-TB drugs are not able to diffuse inside the Mtb cell wall to achieve effective killing. To overcome these challenges, we are synthesizing small compounds, antimicrobial peptides and delivering them at target sites using engineered nanocarriers, quantum dots and MOFs.

**V. Acute Lymphatic Leukemia treatment:** Asparaginases are central to the treatment of acute lymphatic leukemia (ALL), a disease that affects lymphocytes and its precursor cells in the bone marrow. However, current asparaginase drugs show several severe side effects such as immunogenicity, neurotoxicity, low stability and low therapeutic efficacy in relapse ALL. Through protein engineering approach, we have developed novel asparaginase molecules that show better therapeutic efficacy. Our preclinical and pharmacological studies in ALL patient samples and mice models showed that these novel asparaginase molecules exhibit low immunogenicity, neurotoxicity, and high stability. Moreover, these molecules do not bind to pre-existing antibodies present in ALL patients suggesting that these asparaginases can also be used in the treatment of relapse ALL. Now the group plans conduct to perform pharmacokinetic and toxicity studies under GLP facility. Also, we will investigate their therapeutic efficacy using xenograft models.

**Publications:**

1. Sengupta S, Naz S, Das I, Ahad A, Padhi A, Naik SK, Ganguli G, Pattanaik KP, Raghav SK, Nandicoori VK, Sonawane A. (2017) *Mycobacterium tuberculosis* EsxL inhibits MHC-II expression by promoting hypermethylation in class-II transactivator loci in macrophages. J Biol Chem. 292(17):6855-6868.
2. Naik SK, Padhi A, Ganguli G, Sengupta S, Pati S, Das D, Sonawane A. (2017). Mouse Bone Marrow Sca-1+ CD44+ Mesenchymal Stem Cells Kill Avirulent Mycobacteria but Not *Mycobacterium tuberculosis* through Modulation of Cathelicidin Expression via the p38 Mitogen-Activated Protein Kinase-Dependent Pathway. Infect Immun. 85(10). pii: e00471-17.
3. Das I, Padhi A, Mukherjee S, Dash DP, Kar S, Sonawane A. (2017). Biocompatible chitosan nanoparticles as an efficient delivery vehicle for *Mycobacterium tuberculosis* lipids to induce potent cytokines and antibody response through activation of γδ T cells in mice. Nanotechnology. 28(16):165101.
4. Prakash S, Sarangi AN, Alam S, Sonawane A, Sharma RK, Agrawal S. (2017). Putative roleof KIR3DL1/3DS1 alleles and HLA-Bw4 ligands with end stage renal disease and longterm renal allograft survival. Gene. 637:219-229.

**Approved Grants:** Project title: Integrative approach for genomic analysis and drug repurposing of MDR/XDR TB from North-eastern India for better disease interventions. Department of Biotechnology, Govt. of India (2018-2021) (Technically Approved)

1. **Project title:** Pharmacological evaluation of a novel asparaginase used for the treatment of childhood ALL. Board of Research in Nuclear Sciences (BRNS), DAE, Govt. of India (2018-2021). Amount: 33.59 Lakhs
2. **Project title:** To study the role of mesenchymal stem cells in the pathogenesis of tuberculosis in bone marrow. Department of Biotechnology, Govt. of India (2017-2020). Amount: 60.00 Lakhs

**Awards:**

1. Alexander von Humboldt Fellow for Experienced Researcher (2017-2020), Leibniz Center for Medicine & Biosciences, Borstel, Germany
2. Educational Leadership award, Odisha for contribution in promoting education in Odisha state (2017)

# 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

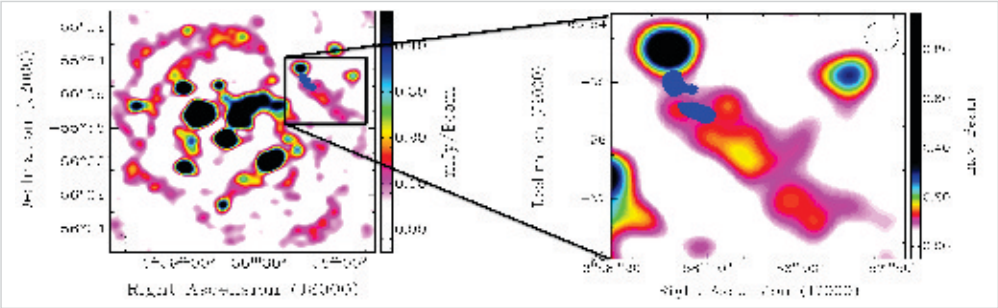
**Dr. Rajesh Kumar**
Associate Professor
Physics

**Dr. Sarika Jalan**
Associate Professor
Physics

**Dr. Sudeshana Chattopadhyay**
Associate Professor
Physics

**Dr. Suman Mukhopadhyay**
Professor
Chemistry

# Centre of Astronomy



### Research Thrust/Facility

- Astrophysics: Modeling, Simulation and Observations
- Radio Astronomy: Instrumentation
- Ionosphere, Space Navigation & Space Weather Monitoring using GNSS & IRNSS
- L-band Radio Interferometer
- RF Measurement & Characterization Facility
- High performance computing

### Application Areas

- Space Electronics, RF/Microwave Devices Testing & Measurement
- Field Programmable Gate array (FPGA) & Software Defined Radio (SDR)
- Space Weather, Sun & Ionosphere
- Spacecraft Control & Navigation
- Galactic & Extragalactic Studies, Cosmology
- Computational Astrophysics, Machine Learning & Big Data

## From the HoD's Desk

**Dr. Abhirup Datta**
Associate Professor
abhirup.datta@iiti.ac.in

The Centre of Astronomy was established in 2015 as an interdisciplinary centre of IIT Indore, in order to promote and promulgate research in Astronomy and Space Sciences. Work being done at the Centre of Astronomy ranges from Space weather / Ionospheric studies, to Novel Materials for Space applications, and from Navigation Systems to the study of high-energy jets from galaxies and stellar-sized objects, compact objects, Active Galactic Nuclei (AGNs), modelling and statistics of the cosmic history of our universe, radio astronomical observations and instrumentation etc. With this wide range of inter-linked and related interests, Astronomy at IIT Indore has grown from a Special Interest Group to a full fledged Centre, with rapidly expanding interdisciplinary research interests, and is now contributing significantly to two consortia / collaborations – the Square Kilometre Array-India Consortium (SKAIC), and Indian Regional Navigation Satellite System (IRNSS), or the NAVIC (NAVigation with Indian Constellation). The Centre now has a regular Ionosphere/Space Weather monitoring facility, high performance computing facilities and radio astronomy instrumentation laboratory. We have started a minor program in Astronomy and an M.Sc. in Astronomy.

# Faculty Members

**Dr. Abhirup Datta**
Associate Professor, HoD
abhirup.datta@iiti.ac.in

**Dr. Siddharth Malu**
Associate Professor
siddharth@iiti.ac.in

**Dr. Bhargav Vaidya**
Assistant Professor
bvaidya@iiti.ac.in

**Dr. Suman Majumdar**
Assistant Professor
suman.majumdar@iiti.ac.in

**Dr. Manoneeta Chakraborty**
DST-Inspire Faculty Fellow
manoneeta@iiti.ac.in

**Dr. Saurabh Das**
DST-Inspire Faculty Fellow
saurabh.das@iiti.ac.in

**Prof. Avinash Deshpande**
Adjunct Professor
desh@iiti.ac.in

**Prof. Hari B. Hablani**
Visiting Professor
hhablani@iiti.ac.in

# Research Areas

## Observational Cosmology

The redshifted HI 21cm line is a promising probe to study the cosmic Dark Ages and Epoch of Reionization. The observational challenges are in removing very bright foregrounds and detect this faint signal in the presence of atmospheric effects and instrumental uncertainties. The research in this group includes cosmological observations at low radio frequency with uGMRT, VLA, ATCA; and in future, SKA. The group's current interest in this field is in foreground characterization and removal from reionization data from radio interferometers, using machine learning techniques like neural networks. The group is also working on using the state-of-the-art radio imaging/calibration algorithms to achieve high dynamic range imaging with low frequency radio data-sets.

The group members are involved in space-based mission proposals submitted to NASA as well as ISRO. The group members are actively involved in important key science projects of the Square Kilometer Array (SKA) as well as it's Indian Consortium.

## Computational Cosmology and Statistical Interference

Cosmology is the study of the history of our universe. However, understanding this history with precision requires a robust interpretation of different cosmological observations. Such interpretation would need state-of-the-art physically motivated simulations of the universe that can model the expected cosmological signal for different observations. Once the observations are done and the models for the observables are ready one would require sophisticated statistical techniques to infer precisely about the 'favoured' model of the Universe's history.

One of the most important missing pictures in this history is the Cosmic Dawn (CD) and the Epoch of Reionization (EoR), the period during which the very first sources of light were formed and thus marked the end of the dark ages. Once the redshifted 21-cm signal (originating from hydrogen atoms) from the CD-EoR is detected, one would require a robust data analysis and interpretation pipeline based on the physical models of the expected signal, to answer the unresolved questions regarding this epoch.

This group's research is presently focused on development of such interpretation pipelines. As the actual signal is yet to be detected, such pipelines need to be trained and tested on simulated signal data sets. A major part of this group's research is focused on the development of detailed but fast computer simulations of the signal, to study different models of the CD-EoR at a relatively low computational cost. Additionally, this group have been studying different statistical estimators (such as the power spectrum, bispectrum, etc.) of the signal to identify its various unique characteristics, which can be used for the confirmative detection as well as for constraining different CD-EoR model parameters. The group is also actively pursuing to apply these statistical tools in the other fields of cosmology to quantify the Large Scale Structures of our Universe. The group leader is an active member of the international science team for modelling and interpretation of the SKA CD-EoR observations. The group leader is also involved in the synergy observations of the CD-EoR using both the SKA (radio) and other upcoming telescopes at infrared wavelengths (e.g. JWST, ELT, Euclid, ALMA etc.).

## Astrophysical Jets

Astrophysical jets are a ubiquitous phenomenon seen in wide variety of astrophysical sources like young stellar objects (YSOs), Active galactic nuclei (AGN), Pulsar wind nebulae (PWNe) etc. Jets and outflows are responsible for removing excess angular momentum from the underlying accretion disk and are believed to be launched and collimated with help of magnetic fields. The study of jets is important as they play a crucial role during the feedback process and are considered to be an efficient source of high-energy particles. One of the major challenges is to connect the microphysical processes responsible for multi-wavelength emission to macro-physical bulk plasma flow.

This group aims to develop a synthetic observatory and create templates using numerical simulations that can predict and/or verify various features observed using existing and upcoming observatories like

ALMA, LOFAR, SKA, TMT and CTA. For this purpose the group uses PLUTO, an astrophysical fluid dynamics code that is widely used among the international astrophysical community. The group leader is one of the lead developer of PLUTO code.

### Plasma Simulations for Space Weather Modeling

The developments of modern technologies to serve the society are susceptible to extremes of space weather. Exposure of spacecraft and commercial airliners to strong flux of energetic particles from Sun can damage critical electronics and radio communications; Geomagnetic storms can have a drastic impact on GPS navigation. A quantitative framework to predict space weather has therefore become an utmost necessity.

The focus of this group is to build a state-of-the-art tool for simulating plasma processes that are encountered in the Sun-Earth System with a goal of providing predictions for space weather. This tool will provide an ideal complement to the data obtained from Aditya L1, India's first mission to study the Sun.

The group leader is part of the science team for Aditya L1 and an affiliate faculty member at the Center for Excellence in Space Sciences India (CESSI).

### Ionosphere Research with GNSS/NavIC and Space Weather Observations

This group studies the effect of ionosphere in low frequency radio astronomy. We have recently acquired a GNSS receiver to study the ionosphere above Indore, and also acquired two IRNSS receivers from ISRO-SAC. The aim is to study and characterize the ionosphere. There is already a dense grid of GNSS receivers in Northern India. Our proposal will complement that in Central and Western India. This will allow us to predict ionospheric conditions and model them with better precision. In turn, this will help in satellite and aerospace communication as well as making it possible to observe at low radio frequencies. This study will help establish leadership in ionospheric research mainly in context of astronomical observations. India's role in SKA (Square Kilometer Array) can be used to share this information with the upcoming state-of-the-art largest radio telescope in the world.

### Pulsars

Pulsars, often described as Cosmic Light-houses, are believed to be strongly magnetized, fast rotating neutron stars, with over 2000 discovered in our Galaxy so far. In the long march towards the elucidation of the mysterious ways of pulsars, the group strives to decipher their intriguing pulse-to- pulse variations, seeking clues on the yet poorly-understood mechanism of coherent radio emission. This necessitates high time resolution multi-frequency observations of individual pulses, using some of the most sensitive radio telescopes in the world, and employing novel hardware and software techniques, to extract and interpret underlying key messages. Apart from using pulsars as a probe of the intervening interstellar medium, we also exploit the imprint of the some propagation effects to search for the elusive unpulsed component of their radiation, and study the spectacular nebulae, resulting from the interaction of the collimated particle and radiation beams with the surroundings.

### Galaxy clusters and cluster mergers - X-ray studies, diffuse radio emission and SZ effect

This group studies mergers or collisions between clusters of galaxies in X-ray and radio wavelengths, which leads to copious amounts of radio emission, with a characteristic power law spectrum, in order to gain insight into particle acceleration.

They also study inverse Compton scattering of cosmic microwave background photons from galaxy cluster electrons – known as the Sunyaev-Zeldovich Effect (SZ effect), as a way to characterize pressure structures. With X-ray observations of thermal plasma and radio observations of non- thermal plasma in clusters, it is possible to characterize the energy distribution of the galaxy cluster plasma. This is the aim of SZ effect observations at cm-wavelengths – these are the lowest frequencies at which SZ effect can be measured. This group is actively involved in observations with the JVLA, uGMRT, ATCA, etc.

### Neutron Stars, Magnetars, Pulsars: High Density, Strong Gravity

Neutron stars are extremely dense compact objects whose core reaches supranuclear densities thereby

offering ideal laboratories to probe strong gravity and the properties of supranuclear matter. The group studies the accretion by such compact objects in binary systems and investigate their radiative properties and variabilities. Several spectral and timing features like thermonuclear bursts, burst oscillations, jets, Quasi-periodic oscillations are studied to probe exotic neutron star conditions. Multi-wavelength observations spanning radio to X-ray wavebands are carried out to pursue the above science goals. A subset of neutron stars called pulsars display highly coherent periodic intensity variations. They exhibit a typical magnetic fields of 1012 – 1014 G while magnetars have magnetic fields of 1014 – 1015 G. Flares observed from magnetars carry signatures of evolving complex magnetic field and the ways it impacts the neutron star crust. Emission and absorption lines generated via the proton cyclotron resonance process are studied to probe the complex magnetic field morphology.

### Radio Astronomy instrumentation

Development of optimal instrumentation and of novel techniques in image and signal processing, assessed at times with detailed simulations, facilitates incisive investigation, in the presence of inherent random noise and the consequent uncertainties. Major initiatives are on, in terms of large optimized surveys to search for pulsars (using the GMRT & Gauribidanur Telescope), as well as to detect sub-second timescale radio transients (using the Arecibo & Green-Bank telescopes), such as the mysterious Fast Radio Bursts (FRBs). These involve not only computational challenges in the processing of voluminous data but also demand sophisticated detection and assessment strategies to desirably bring out faint signals often buried in inherent noise background and man-made Radio Frequency Interference.

The Centre has received funds from DST-SERB to make a 4-element radio interferometer at L and C bands. The idea is to use reconfigurable hardware that uses FPGAs (Field Programmable Gate Arrays) in order to 'program' a Spectrometer and a Correlator, following CASPER (Collaboration for Advanced Signal Processing and Electronics Research) tools; thus, a simple RF frontend and a sophisticated Digital Backend can be combined to form a working radio telescope. The RF lab also helps characterize RF properties of novel materials.

### Navigation, Spacecraft and Payload Pointing and Control

Remote sensing satellites have payloads which scan land, ocean, and space and probe the atmosphere, but the satellites' platform motion interferes with the spatial registration of remote sensing images. One objective of this research is to minimize this interference and meet stringent pointing requirements. The second objective is to develop algorithms for navigation of flight vehicles using the Indian Navigation system, NavIC.

### Radio Remote Sensing

The advent of satellite based remote sensing has completely changed how we understand our environment. Earth's environment and it's interaction with microwaves have significant influence in space and atmospheric studies. The interaction is the source of information for remote-sensing techniques, but is a serious concern for satellite based navigation and communication systems. Another important issue in space and atmospheric science is the flood of data from different sensors, both ground based and satellite based. The interpretation of the data not only required physical understanding of the medium, but also need sophisticated analysis techniques to handle large heterogeneous data coming in different format and with different spatial, temporal as well in various frequencies. Machine learning and Big data applications in these domain is another area of research thrust of this group. The study is directly related to the ISRO's activity and carried in collaboration with ISRO, MoES and DST.

The main thrust areas of research of this group are:

1. Satellite communication and remote sensing of the environment
2. Satellite based navigation and ionospheric research
3. Machine learning and Big data challenges in space and atmospheric sciences

# Publications 2017-2018

1. Manoneeta Chakraborty, Yunus Emre Bahar and Ersin Gogus, Time and energy dependent characteristics of thermonuclear burst oscillations, The Astrophysical Journal, 851, 79, 2017
2. Bhargav Vaidya, Andrea Mignone, Gianluigi Bodo, Paola Rossi, Silvano Massaglia, A Particle Module for the PLUTO code: II - Hybrid Framework for Modeling Non-thermal emission from Relativistic Magnetized flows, The Astrophysical Journal, 2018
3. Chaudhury, Madhurima; Datta, Abhirup, Foreground Subtraction and Signal reconstruction in redshifted 21cm Global Signal Experiments using Artificial Neural Networks, Astronomical Union Proceedings Series, 2017
4. 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
5. Andrea Mignone, Gianlugi Bodo, Bhargav Vaidya, Giancarlo Mattia, A Particle Module for the PLUTO Code: I - an implementation of the MHD-PIC equations, The Astrophysical Journal, vol. 859, pp. 13, 2018
6. Hallman, Eric, J.; Alden, Brian; Rapetti, David; Datta, Abhirup; and Burns, Jack.O., Probing the Curious Case of a Galaxy Cluster Merger in Abell 115 with High Fidelity Chandra X-ray Temperature and Radio Maps, The Astrophysical Journal, 2018
7. Panda, B., and Hablani, H. B, Spacecraft Attitude Dynamics and Control and Attitude Estimation Using GPS - OceanSat-2 (ISRO), Third International Conference on Advances in Control & Optimization of Dynamical Systems (ACODS), 2018
8. Siddharth Malu, Abhirup Datta, Sergio Colafrancesco, Paolo Marchegiani, Ravi Subrahmanyan, D Narasimha and Mark H. Wieringa, Relativistic inverse Compton scattering of photons from the early universe, Scientific Reports, vol. 7, article 16918, 2017
9. Aveek Sarkar, Bhargav Vaidya, Soumitra Hazra, Jishnu Bhattacharyya, Simulating coronal loop implosion and compressible wave modes in a flare hit active region, The Astrophysical Journal, vol. 851, pp. 120, 2017
10. Althaf, A., and Hablani, H. B, Performance Assessment of Indian Regional Navigation Satellites System and Stationary Receiver, ISRO Space Applications Center, 2017
11. Datta, Abhirup; Chakraborty, Sumanjit, Effects of Ionosphere and Troposphere on Sensitive Radio Observations from 70 MHz to 24 Ghz., URSI General Assemby Proceedings, vol. 32, pp. 2342, 2017
12. Bhargav Vaidya, Deovrat Prasad, Andrea Mignone, Prateek Sharma, Luca Rickler, Scalable explicit implementation of anisotropic diffusion with Runge–Kutta–Legendre super-time stepping, Monthly Notices of the Royal Astronomical Society, Volume 472, Issue 3, 2017, Pages 3147–3160
13. Eda Vurgun, Manoneeta Chakraborty, Tolga Guver and Ersin Gogus, Variable Absorption Line in XTE J1810-197, New Astronomy, 2018
14. 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
15. Althaf, A., and Hablani, H. B, Performance Assessment of Indian Regional Navigation Satellites System and Stationary Receiver, ISRO Space Applications Center, 2018
16. Sreeja, S, and Hablani, H. B., Airborne Infrared and Millimeter-Wave Radar Dual Sensor Design for Ground Targets in Snow, Paper No. 2228 (accepted), IEEE Aerospace Conference, March 2019
17. S. Das, M. Chakraborty and S. Chakraborty, Some studies of Ka Band Rain Fade Slope at a Tropical

Location of India, IEEE Antennas and Wireless Propagation Letters, under review, October 2018. (I.F. 3.448)

18. S. Chakraborty, M. Chakraborty and S. Das, Experimental studies of rain attenuation over tropical and Equatorial regions-A Brief Review, IEEE Antennas and Propagation Magazine, under review, September 2018.( I.F. 3.007)
19. Rajesh Mondal, Somnath Bharadwaj, Ilian T. Iliev, Kanan K. Datta, Suman Majumdar, Abinash K. Shaw and Anjan K. Sarkar, A method to determine the evolution history of the mean neutral Hydrogen fraction, Accepted for publication in the Monthly Notices of the Royal Astronomical Society: Letters, (in press), arXiv: 1810.06273 (2018)
20. Sambit K. Giri, Anson D'Aloisio, Garrelt Mellema, Eiichiro Komatsu, Raghunath Ghara, Suman Majumdar, Position-dependent power spectra of the 21-cm signal from the epoch of reionization, Accepted for publication in the Journal of Cosmology and Astroparticle Physics, (in press), arXiv:1811.09633 (2018)

## Notable Achievements of 2017-2018

- The Minor Program in Astronomy was approved in 2016, and the first course in the program started in July 2017.
- The M.Sc. program in Astronomy is now offered from July 2018. With the in-take through JAM Physics exam, eight (8) students enrolled for this program in July 2018.
- Astronomy currently has 17 Ph.D. students, of which eight (8) are in the first-year. A majority of our second and subsequent-year students are supported by externally-funded projects from ISRO and SERB, as well as Fellowships from DST.
- The Ph.D. students of the Centre have won a telescope signed by an astronaut in the "IAU 100 hours of Astronomy - Win A telescope" competition. The Centre of Astronomy, IIT Indore is the only academic institute in India to win this award. Only 10 such signed telescopes were awarded worldwide through this competition.
- Three faculty members of the centre, Dr. Siddharth S. Malu, Dr. Abhirup Datta and Dr. Bhargav Vaidya have become members of the International Astronomical Union (IAU) during this period.
- Dr. Vaidya has also received an IAU Travel Grant to attend the Conference on "Peruses in Sicily: From Black hole to Cluster Outskirts" in Noto, Italy during this period and has become an associate member with Inter-University Centre for Astronomy and Astrophysics (IUCAA).
- Dr. Saurabh Das has been elevated to Senior Membership of IEEE during this period.

### Outreach

The Centre of Astronomy at IIT Indore is actively involved in science education and popularization. Skywatch events are being carried out for the students and public. The lunar eclipse observation event on January 31, 2018 saw participation of 150 students from nearly schools in Indore along with the IIT Indore family. Students from schools and colleges in Indore across several disciplines interact with the students and faculty members of the department.

Additionally, we have been offering a variety of projects to students from engineering colleges in Indore, which provide them an exposure to research in Astronomy.

In the future, the Centre plans to expand this initiative, and provide further opportunities for school children, through such skywatch events, as well as lectures and workshops.

# Sponsored Projects

1. **ISRO Sponsored Project**

   Title: ''Retrieval of atmospheric water vapor from NavIC/GAGAN data and prediction of extreme weather events based on machine learning techniques''

   Sponsoring Agency: ISRO (Indian Space Research Organization) PI: Dr. Saurabh Das

   Amount: INR 43.92 Lakhs

2. **DST-INSPIRE Faculty Fellowship Research Grant**

   Title: ''Integrated studies of cloud-aerosol-precipitation system in the Indian region in a climate change scenario''

   Sponsoring Agency: DST (Department of Science and Technology) PI: Dr. Saurabh Das

   Amount: INR 35 Lakhs

3. **CSIR Research Grant**

   Title: ''Synthetic Observatory for X-shaped radio galaxies''. Sponsoring agency: CSIR (Council for Scientific and Industrial Research) PI: Dr. Bhargav Vaidya; Co-PI: Dr. Abhirup Datta.

   Amount: INR 20 Lakhs

4. **DST-INSPIRE Faculty Fellowship Research Grant**

   Title: "Probing the extreme physics around compact objects in binary and isolated systems through investigations of their burst and outburst behavior"

   Sponsoring agency: DST (Department of Science and Technology) PI: Dr. Manoneeta Chakraborty

   Amount: INR 35 Lakhs

5. **Early Career Research Grant**

   Title: "Unveiling Mergers of Galaxy Clusters with Radio Halos/Relics: Using High Fidelity Radio and X-ray Observations"

   Sponsoring Agency: DST (Department of Science and Technology) PI: Dr. Abhirup Datta

   Amount: INR 50 Lakhs

6. **ISRO Research Grant**

   Title: "Differential NavIC & GAGAN aided Inertial Navigation with Applications to Land, Air and Space Vehicles"

   Sponsoring Agency: ISRO (Indian Space Research Organization) PI: Dr. Abhirup Datta; Co-PI; Prof. Hari Hablani Amount: INR 37 Lakhs

7. **DST-SERB Research Grant**

   Title: ''C and L-Band Interferometer as Galaxy Cluster Observatory Pathfinder'' Sponsoring Agency: DST (Department of Science and Technology)

   PI: Dr. Siddharth Malu ; Co-PIs: Dr. Abhirup Datta, Dr. Somaditya Sen

   Amount: INR 83 Lakhs

# Scientist Profiles

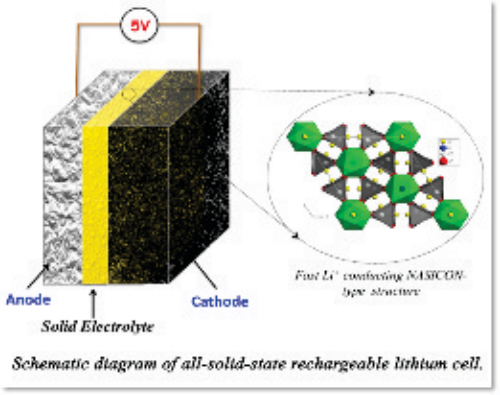
**Dr. Sunil Kumar**
INSPIRE Faculty
sunil@iiti.ac.in

PhD: Indian Institute of Science Bangalore

Visiting Researcher: Polytechnic University of Catalonia- Barcelona, Spain

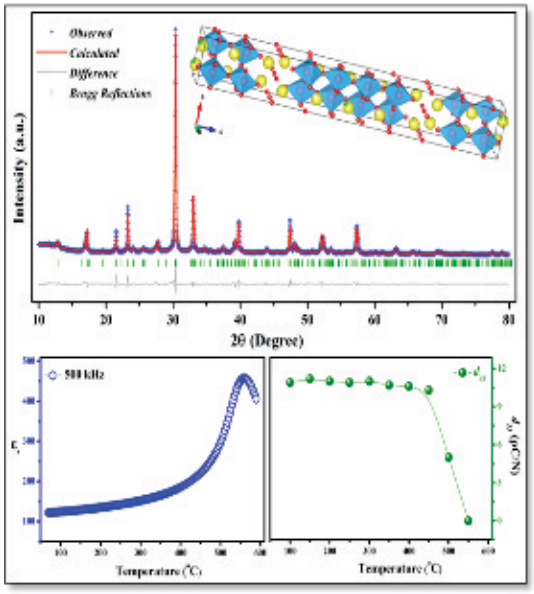
Research Fellow: National University of Singapore

Dr. Sunil Kumar is working as an INSPIRE Faculty in the Discipline of Metallurgy Engineering and Materials Science at IIT Indore since November 2015. He is leading the Solid State Ionics group, and his group's main focus is on the development of solid electrolytes as a mean to have safer, cheaper, and better performing electrochemical energy storage systems. In this regard, they have been systematically investigating various oxides and phosphates to be used as the lithium ion conducting membrane in rechargeable batteries employing metallic lithium as the high capacity anode and spinel structured materials as the high voltage cathode.



*Schematic diagram of all-solid-state rechargeable lithium cell.*

Apart from DST INSPIRE Faculty Research grant ~ 35,00,000/- INR for a project on solid electrolytes, Dr. Kumar has received Early Career Research grant worth over 47,00,000/- from DST-SERB for 3 years on the project titled "Compositionally and Microstructurally Engineered Lead¬-Free Ceramics for Piezoelectric Applications." This project deals with the experimental investigations of structure–property–processing relationship in perovskite structured lead-free piezoceramics. Recently, Dr. Kumar's group designed lead-free materials with good piezoelectric coefficient $d_{33}$ by shifting the rhombohedral-tetragonal polymorphic phase boundary near room-temperature. The high Curie temperature ~ 380°C makes such materials attractive for piezoelectric devices operating at high temperatures. Further, a new lead-free ferroelectric Aurivillius phase, $K_{0.5}Gd_{0.5}Bi_4Ti_4O_{15}$, was synthesized using a sol-gel route. This material exhibited a high Curie temperature of 560°C and a nearly stable piezoelectric charge coefficient ($d_{33}$) 11 pC/N (with piezoelectric voltage coefficient, $g_{33}$, $9.610^{-3}$ Vm/N; measured at 110 Hz & 0.25 N) up to 450°C. The incidence of piezoactivity at such high temperatures in $K_{0.5}Gd_{0.5}Bi_4Ti_4O_{15}$ is a distinct advantage over perovskite-based materials where the lower values of depolarization temperature limit their use in piezoelectric applications typically below 200°C.




Dr. Kumar is supervising currently 2 Ph.D. students for their doctoral theses works at present and successfully guided one postgraduate student for his M. Tech. thesis work. At IIT Indore Dr. Kumar has published more than 42 research articles in reputed peer-reviewed international journals and conference proceedings. More details about his research interest and research group can be found at: http://iiti.ac.in/people/~sunil/

**Award: (June 2017): Early Career Research Award**

Publications (April 2017 - March 2018):


[1] T. Pareek, B. Singh, S. Dwivedi, A.K. Yadav, Anita, S. Sen, P. Kumar, S. Kumar, Ionic conduction and vibrational characteristics of Al3+ modified monoclinic $LiZr_2(PO_4)_3$, Electrochim. Acta, 263 (2018) 533-543.

[2] V. Ramar, S. Kumar, S.R. Sivakkumar, P. Balaya, NASICON-type $La^{3+}$substituted $LiZr_2(PO_4)_3$ with improved ionic conductivity as solid electrolyte, Electrochim. Acta, 271 (2018) 120-126.

[3] D. Kumar, B. Singh, S. Kumar, P. Kumar, Phonon dynamics in $LiZr_{1.9}Al_{0.1}(PO_4)3$. A temperature dependent Raman study, AIP Conf. Proc., 1942 (2018) 140035.

[4] M. Kumar, A.K. Yadav, Anita, S. Sen, S. Kumar, Lithium-ion conduction in sol-gel synthesized $LiZr_2(PO_4)_3$ polymorphs, AIP Conf. Proc., 1942 (2018) 140026.

[5] T. Pareek, S. Dwivedi, S. Kumar, $LiSnZr(PO_4)_3$: an excellent room temperature ionic conductor (under review)

[6] E. Poonia, M.S. Dahiya, V.K. Tomer, K. Kumar, S. Kumar, S. Duhan, Humidity sensing behavior of tin-loaded 3-D cubic mesoporous silica, Physica E: Low-dimensional Systems and Nanostructures, 101 (2018) 284-293.

[7] G. Bajpai, T. Srivastava, F. Husian, S. Kumar, S. Biring, S. Sen, Enhanced red emission from Fe/Si co-doped ZnO nano-particles, Scripta Mater., 144 (2018) 27-30.

[8] A.K. Yadav, P. Rajput, O. Alshammari, M. Khan, G. Kumar, S. Kumar, P.M. Shirage, S. Biring, S. Sen, Structural distortion, ferroelectricity and ferromagnetism in $Pb(Ti_{1-x}Fe_x)O_3$, J. Alloys Compd., 701 (2017) 619-625.

[9] A.K. Yadav, S. Kumar, V.R. Reddy, P.M. Shirage, S. Biring, S. Sen, Structural and dielectric properties of $Pb_{(1-x)}(Na_{0.5}Sm_{0.5})_xTiO_3$ ceramics, J. Mater. Sci. - Mater. Electron., 28 (2017) 10730–10738.

[10] A.K. Yadav, Anita, S. Kumar, A. Panchwanee, V.R. Reddy, P.M. Shirage, S. Biring, S. Sen, Structural and ferroelectric properties of perovskite $Pb_{(1-x)}(K_{0.5}Sm_{0.5})_xTiO_3$ ceramics, RSC Adv., 7 (2017) 39434-39442.

[11] T. Srivastava, A. Sadanandan, G. Bajpai, S. Tiwari, R. Amin, M. Nasir, S. Kumar, P.M. Shirage, S. Biring, S. Sen, $Zn_{1-x}Si_xO$: Improved optical transmission and electrical conductivity, Ceram. Int., 43 (2017) 5668-5673.

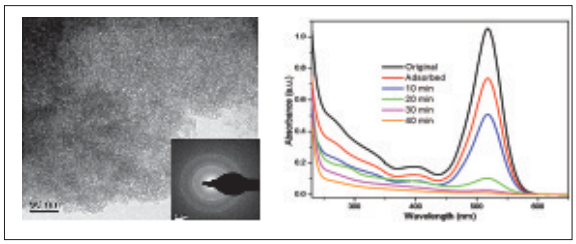
[12] T. Srivastava, G. Bajpai, N. Tiwari, D. Bhattacharya, S.N. Jha, S. Kumar, S. Biring, S. Sen, Opto-electronic properties of $Zn_{(1-x)}V_xO$: Green emission enhancement due to V4+ state, J. Appl. Phys., 122 (2017) 025106.

[13] M. Nasir, N. Patra, M.A. Ahmed, D.K. Shukla, S. Kumar, D. Bhattacharya, C.L. Prajapat, D.M. Phase, S.N. Jha, S. Biring, S. Sen, Role of compensating Li/Fe incorporation in $Cu_{0.945}Fe_{0.055-x}Li_xO$: structural, vibrational and magnetic properties, RSC Adv., 7 (2017) 31970-31979.

**Dr. Archana Chaudhary**

Scientist DST WOS-A
Chemistry
archana@iiti.ac.in


**Design and development of metal/metal oxides nano particles and their catalytic applications**




The main aim of this project is to design and develop better metal/metal oxides nanoparticles for catalytic and photocatalytic applications. Since knowledge of structural and bonding aspects of the molecular precursors is essential for the rational material designing, there is also a great emphasis on the structural characterization of newly synthesized single-source molecular precursors (SSMPs).

First, SSMPs are synthesized by the reaction of metal salt with suitable chelating ligand and characterized using sophisticated instruments such as- Single crystal XRD, FT-NMR, ESI-mass, etc. These precursors are used for the controlled synthesis of metal/metal oxides nanoparticles which are further tested for the catalytic applications.

**Publications:**


1. A. Chaudhary, A. Mohammad, and S. M. Mobin, Mater. Sci. Eng. B, 2018, 227, 136-144.
2. A. Mohammed, S. N. Ansari, A. Chaudhary, K. Ahmed, R. Rajak, and S. M. Mobin, ChemSelect, 2018, 3, 5733-5741.
3. A. Chaudhary, A. Mohammad, and S. M. Mobin, Cryst. Growth & Des., 2017, 17, 2893-2910.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## Dr. E. G. Rini

DST Women Scientist A
MEMS
egrini@iiti.ac.in

Ph.D. in Physics (2007) Barkatullah University, Bhopal


Project Investigator: First principle studies and synthesis, characterization, physical properties of multiferroic $RFeO_3$ (R=Bi, Ga, La, Nd)

Sanction Order No and Date: SR/WOS-A/PM-99/2016 (G) and 22-08- 2017, Total Cost: INR 30.15 Lakhs.

Principal Investigator: Dr. Somaditya Sen

Postdoctoral Fellow: 1st April 2015 to 30 June 2016.

Principal Investigator: Dr. Somaditya Sen

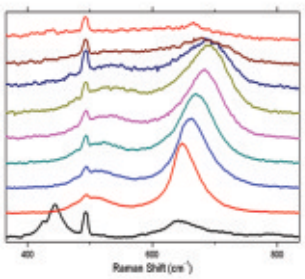
Teaching: 5 years in Govt. Holkar Science College, Indore as Visiting Assistant Professor (2010-2014).

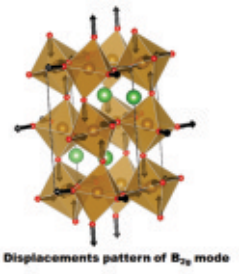
Academic Honors: MP Young Scientist Award in Physics in 2003.

Award of Senior Research Fellowship Sponsored by Council of Scientific and Industrial Research (C.S.I.R), New Delhi, India of the Year 2004.

Present Work: Synthesis, Structural, Magnetic, Opto-Electronic and Electrical properties of multiferroic $RFeO_3$. Microscopic origin of material properties, Response to various thermodynamic conditions,

First-principle density functional theory (DFT) calculations, Multifunctionality tests Rare-earth orthoferrites $RFeO_3$ are important functional materials and are promising due to their use in advanced technologies. They have extensive applicability due to their unique magnetic properties. Spin reorientation, spin canting, ultra-fast spin switching, magneto-optical, magnetization reversal, etc. are critically important problems of investigation in these materials. Spin reorientation is important because this transition is closely related to excellent coupling between electric and magnetic orders. Control of the electric polarization with the help of a magnetic field or control of magnetization by an electric field are novel features of these magnetoelectric multiferroics.




**Important Publications:**

- Phonon dynamics of lanthanum manganite $LaMnO_3$ using an interatomic shell model potential, E. G. Rini, Mala N. Rao, S. L. Chaplot, N. K. Gaur, and R. K. Singh, Physical Review B Vol. 75, 214301, 2007.

**Book Chapter**

- E. G. Rini, N.K. Gaur, Vilas Shelke, M.P. Verma & R.K. Singh, Cohesive and Thermal Properties of Colossal Magnetoresistive $La_{0.88}Sr_{0.12}MnO_3$, in "Phonons in Condensed Materials" eds. S. P. Sanyal and R. K. Singh, (Allied, New Delhi, 2004), p.352.

**Recent Publications:**


- Gaurav Bajpai, Tulika Srivastava, Mohd. Nasir, Saurabh Tiwari, Shubhra Bajpai, E. G. Rini, Sajal Biring, Somaditya Sen, "A Comprehensive Theoretical and Experimental study on Structural and Mechanical Properties of Si doped ZnO", Scripta Materialia, Vol.135, 1-4, 2017.
- Tulika Srivastava, E.G., Rini, Ashutosh Joshi, Parasharam Shirage and Somaditya Sen, ''Structural distortion and bandgap increment in nanocrystalline wurtzite Si substituted ZnO'', Journal of Nanoscience and Nanotechnology, Vol. 17, 1356-1359, 2017.
- Gaurav Bajpai, Mohd. Nasir, E. G. Rini, Pritpal K. Sandhu, Siddharth Malu, Sunil Kumar, Parasharam M. Shirage, and Somaditya Sen, "Structural and Mechanical Characterization of Si Doped ZnO", Journal of Nanoscience and Nanotechnology Vol. 17, 1806–1812, 2017.
- Nasima Khatun, E. G. Rini, Parasharam Shirage, Parasmani Rajput, S. N. Jha and Somaditya Sen, ''Effect of lattice distortion on bandgap decrement due to vanadium substitution in $TiO_2$ nanoparticles'', Materials Science in Semiconductor Processing, Vol. 50, 7, 2016.

**Dr. Abhijeet Joshi**

INSPIRE Faculty

abhijeet.joshi@iiti.ac.in


**Research Areas:** Drug delivery, Biosensors, Theranostics, Biomaterials

**1. Novel Polymeric Biomaterials:**

Development of polymers is useful for implantation and for drug delivery inside the human body. Several drugs cannot be delivered inside the body owing to their low bioavailability and or greater toxicity. For such drugs, newer methods of delivery and newer biomaterials, or polymers carriers need to be investigated.

**2. Biosensors**

Optical Biosensors for common clinically present analytes which are important for diagnosis of diseases and health monitoring. Till date, now several projects dealing with glucose, lactate, urea, uric acid, cholesterol biosensors using fluorescence assay have been standard. The method used analyte specific enzyme based fluorescent detection of catalytic reaction.

The method has ample scope for developing cheap point of care devices in rules India. The health services can be improved by offering cheap diagnostic devices for biomarkers and drugs. The platform of analyte detection can be easily transformed into other related areas of food, fermentation industry, antibiotic production, space medicine, exercise, and health monitoring.

**3. Stimuli Responsive Drug Delivery**

Stimuli responsive drug delivery is a area with tremendous potential. With the scarcity of new drugs in health care all current treatment methods and drugs need to be used to their potential. This can be brought about by bringing spatial and temporal control over drug release by passive and active targeting. Another way is to deliver drugs based on stimuli (heat, light, pressure, chemical, pH, NIR light, magnetism, etc).

**4. Implantable Devices esp. Implantable Biosensors**

Implantable biosensor based on NIR radiations allows for concepts such as the smart tattoo to be practically realized. The smart tattoo concept describes the possibility of implanting sensing assay under the skin and then measuring the in vivo clinical analytes by having an analyte specific biological recognition element in close proximity to fluorophore. This project aims to develop implantable biosensors.

**5. Theranostics: Diagnostics, Imaging and Therapeutics**

Theranostics refers to the merger of diagnostics and theranostics. It is imperative that both need to be coupled in a single system to better understand of patient wellbeing. Patient health can be monitored or treated effectively with minimal side effects by coupling diagnosing machinery to drug delivery devices.

Such systems can serve multiple functionalities (biosensing, drug delivery, imaging, etc).

**6. Interdisciplinary Research:**

In areas relating to biosensors and pharmaceutical sciences, biology and engineering and can be used to develop useful applications. For instance this approach develop biological detecting assays for clinical analytes and biochemical compounds such as metabolites, toxins, xenobiotics, drugs, plant compo.

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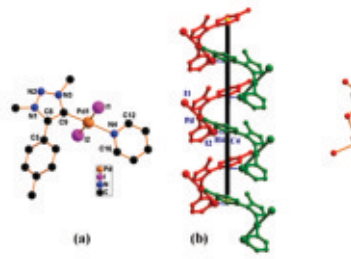
**Dr. Sanjay Kumar Verma**

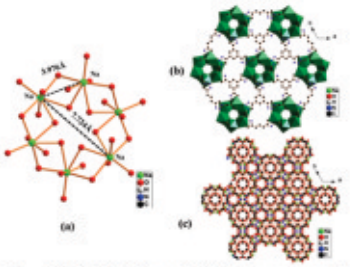
National Post-Doctoral Fellow, Chemistry
sanjaykv@iiti.ac.in
Ph.D.: The Maharaja Sayajirao University of Baroda

**Organometallic Based MOFs: Synthesis, Structures and Properties**

**Dr. Sanjay Verma** conducts research on Organometallic metal frameworks, mesoionic carbene, single crystal to single crystal transformation in organic and inorganic molecules, synthesis of organic/organometallic ligand and their metal complexes, gas storage and catalytic properties of MOFs etc. Metal complexes of the monodentate palladium (II) of N-heterocyclic carbene containing 1,2,3-triazole ligand has been synthesised used in selectively localizing to the endoplasmic reticulum (ER) domain in live cells as well as anti-cancer agent respectively. Only a few mesoionic carbene (MIC) ligands possessing a metal centre at MIC donor have been reported in the literature. Organometallic metal complexes are very less studies for their selective labelling of organelles in live cells.



(a) Perspective view of **1** (b) Helical view of **1** via intermolecular I2···H4−C4 interactions.



In **Na-MOF1**, each Na(I) site exists with coordination number 7.

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**Dr. Sivakumar Gangala**

Post Doctoral Fellow
Chemistry
sivakumargangala
@iiti.ac.in

**Dr. Sivakumar Gangala** has been a Postdoctoral Fellow since February-2017 in Prof. Rajneesh Misra's research group. He completed his Ph.D. under the supervision of Prof. V. Jayathirtha Rao from the Indian Institute of Chemical Technology, Hyderabad. In February - 2015, he moved to UNICAMP, Brazil for his post-doctoral studies with Dr. Ana Flavia Nogueira on design, synthesis, and characterization of non-fullerene acceptors for organic bulk heterojunction solar cells. Currently, his research focuses on the design, synthesis, and characterization of hole and electron transporting materials for perovskite solar cells.

**Ongoing project:** "Novel Fullerene Derivatives as Electron Transport Materials for Inverted Perovskite Solar Cells"; Funding agency: SERB; Amount: INR 19.2 Lakhs

**Publications under this project:** Review article "Spiro-linked organic small molecules as hole transport materials for perovskite solar cells" J. Mater. Chem. A, 2018, 6, 18750–18765.

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**Dr. Sonali Bhagwat**

Post Doctoral Fellow
BSBE
sonalibhagwat@iiti.ac.in

**Dr. Sonali Bhagwat** recieved her Ph.D. from the National Institute for Research in Reproductive Health, Mumbai. She has been actively involved in employing various proteomics-based techniques for the identification of novel proteins that may be contributing to embryo-endometrial adhesion during endometrial receptivity period in humans. Currently, a recipient of a post-doctoral fellowship from Department of Biotechnology, New Delhi in Dr. Amit Kumar's lab, BSBE; she is working on proteomics-based method development for the identification of putative substrates of various proteases with a special focus on Thrombin and Mannose Binding Lectin associated serine proteases (MASPs). She has been able to identify at least nine hitherto unreported substrate of thrombin using the N-terminal peptide modification technique followed by peptide sequencing. Efforts are underway to identify substrates of MASPs to augment the present understanding of the alternate complement pathway of the immune system.

## Recent Publication:

S.R. Bhagwat, K. Hajela, A. Kumar, Proteolysis to Identify Protease Substrates: Cleave to Decipher, Proteomics. (2018) 1800011. doi:10.1002/pmic.201800011.

1. Project Title: **SB/FT/CS-123/2014**
   Synthesis and properties of fluorescent (6-arene) Ru- and (5-C5Me5)Rh/ Ir- complexes based on chromene derivatives and their bio-catalytic activity

2. PI (Name & Address): Dr. Radhe Shyam Ji
   Young Scientist - SERB Discipline of Chemistry
   Indian Institute of Technology Indore
   Khandwa Road, Simrol, Indore-453552, MP, India

3. Mentor (Name & Address): NA

4. Broad area of Research: Chemical Sciences
4.1 Sub Area Inorganic and Organometallic Chemistry

5. Approved Objectives of the Proposal:

The work focuses on synthesis of ferrocene-substituted acetylenes with metal carbonyls due to their redox chemistry and general robustness under most reaction conditions, resulting in the synthesis of several new ferrocenyl containing metal cluster compounds. The research has investigated the reaction of (Z)-1-ferrocenyltelluro-1-ferrocenyl-4-ferrocenyl-1-buten-3-yne (tellurium ene-yne) with Os3(CO)12. Here, i) the generation of a metallabenzene unit resulting from the orthometallation of a ferrocene Cp-ring, and ii) an unusual intramolecular rearrangements of Te and ferrocene, including migration of H atom (orthometallation of ferrocene) along with C-C complexation to form 6- and 5- membered cyclometallated rings with intact Os3-triangle in the reaction of same tellurium ene-yne with [Os3(CO)12] have been described.

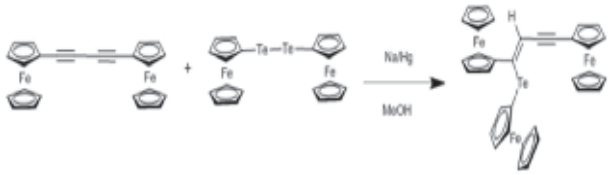
The current work will be carried out as per the following major objectives.

- To design new ligands based on Tellurium based ene-yne system.
- To synthesise new method for the synthesis of multimetallic complexes and their complete spectroscopic characterization as well as structure determination.
- Understanding of theoretical and mechanistic perceptive of formed complexes.

Date of initiation: 19th December 2015 The total cost of Project: 32,00000.00

**6. Methodology:**

**Scheme 1: Te-ene-yne ligand preparation**



The ligand Z)-1-ferrocenyltelluro-1-ferrocenyl-4-ferrocenyl-1-buten-3-yne have been prepared by reaction of diferrocenylbutdiyne and diferrocenyl ditelluride **(Scheme 1)**. These Tellurium based ene-yne ligand have been examined with various metal carbonyl such $Fe(CO)_5$ and $O_{s3}(CO)_{12}$. Their transition metal complexes characterized by various spectroscopic methods ($^1H$, $^{13}C$ NMR) , mass , IR spectroscopy and single crystal X-ray diffraction analysis.

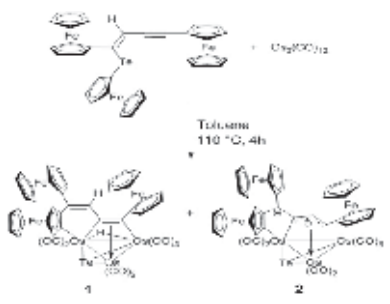
**7. Salient Research Achievements:**

**7.1 Summary of Progress**

**Work**

**(A) Synthetic of orthometallated ferrocene based Osmium carbonyl clusters by reaction with Z)-1-ferrocenyltelluro-1-ferrocenyl-4-ferrocenyl-1-buten-3-yne and $O_{s3}(CO)_{12}$**

- To a solution of (Z) 1-ferrocenyltelluro-1-ferrocenyl-4-ferrocenyl-1-buten-3-yne (92 mg, 0.125 mmol), in toluene (20 ml), $[O_{s3}(CO)_{12}]$ (38 mg, 0.042 mmol) was added and the solution was refluxed at 110 °C for 4 h under nitrogen atmosphere. **(Scheme 2)**.
- The solvent was removed under reduced pressure, and the residue was subjected to a chromatographic workup on silica gel TLC plates by using 35:65 v/v dichloromethane/hexane solvent mixtures as eluent.
- The formations of tellurium based Os3 cluster have been confirmed using various spectral methods such as 1H NMR and Mass and Infrared Spectroscopy.
- These compounds have been crystallized from methanol/DCM by slow diffusion of diethyl ether, and their structures could be unambiguously determined by X-ray single-crystal diffraction (see in figures).



**Scheme 2** Schematic representations of Tellurium based Os3 complexes.

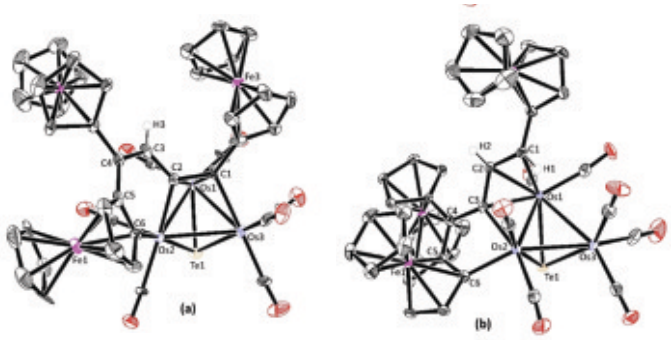


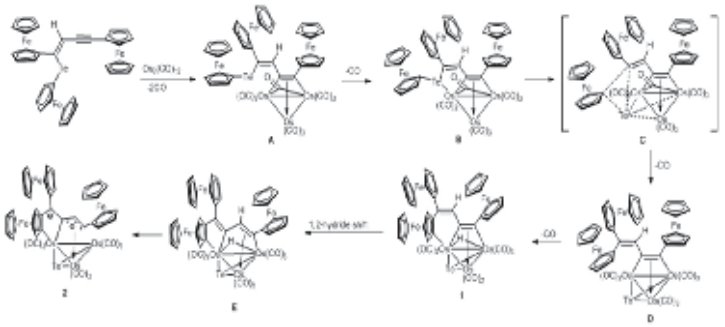
**Fig 1 (A) Molecular structure of compound 1 and 2.**

**(B) Plausible mechanism for formation of complex 1 and 2:**

The formation of 1, we propose likely proceeds along following steps: (1) C-C coordination, (2) rearrangement of FcTe unit followed by C-Te cleavage and migration of Fc unit to ene-yne (3) orthometallation of ferrocene (Scheme 3). In the first step, mechanism may involve an initial coordination of unsaturated "Os3(CO)10" fragment to the acetylenic group of tellurium ene-yne ligand, forming complex [O (CO) { η1:η2:η1-FcTeC(Fc)C(H)CCFc}], A. This is followed by the initial coordination of Te to one of the Os atoms (B) and subsequent migration of Te to the Os3 core to give D, via C. This initial coordination is supported by Delgado et al. wherein FcC÷ CSC÷ CFc reacts via C÷ C coordination followed by S-C cleavage.2,11 Orthometallation of a ferrocene unit in D, with a loss of CO, leads to the formation of 1.

Complex 1 can rearrange to 2 in two steps where the first step involves a 1,2-hydride shift leading to a less strained 5-membered metallacycle (E) followed by insertion of bridging hydride into the metal-carbon bond. While 1 appears to be the first isolable kinetic product, 2 is the more stable, thermal product. The conversion of 1 to 2 shows the initial step required for alkene hydrogenation using a tellurium bridged triosmium cluster. Further investigations are underway for suitable modifications of these complexes for their use as catalysts in alkene hydrogenation reactions.

**Scheme 3 Schematic representations complex 1 and 2.**



**7.2 New Observations**

The research observes multifunctional organotellurium (tellurium ene-yne) ligand bearing ferrocenyl groups, (Z)-1-ferrocenyltelluro-1-ferrocenyl-4-ferrocenyl-1-buten-3-yne with [Os3(CO)12] in thermolysis condition, gives electronically saturated 6-membered and unsaturated 5-membered cyclometallated ring complex, formed by C-H activation of ferrocene along with intramolecular rearrangement of atoms. In 1, triple bonds of the tellurium ene-yne grouping are coordinated as a triple bridge to a triangle of three osmium atoms while in 2 C4 chain is coordinated as a linear chain forming a 5-membered metallacycle as well as the allylic system.

**7.3 Innovations**

Transition metal carbonyl clusters are in terms of their multi metal centers. And these metal center can be utilize in catalysis and polymerization.

**7.4 Application Potential**

**7.4.1 Long term :** Synthesis of transition metal complexes and its applications as catalyst in many reactions of industrial importance such as small molecule reduction, polymerization and biological activity.

**7.4.2 Immediate :** The synthesized iron based carbonyl clusters and its characterization and theoretical studies. Research work which remains to be done under the project (for on-going projects)

- The synthesis of Fe based transition clusters by reaction of bisacetylene with Fe(CO)5
- Synthesis of Fe- demetaled organometallic complexes and their spectroscopic and X-ray structural characterization.
- Theoretical studies have to be carried out.
- Communication of the results.

**Dr. Srimanta Pakhira**

Ramanujan Fellow, MEMS

spakhira@iiti.ac.in

Report: January 2018 – March 2018

**Ph.D. (Sc):** Indian Association for the Cultivation of Science (IACS) and Jadavpur University.

**Post-Ph.D.(Sc):** University of California at Berkeley and Lawrence Berkeley National Laboratory (LBNL), Berkeley, CA, USA; Nagoya University, Nagoya, Aichi, Japan; Florida State University, National High Magnetic Field Laboratory, FSU, Tallahassee, Florida, USA.

**Research:** Major Research Area: Computational Materials Science and Engineering.

**Project:** Construction of Porous Metal-Organic Frameworks (MOFs) and Covalent Organic Frameworks (COFs) and Its Applications. DST-SERB, Project Value 1.25 Core Yr. 2018-2023.

**Research Project Report:** Hybrid porous materials such as metal–organic frameworks (MOFs) or porous coordination polymers (PCPs) or constructed by various kind of organic linkers with metal cations, have a promising and potential applications of various field of science, such as gas storage, gas separation, gas adsorption, physisorption, selective gas separation, heterogeneous catalysis, solar cell, radical polymerization reactions in the MOFs or PCPs channels, controlling the tacticity and polymerization, more recently biomedicine, nanotechnology and drug delivery. In the last decade, a large number of MOFs containing various organic ligands were synthesized experimentally and studied theoretically as well as computationally. Additionally, scientists are always still researching

and finding ways to design MOFs to target specific properties. Moreover, systematic functionalization of MOFs by introducing various substituents onto the component organic ligand, i.e. changing the ligand benzene groups, or the rotational groups, has been performed to regulate the radical polymerization of methyl methacrylate (MMA) in the nano-channels. The important advantages of these kinds of MOFs are very low weight, high pore volumes, fast adsorption–desorption kinetics, large surface and tunable pore, and easy refueling. These would be sufficient for technological applications.

To construct the pristine COFs, we first used graphene sheets and formed graphene bilayer (BLG) structure. The first row transition metal atoms (TM = Sc-Zn) were intercalated between two graphene layers and formed a new type of 2D layer structure and 3D bulk structure material noted as BLG-TM and bulk-BLG-TM. Using first-principles dispersion-corrected DFT techniques, we have designed 20 new materials in-silico by intercalating first row transition metals (TMs) with BLG, i.e. 10 layered structure and 10 bulk crystal structures of TM intercalated in BLG. Our present DFT-D calculations found the Dirac Cone at the band structure of the 2D BLG-V material and we showed how the Dirac points moved. This work opens up new avenues for the efficient production of two-dimensional and three-dimensional carbon-based intercalated materials with promising future applications in nanomaterial science. This article has just been published in high impact international journal, *The Journal of Physical Chemistry C* 122, 2018, pp 4768–4782. In parallel, we continued one work to study the modulating electrocatalysis on graphene heterostructures which have an important role in alkali-ion battery and the findings were published high impact international journal, *ACS Nano* 12, 2018, pp. 2980-2990, Impact Factor: 13.942.

### List of Publications:

(i) Srimanta Pakhira and J. L. Mendoza-Cortes, Tuning Dirac Cone of Two Dimensional Bilayer Graphene and Graphite by Intercalating First Row Transition Metals using First Principles, *The Journal of Physical Chemistry C* 122, 2018, pp 4768–4782, Impact Factor: 4.805.

(ii) J. Hui, Srimanta Pakhira, R. Bhargava, Z. Barton, X. Zhou, A. Chinderle, J. L. Mendoza-Cortes, J. Rodríguez-López; Modulating Electrocatalysis on Graphene Heterostructures: Physically Impermeable Yet Electronically Transparent Electrodes. *ACS Nano* 12, 2018, pp. 2980-2990, Impact Factor: 13.942.

(iii) Srimanta Pakhira, K. P. Lucht, J. L. Mendoza-Cortes, 2017 Iron Intercalation in Covalent-Organic Frameworks: A Promising Approach for Semiconductors. *The Journal of Physical Chemistry C* 121, pp. 21160-21170. Impact Factor: 4.805

(iv) Srimanta Pakhira,† Y. Lei†, K. Fujisawa, X. Wang, O. Iyiola, N. López, A. Elías, L. Rajukumar, C. Zhou, B. Kabius, N. Alem, M. Endo, R. Lv, J. L. Mendoza-Cortes, and M. Terrones, 2017. Low Temperature Synthesis of Heterostructures of Transition metal Dichalcogenides Alloys (WxMo1-xS2) and Graphene with Superior Catalytic Performance for Hydrogen Evolution. *ACS Nano* 11, pp. 5103-5112. (Cover Article) Impact Factor: 13.942

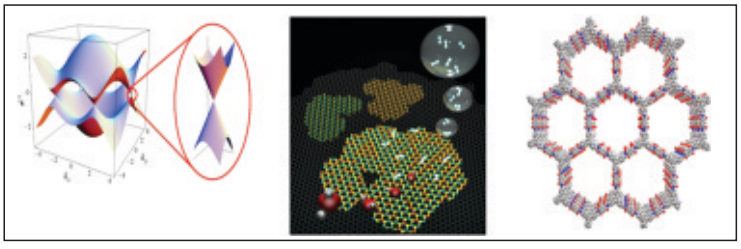
†Equal Contribution: First Authorship.

### Teaching Courses

MM 309: Computational Methods for Materials. (B. Tech. Course Coordinator).

MSE 605: Computational Techniques in Materials Engineering. (M. Tech. Co-coordinator).

IC 151: Programming and Computer Laboratory. (B. Tech. Co-coordinator).



We are going to develop a High Performance Computing Facility (HPC) in the Discipline of MEMS, IIT Indore. Several proposals to get research funds such as DST-SERB, DST, MHRD, DCPC, CSIR, etc. have been submitted. We are waiting for the approved funds. Website Link: https://sites.google.com/view/dr-pakhiras-research-group

Photographs and pictures of the facilities and activities

# International Cell Update

IIT Indore faculty and students have been collaborating with countries worldwide since its inception. Most notable among these have been with Germany and France. Status of these collaborations is listed at the end. Other important collaborations have been with USA, Canada, UK, Russia, Japan, and Australia. Here, we have active research collaborations at individual levels, which we are trying to formalize including talks regarding joint-degree programmes.

We have international students present on our campus during substantial time of the year under internship/ exchange programs from all over the world (North America, Europe, Africa, and Asia). We are also actively participating in the Study in India Program (of MHRD) for attracting international students to our degree programs, especially those from the developing world (SAARC, ASEAN, West Asia, and Africa).

## German Collaboration

Most notable links among German institutes have been with the TU9 universities, which are centers of technological excellence in Germany. Namely, KIT, LU Hannover, RWTH Aachen, TU Berlin, TU Braunschweig, TU Darmstadt, TU Dresden, TU Munich, and University of Stuttgart.

Over the past three years, due to our diligent efforts and support of both the Indian and the German partners, we have had steep expansion in collaborative research with these TU9s. Currently, we are leading all the Indian institutions in the most links with them. That is, we are collaborating with all the nine in multiple areas, have signed individual Memoranda of Understanding with six of the nine (the latest MoU with University of Stuttgart was signed on behalf of all the Tu9s), and are solving important/ relevant problems (joint papers are constantly being published).

We have strong links with non-TU9 institutions as well. That is, with IFW Dresden, IKP Forschungszentrum Juelich, five Max Planck Institutes (Dresden, Heidelberg, Leipzig, Magdeburg and Munich), University of Dortmund, and University of Bonn. Here, we have signed a Memorandum of Understanding with Max Planck Institute in Magdeburg.

## French Collaboration

France related activities started at IIT Indore with the beginning of French classes in 2010. We have had a French instructor on-campus for most of this past decade, and many of our students have being taking minor degree programs in the French language.

Since then, our interactions with France have gone from strength to strength. This includes regular exchange of faculty and students as well as work on joint research projects. Since the past two years, we have had an increase in French related activities on our campus. In 2017, we hosted the French admissions tour organized by French Embassy, and also actively participated in the French Embassy programs of Bonjour India, Future Tour, and Entrepreneurship Challenge. As of now, we are collaborating with fifteen universities in France in multiple research areas.

Second-IITI-TU9-Workshop

# Student Enrolments & Graduation

**Courses offered : 758**
**Undergraduate Courses : 384**
**Postgraduate Courses : 279**
**Cross Listed Courses : 95**

**Doctoral Students Admitted**
Academic Year 2013-14: 87
Academic Year 2014 -15: 93
Academic Year 2015-16: 118
Academic Year 2016-17: 83
Academic Year 2017-18: 110
Academic Year 2018-19: 44 (upto Autumn Semester, including dual degree)

**PG Students Admitted**
Academic Year 2013-14: 20 (05 M.Tech and 15 M.Sc)
Academic Year 2014-15: 44 (24 M.Tech and 20 M.Sc)
Academic Year 2015-16: 54 (30 M.Tech and 24 M.Sc)
Academic Year 2016-17: 78 (31 M.Tech and 47 MSc)
Academic Year 2017-18: 90 (34 M.Tech and 56 MSc)
Academic Year 2018-19: 135 (60 M.Tech, 68 MSc and 7 MS (Research))

**UG Students Admitted**
Academic Year 2013-14: 119
Academic Year 2014-15: 117
Academic Year 2015-16: 111
(3 Preparatory students joined at IITH)
Academic Year 2016-17: 258
(1 Preparatory student joined at IITH)
Academic Year 2017-18: 249
Academic Year 2018-19: 265

**Doctoral Students Graduated**
2014-Convocation (Academic Year 2013-14): 06
2015-Convocation (Academic Year 2014-15): 23
2016- Convocation (Academic Year 2015-16): 24
2017- Convocation (Academic Year 2016-17): 37
2018- Convocation (Academic Year 2017-18): 64

**PG Students Graduated**
2015- Convocation (Academic Year 2014-15): 19
(05= M.Tech and 14= M.Sc)
2016- Convocation (Academic Year 2015-16): 42
(22=M.Tech and 20= M.Sc)
2017- Convocation (Academic Year 2016-17): 47
(25=M.Tech and 22= M.Sc)
2018- Convocation (Academic Year 2017-18): 67
(26=M.Tech and 41= M.Sc)

**UG Students Graduated**
2013-Convocation (Academic Year 2012-13): 101
2014-Convocation (Academic Year 2013-14): 117
2015-Convocation (Academic Year 2014-15): 114
2016-Convocation (Academic Year 2015-16): 108
2017-Convocation (Academic Year 2016-17): 118
2018- Convocation (Academic Year 2017-18): 112

## Indian Institute of Technology Indore

# 6th Convocation 2018: Recipients of Medals and Awards

## President of India Gold Medal

For the best academic performance among all the graduating UG students

**Mr. Vedaanta Agarwalla**
B.Tech. (CSE)
Roll No. 140001038

## Institute Silver Medal

For the best academic performance among all the graduating UG students of a particular Discipline

**Mr. Varun Vinayak Joglekar**
B.Tech. (CSE)
Roll No. 140001037

**Mr. Kartikeya Surendra Singh**
B.Tech. (EE)
Roll No. 140002016

**Mr. Adithyan Kannaiyan**
B.Tech. (ME)
Roll No. 140003002

## Institute Silver Medal

For the best overall performance among all the graduating students of all the M.Tech and M.Sc. programs

**Ms. Ekta Yadav**
M.Sc. (Physics)
Roll No. 1603151003

## Institute Silver Medal

For the Best All Round Performance among all the graduating UG students

**Mr. Ramesh Balaji**

B.Tech. (CSE)
Roll No. 140002025

## Award For Best B.Tech Project (BTP)

Amongst all the graduating UG students

**Mr. Abhishek Kumar**

B.Tech. (ME)
Roll No. 140003001

**Mr. Ishan Meshram**

B.Tech. (ME)
Roll No. 140003018

**Mr. Rohan Rathore**

B.Tech. (ME)
Roll No. 140003031

Project Title: "Design and development of self adaptive and self energized intelligent solar tracker "

# Research & Development Report

IIT Indore has always pursued a multidisciplinary approach in seeking to accomplish its research objectives. The Institute has done very well in all areas- Science, Engineering, Humanities and Social Sciences. It has the highest h-index amongst all new IITs. Last year, it secured 66 externally funded research projects from various funding agencies. The Institute has also filed 37 patent applications (with another 16 in progress).

Research has been globally recognized through joint collaborations with research organizations/ institutes/universities in Japan, South Korea, Portugal, France, Germany, USA, Taiwan, UK, Canada, South Africa, and many other countries. The research funding from these projects is nearly Rs. 18.79 Crore. International projects with Brazil, Russia, UK, Tunisia, Germany, and Poland have been approved under various collaborative schemes in the last year. Besides, faculty members have been successful in securing several international fellowships/awards for joint research work.

The Institute has conducted 38 courses under the Global Initiative of Academic Networks (GIAN) scheme of the Ministry of Human Resource Development. These courses are aimed at sharing knowledge and expertise of distinguished visitors; and, further strengthening of the existing linkages between institutions of higher-education.

In a major initiative to engage Indian Industry in cutting-edge research, the Institute has successfully conducted numerous sponsored consultancy projects. These projects aim at jointly developing technologies for participating industrial partners.

IIT Indore has consciously promulgated the idea of involving undergraduate students in research projects. This is done through a research scheme- 'Promotion of Research and Innovation for Undergraduate Students (PRIUS)'. This scheme has been instrumental in involving students in state-of-the-art research in various laboratories. The 7th semester has been earmarked for the purpose.

The Sophisticated Instrumentation Centre is a unique facility of state-of-the-art equipments. 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.

The Institute has inaugurated a Start-up Centre on August 15, 2017, which is part of the Centre for Innovation and Entrepreneurship (CIE). Other constituents of CIE are: Industry Relation Cell, Innovation and Entrepreneurship Development Centre (IEDC) (supported by DST), Student Entrepreneurship Support Cell (SESC) and ENACTUS. Since its inception, IEDC has supported 20 student projects and several patent applications have been filed out of these projects. In addition, three start-up companies have been incubated at the start-up Centre at IIT Indore.

# Publication Statistics (April 2017- March 2018)

## No. of Journals / Conferences / Book Chapters / Books

| Sl. | Name | Designation | Discipline / Center | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Dr. Narendra S. Choudhari | Professor | CSE | 17 | 19 | 32 | 37 | 16 | 14 | 5 | 16 | 17 | 10 | 183 |
| 2. | Dr. Abhishek Srivastava | Associate Professor | CSE | 1 | 4 | 2 | | 2 | 8 | 2 | 3 | 3 | 3 | 28 |
| 3. | Dr. Aruna Tiwari | Associate Professor | CSE | 1 | 3 | 3 | 3 | 5 | 10 | 10 | 6 | 3 | 14 | 58 |
| 4. | Dr. Anirban Sengupta | Assistant Professor | CSE | 6 | 13 | 11 | 5 | 6 | 16 | 26 | 18 | 28 | 52 | 181 |
| 5. | Dr. Surya Prakash | Assistant Professor | CSE | 6 | 1 | 1 | 4 | 5 | 2 | 4 | 4 | 4 | 12 | 43 |
| 6. | Dr. Somnath Dey | Assistant Professor | CSE | | | | | 1 | 2 | 3 | 4 | 4 | 8 | 22 |
| 7. | Dr. Kapil Ahuja | Associate Professor | CSE | 1 | | 1 | 1 | 1 | | 1 | 3 | 2 | 5 | 15 |
| 8. | Dr. Gourinath Banda | Associate Professor | CSE | | | | | | | 1 | 1 | 1 | | 3 |
| 9. | Dr. Neminath Hubballi | Assistant Professor | CSE | 1 | 5 | 6 | 3 | 2 | 2 | 5 | 7 | 7 | 8 | 46 |
| 10. | Dr. Bodhisatwa Mazumdar | Assistant Professor | CSE | | | | 1 | 3 | 3 | 7 | 6 | 7 | 2 | 29 |
| 11. | Dr. Mukesh Kumar | Associate Professor | Electrical Engineering | | | | | | | | 3 | 4 | | 7 |
| 12. | Dr. Prabhat Kumar Upadhyay | Associate Professor | Electrical Engineering | | | | 1 | 4 | 4 | 4 | 14 | 14 | 17 | 58 |
| 13. | Dr. Vimal Bhatia | Professor | Electrical Engineering | | | | | 1 | 5 | 16 | 36 | 53 | 32 | 143 |
| 14. | Dr. Shaibal Mukherjee | Associate Professor | Electrical Engineering | | | 2 | 4 | 14 | 10 | 11 | 16 | 23 | 27 | 107 |
| 15. | Dr. Trapti Jain | Associate Professor | Electrical Engineering | | | | | 1 | 9 | 5 | 4 | 10 | 10 | 39 |
| 16. | Dr. Abhinav Kranti | Professor | Electrical Engineering | | | 1 | 1 | 9 | 8 | 6 | 9 | 14 | 17 | 65 |
| 17. | Dr. Santosh Kumar Vishvakarma | Associate Professor | Electrical Engineering | | | 2 | 4 | 14 | 6 | 15 | 17 | 11 | 20 | 89 |
| 18. | Dr. Vipul Singh | Associate Professor | Electrical Engineering | | | 1 | | 14 | 9 | 10 | 6 | 14 | 2 | 56 |
| 19. | Dr. Srivathsan Vasudevan | Associate Professor | Electrical Engineering | | | | | | 1 | | 3 | 1 | | 5 |
| 20. | Dr. Anbarasu M. | Associate Professor | Electrical Engineering | | | | 1 | | 1 | | 3 | 7 | 2 | 14 |
| 21. | Dr. Amod Umarikar | Associate Professor | Electrical Engineering | | | | 1 | 1 | 1 | 3 | 4 | | | 10 |

| Sl. | Name | Designation | Discipline / Center | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22. | Dr. Vivek Kanhangad | Associate Professor | Electrical Engineering | | | | | 1 | 1 | 2 | 3 | | 3 | 10 |
| 23. | Dr. Ram Bilas Pachori | Associate Professor | Electrical Engineering | | 5 | 7 | 5 | 10 | 11 | 20 | 11 | 26 | 32 | 127 |
| 24. | Dr. Anand Parey | Professor | Mechanical Engineering | 1 | 2 | 1 | 1 | 7 | 3 | 9 | 15 | 13 | 4 | 56 |
| 25. | Dr. Santosh K. Sahu | Associate Professor | Mechanical Engineering | 3 | 1 | | 3 | 17 | 15 | 14 | 13 | 11 | 9 | 86 |
| 26. | Dr. Ritunesh Kumar | Associate Professor | Mechanical Engineering | | 1 | 2 | 1 | 1 | 8 | 2 | 7 | 3 | 4 | 29 |
| 27. | Dr. Neelesh K. Jain | Professor | Mechanical Engineering | | 6 | 6 | 6 | 14 | 14 | 8 | 20 | 11 | 10 | 95 |
| 28. | Dr. Bhupesh K. Lad | Associate Professor | Mechanical Engineering | | | 1 | | 4 | 2 | 7 | 15 | 5 | 11 | 45 |
| 29. | Dr. Satyajit Chatterjee | Assistant Professor | Mechanical Engineering | | | | 1 | | | | | 6 | 3 | 10 |
| 30. | Dr. Santhakumar Mohan | Assistant Professor | Mechanical Engineering | | | | 7 | 11 | 10 | 9 | 15 | 16 | 14 | 82 |
| 31. | Dr. Kazi Sabiruddin | Associate Professor | Mechanical Engineering | | | | 1 | 2 | | 1 | 3 | 5 | 1 | 13 |
| 32. | Dr. Devendra L. Deshmukh | Associate Professor | Mechanical Engineering | | | | 1 | | 4 | 3 | 4 | 4 | 4 | 20 |
| 33. | Dr. Palani I. Anand | Associate Professor | Mechanical Engineering | | | | 7 | 9 | 4 | 9 | 22 | 18 | 16 | 85 |
| 34. | Dr. Shanmugam Dhinakaran | Associate Professor | Mechanical Engineering | | | | | 1 | | | 4 | 5 | 4 | 14 |
| 35. | Dr. Subbareddy Daggumati | Assistant Professor | Mechanical Engineering | 2 | 7 | 6 | | 2 | | 2 | 1 | 1 | | 21 |
| 36. | Dr. Shailesh Kundalwal | Assistant Professor | Mechanical Engineering | | | | | | | | | 9 | 11 | 20 |
| 37. | Dr. Indrasen Singh | Assistant Professor | Mechanical Engineering | | | | | 1 | 2 | 1 | 4 | 3 | 1 | 12 |
| 38. | Dr. Sandeep Chaudhary | Professor | Civil Engineering | | | | | | | | | | 7 | 7 |
| 39. | Dr. Neelima Satyam | Assistant Professor | Civil Engineering | | | | | | | | | 4 | 5 | 9 |
| 40. | Dr. Manish K. Goyal | Associate Professor | Civil Engineering | | | | | | | | | | 1 | 1 |
| 41. | Dr. Munir Ahmad Nayak | Associate Professor | Civil Engineering | | | | | | | | | | 3 | 3 |
| 42. | Dr. Mohd. Farooq Azam | Assistant Professor | Civil Engineering | | | | | | | | | | 2 | 2 |
| 43. | Dr. Lalit Borana | Associate Professor | Civil Engineering | | | | | | | | | 1 | | 1 |
| 44. | Dr. Pradeep Mathur | Professor | Chemistry | | 7 | 5 | 8 | 5 | 11 | 1 | 4 | | 7 | 48 |

| Sl. | Name | Designation | Discipline / Center | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 45. | Dr. Amrendra K. Singh | Assistant Professor | Chemistry | | | | | | | | | | 3 | 3 |
| 46. | Dr. Rajneesh Misra | Professor | Chemistry | | | | 3 | 12 | 14 | 4 | 7 | 8 | 18 | 66 |
| 47. | Dr. Suman Mukhopadhyay | Professor | Chemistry | | 1 | | | 3 | 4 | 3 | 5 | 5 | 8 | 29 |
| 48. | Dr. Anjan Chakraborty | Associate Professor | Chemistry | | | 2 | 2 | 2 | 5 | | 4 | 1 | 2 | 18 |
| 49. | Dr. Apurba K. Das | Associate Professor | Chemistry | | 1 | | 2 | 3 | 8 | 6 | 8 | 1 | 10 | 39 |
| 50. | Dr. Sampak Samanta | Associate Professor | Chemistry | | | | 2 | 5 | 3 | 3 | 9 | 2 | 9 | 33 |
| 51. | Dr. Tushar Kanti Mukherjee | Associate Professor | Chemistry | | | | | 2 | 4 | 2 | 6 | 5 | 4 | 23 |
| 52. | Dr. Mohammad Mobin Shaikh | Assistant Professor | Chemistry | | | | 46 | 54 | 66 | 42 | 44 | 10 | 31 | 293 |
| 53. | Dr. Sanjay K. Singh | Assistant Professor | Chemistry | | | | | 2 | 3 | 4 | 8 | 4 | 14 | 35 |
| 54. | Dr. Biswarup Pathak | Associate Professor | Chemistry | | | | 3 | 14 | 6 | 1 | 22 | 10 | 20 | 76 |
| 55. | Dr. Satya Silendra Bulusu | Assistant Professor | Chemistry | | | | | 2 | | 1 | 2 | 3 | 4 | 12 |
| 56. | Dr. Chelvam Venkatesh | Assistant Professor | Chemistry | | | | 2 | 4 | 1 | 2 | 1 | 1 | 10 | 21 |
| 57. | Dr. Tridib Kumar Sharma | Assistant Professor | Chemistry | | 1 | | 1 | 2 | 2 | 2 | 1 | 4 | 7 | 20 |
| 58. | Dr. Swadesh Kumar Sahoo | Associate Professor | Mathematics | | | | | 1 | 6 | 2 | 4 | 5 | 4 | 22 |
| 59. | Dr. Santanu Manna | Visiting Asst. Prof. | Mathematics | | | | | | | | | | 2 | 2 |
| 60. | Dr. M. Tanveer | Assistant Professor | Mathematics | | | | | | | | | | 11 | 11 |
| 61. | Dr. Ashisha Kumar | Assistant Professor | Mathematics | | | | | | 1 | | 1 | | | 2 |
| 62. | Dr. Anand Parkash | Assistant Professor | Mathematics | | | | | | | 1 | | | | 1 |
| 63. | Dr. Niraj Kumar Shukla | Assistant Professor | Mathematics | | | | | | 2 | 1 | 1 | 1 | 6 | 11 |
| 64. | Dr. Md. Aquil Khan | Associate Professor | Mathematics | | | | | | 1 | 5 | 2 | 1 | 2 | 11 |
| 65. | Dr. V. Antony Vijesh | Associate Professor | Mathematics | | | | | | 1 | 3 | 2 | 3 | 3 | 12 |
| 66. | Dr. Sanjeev Singh | Assistant Professor | Mathematics | | | | | | | | | | 1 | 1 |
| 67. | Dr. Sk. Safique Ahmad | Associate Professor | Mathematics | | 2 | 1 | | 1 | | 1 | 2 | | 1 | 8 |

| Sl. | Name | Designation | Discipline / Center | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 68. | Dr. Subhendu Rakshit | Professor | Physics | | | | | | 1 | 3 | 1 | 3 | 2 | 10 |
| 69. | Dr. Krushna R. Mavani | Professor | Physics | | | | 3 | 3 | 4 | 2 | 1 | 1 | 2 | 16 |
| 70. | Dr. Sarika Jalan | Professor | Physics | NA* (4) | NA* (2) | 1 | 2 | 4 | 8 | 12 | 7 | 12 | 5 | 51 (57) |
| 71. | Dr. Ankhi Roy | Associate Professor | Physics | | | 1 | 3 | 5 | 5 | 1 | 3 | 3 | 1 | 22 |
| 72. | Dr. Raghunath Sahoo | Associate Professor | Physics | | | 1 | 16 | 30 | 21 | 22 | 52 | 24 | | 166 |
| 73. | Dr. Manavendra Mahato | Associate Professor | Physics | | 1 | 1 | | | | | 1 | | 1 | 4 |
| 74. | Dr. Preeti Bhobe | Associate Professor | Physics | | | | | 1 | | 3 | 4 | 7 | 6 | 21 |
| 75. | Dr. Pankaj Sagdeo | Associate Professor | Physics | | | | | 3 | 3 | 8 | 9 | 16 | 14 | 53 |
| 76. | Dr. Rajesh Kumar | Associate Professor | Physics | | | | 1 | 1 | 3 | 3 | 11 | 17 | 23 | 59 |
| 77. | Dr. Somaditya Sen | Associate Professor | Physics | | | | | 1 | 1 | 4 | 6 | 17 | 15 | 44 |
| 78. | Dr. Sudeshna Chattopadhyay | Associate Professor | Physics | | | | 2 | 1 | 1 | | 1 | 4 | 4 | 13 |
| 79. | Dr. Parasharam M. Shirage | Associate Professor | MEMS | | | | | 1 | 4 | 6 | 12 | 18 | 14 | 55 |
| 80. | Dr. Jayaprakash Murugesan | Assistant Professor | MEMS | | | | | | | | | | 5 | 5 |
| 81. | Dr. Rupesh S. Devan | Assistant Professor | MEMS | | | | | | | | | 1 | 9 | 10 |
| 82. | Dr. Santosh S. Hosmani | Assistant Professor | MEMS | | | | | | | | | | 2 | 2 |
| 83. | Dr. K. Eswara Prasad | Assistant Professor | MEMS | | | | | | | | | | 1 | 1 |
| 84. | Dr. Dhirendra Kumar Rai | Assistant Professor | MEMS | | | | | | | | | | 1 | 1 |
| 85. | Dr. Sumanta Samal | Assistant Professor | MEMS | | | | | | | | | | 2 | 2 |
| 86. | Dr. Mrigendra Dubey | Assistant Professor | MEMS | | | | | | | | | | 2 | 2 |
| 87. | Dr. Ajay Kumar Kushwaha | Assistant Professor | MEMS | | | | | | | | | 5 | 7 | 12 |
| 88. | Dr. Vinod Kumar | Assistant Professor | MEMS | | | | | | | | | 1 | 8 | 9 |
| 89. | Dr. Abhijit Ghosh | Assistant Professor | MEMS | | | | | | | | | | 1 | 1 |

| Sl. | Name | Designation | Discipline / Center | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 90. | Dr. Hemant Borkar | Assistant Professor | MEMS | | | | | | | | | | 1 | 1 |
| 91. | Dr. Sunil Kumar | INSPIRE Faculty | MEMS | | | | | | | | | 6 | 12 | 18 |
| 92. | Dr. Srimanta Pakhira | Ramanujan Fellow | MEMS | | | | | | | | | | 2 | 2 |
| 93. | Dr. Akshaya Kumar | Assistant Professor | Sociology | | | | | | | | | 4 | 5 | 9 |
| 94. | Dr. Ananya Ghoshal | Assistant Professor | English | | | | | | | | | 3 | 3 | 6 |
| 95. | Dr. Ashok Kumar Mocherla | Assistant Professor | Sociology | | | | | | | | | | 1 | 1 |
| 96. | Dr. C. Upendra | Associate Professor | Philosophy | | | 1 | 3 | 6 | 6 | 2 | 2 | | | 20 |
| 97. | Dr. Neeraj Mishra | Assistant Professor | Sociology | | 1 | 1 | | | | | 1 | 4 | 1 | 8 |
| 98. | Dr. Nirmala Menon | Associate Professor | English | | | | 1 | 2 | 8 | 6 | 3 | 2 | 6 | 28 |
| 99. | Dr. Pritee Sharma | Associate Professor | Economics | | | | 4 | 6 | 3 | 6 | 4 | 4 | 7 | 34 |
| 100 | Dr. Ruchi Sharma | Associate Professor | Economics | 2 | | 1 | 4 | 1 | 2 | 4 | 10 | 4 | 6 | 34 |
| 101. | Dr. Sanjram P. Khanganba | Associate Professor | Psychology | | | | | 4 | | | 1 | | 2 | 7 |
| 102. | Dr. Hem Chandra Jha | Assistant Professor | BSBE | | | | | | | | | 3 | 7 | 10 |
| 103. | Dr. Prashant Kodgire | Associate Professor | BSBE | | | | 1 | 1 | | | 1 | 1 | 2 | 6 |
| 104. | Dr. Amit Kumar | Associate Professor | BSBE | | | | | | | 2 | 5 | 2 | 6 | 15 |
| 105. | Dr. Sharad Gupta | Assistant Professor | BSBE | | | | | 3 | 1 | 2 | 2 | 1 | 2 | 11 |
| 106. | Dr. Debasis Nayak | Assistant Professor | BSBE | | | | | | 1 | 2 | 2 | | 5 | 10 |
| 107. | Dr. Abhijeet Joshi | Inspire Faculty | BSBE | | | | | | | | 2 | 5 | 3 | 10 |
| 108. | Dr. Parimal Kar | Assistant Professor | BSBE | | | | | | | | | 1 | | 1 |
| 109. | Dr. Mirza S. Baig | Assistant Professor | BSBE | | | | | | | 1 | 6 | 2 | 4 | 13 |
| 110. | Dr. Kiran Bala | Assistant Professor | BSBE | | | | | | 3 | | 7 | 4 | 2 | 16 |
| 111. | Dr. Sushabhan Sadhukhan | Assistant Professor | BSBE | | | | | | | | | | 2 | 2 |
| 112. | Dr. Avinash Sonawane | Associate Professor | BSBE | | | | | | | | | | 4 | 4 |

| Sl. | Name | Designation | Discipline / Center | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 113. | Dr. Abhirup Datta | Associate Professor | Astronomy | | | | | | | 4 | 9 | 6 | 5 | 24 |
| 114. | Dr. Siddharth Malu | Associate Professor | Astronomy | | | | 2 | 1 | | | 2 | 1 | 2 | 8 |
| 115. | Dr. Bhargav Vaidya | Assistant Professor | Astronomy | | | | | | | | | 2 | 3 | 5 |
| 116. | Dr. Manoneeta Chakraborty | DST-INSPIRE Faculty Fellow | Astronomy | | | | | | | | | 1 | 2 | 3 |
| 117. | Dr. Hari B. Hablani | Visiting Professor | Astronomy | | | | | | | | | 1 | 2 | 3 |

## Major Achievements/ Awards/ Milestones

**1st April, 2017 – 31st March, 2018**

| | |
|---|---|
| 1 | **Dr. Narendra S. Choudhari** (Computer Science & Engineering)<br>• Keynote Speaker – National Conference on Recent Advances in Computing, Communication and Bioinformatics, (RAC2B) (website: RAC2B-2017(https://cse.nitrr.ac.in/rac2b /). National Institute of Technology (NIT), Raipur (09-08 Dec., 2017).<br>• Global Award for Excellence in Education for Last two Decades, (in the series: Rising Men of India Award, the Indian Institute of Global Brotherhood, New Delhi 110047 (17th Nov. 2017).<br>• Chief Guest - on the occasion of CSIR Platinum Jubilee Foundation Day Celebration at CSIR - National Environmental Engineering Research Institute (NEERI), Nagpur (25th September, 2017). |
| 2 | **Dr. Abhishek Srivastava** (Computer Science & Engineering)<br>• Best Teacher Award for the Academic Year 2017-18, IIT Indore<br>• Ph.D. degree awarded to Mr. Tanveer Ahmed under Dr. Srivastava's supervision |
| 3 | **Dr. Aruna Tiwari** (Computer Science & Engineering)<br>• Research Project granted Sponsoring Agency: Council of Scientific and Industrial Research (CSIR), Govt. of India.<br>**Title:** ''Development of an Efficient Scalable Clustering Algorithms for Big Data and investigation of Integrated system for Protein Sequence Classification'' (Approved on October 10, 2017 for three years).<br>**Collaborator:** Dr. Milind Ratnaparkhe, Senior Scientist (Biotechnology) ICAR-Indian Institute of Soyabean Research (ICAR-IISR) Indore. Funding Amount: 30 Lakhs INR<br>• Grants received For an International Symposium on Computational Mathematics, Optimization, and Computational Intelligence (CMOCI 2017) during July 17-19, 2017. It was first NTU-India Connect Program of our country. These grants were received from following Sponsoring agencies : (i) Science and Engineering Research Board (SERB), New Delhi (2 Lakhs INR) (ii) National Board for Higher Mathematics (NBHM), DAE, Mumbai ( 30,000 INR), (iii) Council of Scientific and Industrial Research (CSIR), New Delhi (1 Lakh INR) (iv) Indian National Science Academy (INSA), New Delhi (1.5 Lakhs INR) (v) State Bank of India (SBI), Simrol Branch, Indore (1 Lakh INR)<br>• Expert lecture in 5th Industry-Academia Conclave at Indian Institute of Technology Indore on 06th September, 2017, Title: ''Design of a quantum inspired fuzzy based neural network and its hardware realization''.<br>• One student Neha Bharill graduated with Ph.D. degree in January 2018 under the supervision of Dr. Tiwari. |
| 4 | **Dr. Anirban Sengupta** (Computer Science & Engineering)<br>• Elected 'Chairman of IEEE Computer Society Technical Committee on VLSI (TC-VLSI)' for a term from Oct 2018 - 2020. |

| | |
|---|---|
| | • Awarded 'IEEE Consumer Electronics Society Best Paper Award 2019' in IEEE CE Society's Flagship Conference - 37th IEEE Int'l Conference on Consumer Electronics (ICCE), LV.<br>• Awarded 'IETE Best Research Award 2018' by IETE Sub-Center, 2018.<br>• Awarded prestigious IEEE Distinguished Lecturer by IEEE Consumer Electronics Society.<br>• "Outstanding Associate Editor" Award from IEEE TCVLSI Editorial Board, IEEE Computer Society.<br>• Founder Chairman, IEEE Consumer Electronics Society - Bombay Section<br>• IEEE CESoc Education and Distinguished Lecturer Nominations Committee<br>• General Chair, 37th IEEE Int'l Conference on Consumer Electronics (ICCE) 2019, Las Vegas<br>• Author of IET Book on "IP Core Protection and Hardware-Assisted Security for Consumer Electronics" releasing in Jan 2019.<br>• Associate Editor, IEEE Transactions on VLSI Systems<br>• Associate Editor, IEEE Transactions on Aerospace and Electronic Systems<br>• Associate Editor, IEEE Transactions on Consumer Electronics<br>• Technical Chair, 16th IEEE Computer Society Annual Symposium on VLSI (ISVLSI), Florida.<br>• Recipient of IEEE Computer Society TC-VLSI Best Paper Award 2017 in IEEE iNIS |
| 5 | **Dr. Surya Prakash** (Computer Science & Engineering)<br>• Nominated as Member of Board of Studies, Centre for Advance Studies, Dr. APJ Abdul Kalam Technical University (AKTU), Lucknow by the Academic Council of the University, 2017<br>• Certificate of Reviewing awarded by Pattern Recognition Letters Journal in May 2017<br>• Certificate of Outstanding Contribution in Reviewing awarded by Neurocomputing Journal in June 2017.<br>• Certificate of Outstanding Contribution in Reviewing awarded by Pattern Recognition Letters Journal in December 2017.<br>• GIAN proposal with Prof. Gaurav Sharma of University of Rochester, USA got approved by MHRD for the course Media Security and Forensics. [Funding: INR 8,16,000]<br>• GIAN proposal with Prof. Massimo Tistarelli of University of Sassari, Italy got approved by MHRD for course Advanced Pattern Recognition Techniques for Biometrics. [Funding: INR 5,44,000] |
| 6 | **Dr. Kapil Ahuja** (Computer Science & Engineering)<br>• Invited for participation in French Future Tour@CMI-Chennai and Knowledge Summit@ New Delhi, February-March 2018.<br>• Funded and invited for research talk and collaboration at IMT Atlantique, France and UC Louvain, Belgium, January 2018.<br>• Successfully organized the second IIT Indore - TU9 research workshop at IIT Indore, October 2017<br>• Appointed as Dean of International Affairs at IIT Indore, August 2017.<br>• Funded and invited for research talk and collaboration at Lawrence Berkeley National Laboratory, Berkeley, USA, July 2017.<br>• Funded and invited for research talk and collaboration at Sandia National Laboratory, Albuquerque, USA, June 2017.<br>• Awarded Council of Scientific & Industrial Research (CSIR) Foreign Travel Grant to present at Householder Symposium XX, USA, June 2017.<br>• Visiting professor at TU Dresden, Germany, May-June 2017.<br>• Undergraduate student of Dr. Ahuja, Mr. Ruchir Garg, was awarded Promotion of Research/ Innovation for Undergraduate Students (PRIUS) grant at IIT Indore to visit Max Planck Institute in Magdeburg (Germany) for research collaboration, May-July 2017. |
| 7 | **Dr. Neminath Hubballi** (Computer Science & Engineering)<br>• Oct 2018: TPC Chair, IEEE Advanced Networks and Telecommunication Systems 2018 Conference.<br>• Oct 2018: Nominated as Reviewer for CEFIPRA project evaluation.<br>• Feb 2018: Invited Talk on Intrusion Detection Systems, IDRBT Hyderabad.<br>• Dec 2017: Mayank Swarnkar, Ph.D. student of Dr. Hubballi, participated in 12th Inter-Research-Institute Student Seminar in Computer Science (IRISS 2018) for presenting research work.<br>• Dec 2017: Nikhil Tripathi, Ph.D. student of Dr. Hubballi participated in 12th Inter-Research-Institute Student Seminar in Computer Science(IRISS 2018)for presenting research work.<br>• Dec 2017: CSIR Travel grant to present paper at GLOBECOM 2017. |

| | |
|---|---|
| | • Dec 2017: Chaired a session in IEEE Globecom 2017.<br>• Dec 2017: Chaired a session in IEEE ANTS 2017.<br>• July 2017: Organized a GIAN course on Optimization Techniques and Applications in Engineering. |
| 8 | **Dr. Gourinath Banda** (Computer Science and Engineering)<br>• Project in Cyber Physical Systems titled "High Confidence Cyber Physical Systems" approved for funding under DST-ICPS Call. |
| 9 | **Dr. Prabhat Kumar Upadhyay** (Electrical Engineering)<br>• IETE-Prof SVC Aiya Memorial Award-2018 by Institution of Electronics and Telecommunication Engineers.<br>• Best Paper Award in International Conference on Advanced Communication Technologies and Networking (CommNet), Marrakech, Morocco, April 2018.<br>• Awarded with Sir Visvesvaraya Young Faculty Research Fellowship of MeitY, Government of India, January 2018.<br>• Co-ordinator, CEP Short-Term Course on Information Communication Technologies (ICT): Concepts, Implementations, and Prospects, IIT Indore, Mar 2018.<br>• Principal Investigator, BRICS Multilateral Project on LargEWiN (No. BRICS2017-591), 2018.<br>• Principal Investigator, Council of Scientific and Industrial Research (CSIR) Project (22(0763)/18/EMR-II), 2018.<br>• TPC Co-chair, IEEE International Conference on Advanced Networks and Telecommunication Systems (ANTS), Indore, India, 2018.<br>• Co-organizer, Workshop on "Energy Harvesting Communication Networks", IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC), Bologna, Italy, Sep. 2018.<br>• Guest Editor, IEEE Transactions on Cognitive Communications and Networking, Special Issue on "Energy-Harvesting Cognitive Radio Networks", 2018.<br>• Associate Editor, IEEE Access, Jan. 2018 onward. |
| 10 | **Dr. Shaibal Mukherjee** (Electrical Engineering)<br>• Recipient of the prestigious Materials Research Society of India (MRSI) Medal for 2018.<br>• 2018 Bhaskara Advanced Solar Energy (BASE) Internship Award given to Mr. Brajendra S. Sengar, a Ph.D. student working under the supervision of Dr. Mukherjee, under the program supported by Department of Science and Technology, Government of India, and the Indo-U.S. Science and Technology Forum (IUSSTF).<br>• Recipient of 2017 Bhaskara Advanced Solar Energy (BASE) Fellowship Award under the program supported by Department of Science and Technology, Govt. of India, and the Indo-U.S. Science and Technology Forum (IUSSTF).<br>• Recipient of Young Faculty Research Fellowship (YFRF) under Visvesvaraya Ph.D. Scheme for Electronics and Information Technology, Ministry of Electronics and Information Technology (MeitY).<br>• Best Presentation Award in 6th International Symposium on Integrated Functional ities, India on December 10-13, 2017 is awarded to Mr. Amitesh Kumar, a Ph.D. student working under the supervision of Dr. Mukherjee.<br>• Young Researcher Award given to Mr. Pankaj Sharma, a Ph.D. student under the supervision of Dr. Mukherjee, for Outstanding Work presented in 3rd International Conference on Smart Materials and Structures, Florida, USA, 2017.<br>• 2017 Recognition for Outstanding Work from The International Precious Metals Institute (IPMI), Inc., USA to Mr. Vivek Garg, a Ph.D. student being supervised by Dr. Mukherjee.<br>• CSIR International Travel Support awarded to Mr. Brajendra S. Sengar, to attend and present paper in 33rd European PV Solar Energy Conference and Exhibition held in Amsterdam, Netherlands, September 25-29, 2017.<br>• DST International Travel Support awarded to Mr. Vivek Garg, to attend and present paper in 33rd European PV Solar Energy Conference and Exhibition held in Amsterdam, Netherlands, September 25-29, 2017. |

- CSIR International Travel Support awarded to Mr. Vivek Garg to attend and present paper in 44th IEEE Photovoltaic Specialists Conference held in Washington D.C., USA, June 25-30, 2017.
- CSIR International Travel Support awarded to Mr. Pankaj Sharma, to attend and present paper in 3rd International Conference on Smart Materials and Structures held in Orlando, Florida, USA, March 20-22, 2017.
- Received a research grant as PI from DST-SERB (EMR Project Grant) with a sanctioned amount of Rs. 67,58,620/-
- Received a research grant as PI from DST-RFBR Project under India-Russia Programme of Cooperation in Science and Technology with a sanctioned amount of Rs. 20,89,600/-
- Received a research grant as PI from CSIR EMR Project with a sanctioned amount of Rs. 6,00,000/-
- DST INSPIRE Fellowship is awarded to Mr. Sanjay Kumar, a Ph.D. student working under the supervision of Dr. Mukherjee
- Dr. Pankaj Sharma, after graduating with Ph.D. degree from the research group of Dr. Mukherjee, has secured the position of Assistant Professor in IIIT Pune.
- Dr. Pankaj Sharma, Ph.D. student from the research group of Dr. Mukherjee, has joined as Senior System Architect R&D of a Start-up company Karma Lab, Bangalore.
- Dr. Mukherjee was Organizing Committee Member of Thematic Workshop and Call for CRS Research Proposals on Techniques and Instrumentation in Materials Research (TIMR), August 21-22, 2017

*Three Patents Published:*

- o A method of fabricating high two dimensional electron gas density yielding zinc oxide hetero structure
- Inventors: Shaibal Mukherjee, Abhinav Kranti, Md Arif Khan and Rohit Singh
- Patent Application No. 201721010866.
- o A method of fabricating zinc oxide based hetero structure for high electron mobility transistor
- Inventors: Shaibal Mukherjee, Abhinav Kranti, Rohit Singh and Md Arif Khan
- Patent Application No. 201721007309.
- o Dual ion beam sputtered cost-effective and non-volatile resistive memory devices
- Inventors: Shaibal Mukherjee and Amitesh Kumar
- Patent Application No. 201621020046.

**11** **Professor Vimal Bhatia** (Electrical Engineering)

- TEDx IIT Indore 2017: 1st TED event organised in IIT Indore.
- IAC 2017: Organised with participation of over 400+, resulting in publicity and increased enquiries for SIC and other facilities at IIT Indore. The 5th annual Industry Academic Conclave (IAC) was held on 6th September 2017 at IIT Indore.

  IAC 2017, as an endeavor, focuses on exploring research avenues between academic institutions and corporate organizations. The theme of IAC 2017 was: 'Possibilities for Tomorrow'. IAC 2017 also presented an 'Innovation Pavilion' where innovators from all over India are given a chance to exhibit their products on one of the most prestigious platforms for Industry-Academia interaction. IAC 2017, for the first time, presented an 'Incubation Centre & Centre for Excellence' where younger ideas are invited and a base is set for the technology of future.

  IAC 2017 witnessed 6 new start-ups, more than 60 research facilities and posters, 13 prototypes, 18 technical talks, a panel discussion, and a reinvented incubator and over a dozen sponsorships. It beckoned a footfall of over 400 people. IAC 2017 also garnered support of 11 external sponsors for the event.

  This edition of the IAC saw an influx of powerful speakers, how spoke about how governmental educational institutes and the Industry can interact so that the Industry and Academia can evolve together. The Chief Guest, Mr. Gurjit Singh, the former Indian Ambassador to Germany, talked about his prior experiences dealing with the overlap of Industry and Academia in Ethopia and Japan. Dr. Vimal Bhatia, Convener of the Industry Relations Team, initiated the session by talking about the importance of IAC and how it has grown over the years. Professor Pradeep Mathur, Director of IIT

Indore, emphasized the role of IIT Indore as a catalyst in this simultaneous growth of industry and academia, especially long term growth and inviting application for setting up center of excellence at IIT Indore. Dr. Debojit Chakraborty, Global Category Head of Technology and Applications at Keva Fragrance Innovation, spoke about the interest of private organizations in academic research. Dr. Kumar B Salui from ANSYS, India talked about implications of modern research in the field of computer aided simulations, and its usage in autonomous vehicles and efficient industrial production. Mr. Sandeep Saxena from TCS, Mumbai predicted the exponential growth of digital data in the near future and its management and utility. He briefly touched on the urgent need to create a more efficient workspace for employees and researchers. IAC plays a vital role as a forum for such Industry-Academia interaction, and also provides an opportunity for the Industry to present areas where they would seek research assistance from the Academia. The industry could also benefit from the knowledge of the on-going R&D projects, and could then actively participate in those that might interest them. The exchange of perspectives between the industry personnel and the academia can provide an impetus for various research and development opportunities; it could later lead to efficient and holistic industrial processes.

- IEEE ANTS 2017: As general vice-chair for 11th IEEE ANTS 2017 and publicity for IIT Indore for IEEE ANTS 2018 – only IEEE ComSoc conference in India technically and financially, supported by IEEE.
- Presentation of research publications in IEEE Globecom, ICC, VTC and other flagship IEEE conferences
- 5. 3-year DST-UKIERI project for joint R&D on future wireless systems.
- Alumni Start-ups incubated and mentoring of Swaaha, Chota Hospital, Esmatify, Engross. With support from CIE@IIT Indore Swaaha and Chota Hospital successfully received Govt. of India certification as start-up.

*Three patents granted:*

- V. Bhatia, S. Kalsi, D. Singh, S. Goyal, "Method and apparatus for managing phone/device profile based on an event", 3415/MUM/2015.
- V. Bhatia and A. Bishnu, "Method and apparatus for low complexity natural gradient based OFDM channel estimator", 201621034423.
- V. Bhatia and A. Bishnu, "Method and apparatus for Detection of Active Taps Location in OFDM System", 201621036738.
- Total Publications= (journals: 23 and conferences: 24), Total Impact Factor: 50.4

12 **Dr. Trapti Jain** (Electrical Engineering)

- Dr. Karthik Thirumala, research scholar from Power group (Co-Supervised by Dr. Amod C. Umarikar), has been awarded with POSOCO Power System Award. POSOCO Power System Award (PPSA) is an initiative to recognize and reward innovative technical research excellence in power system by discovering and encouraging fresh Doctoral/Masters research accomplishments in power system and related field.

13 **Professor Abhinav Kranti** (Electrical Engineering)

- German Academic Exchange Service (DAAD) scholarship to visit RWTH Aachen, June 2017.
- An outstanding reviewer for IOP Nanotechnology, 2017.
- Mr. Manish Gupta, Ph.D. scholar, received best oral presentation for the session CMOS Technology Extended – Novel Systems and Approaches at 6th International Symposium on Integrated Functionalities (ISIF), New Delhi, India, 2017.

14 **Professor Ram Bilas Pachori** (Electrical Engineering)

- Top social media article in the list of 2017 articles (Knowledge-Based Systems Journal)
- Associate Editor: Biomedical Signal Processing and Control Journal
- Mr. Abhijit Bhattacharyya, a Ph.D. scholar under the supervision of Dr. Pachori was awarded Raman-Charpak Fellowship at the University of Lorraine, CNRS, France.

15 **Dr. Amod C. Umarikar** (Electrical Engineering)

- Dr. Karthik Thirumala, research scholar from Power group (Co-Supervised by Dr. Trapti Jain), has been awarded with POSOCO Power System Award.

16 **Dr. Satyajit Chatterjee** (Mechanical Engineering)

- The SEM photograph of the research group's latest publication has been chosen to be at the cover page of the latest edition of Ceramics international journal (Volume 44, Issue 14).

17 **Dr. Shailesh Kundalwal** (Mechanical Engineering)

- SERB Early Career Research Award
- Invited Expert Reviewer of Grant Applications [Pazy Research Foundation(Joint research foundation of the Israeli Atomic Energy Commission and the University Planning and Budgeting Committee)]
- Elsevier Outstanding Reviewer Awards: Materials Science & Engineering B , Composite Part B, Int J of Mechanical Sciences, Mechanics Research Comm, Thin-Walled Structures, Composite Structures.
- Ph.D. student under supervision (Vijay Choyal) received the SERB International Travel Grant to present research at Portland, Oregon, USA.
- Recognized Reviewer: Materials Science & Engineering B, Composite Part B, Int J of Mechanical Sciences, Mechanics Research Communications, Composite Structures, Thin-Walled Structures, Applied Mathematical Modelling, Aerospace Sc & Technol.
- Session Chairs: International Conference on Mathematical Modelling & Scientific Computing
- Academic Editor: Mathematical Problems in Engineering
- Ph.D. student Rohit Kothari (being co-supervised by Dr. Kundalwal) received DST INSPIRE Fellowship.
- Rohit Kothari received the prestigious SERB International Travel Grant to present research work in Croatia.

18 **Dr. Santhakumar Mohan** (Mechanical Engineering)

- Received the European Master on Advanced Robotics Plus (EMARO+) from Erasmus Mundus, France, April – May 2018
- Received best paper award at the International Conference on Signals, Machines and Automation (SIGMA'18), NSIT Delhi, India
- Received the Visiting Associate Professor position at the Ecole Centrale de Nantes from the ECN university grant, April 2017.

19 **Dr. Santosh K. Sahu** (Mechanical Engineering)

- Research article selected as qualified student award winner of the student paper competition in the 25th International Conference on Nuclear Engineering (ICONE25), Shanghai, China, 2017.
- Research article selected as qualified student award winner of the student paper competition in the 26th International Conference on Nuclear Engineering (ICONE26), London, UK, 2018.
- SERB International Travel Grant awarded to Dr. Sahu's Ph.D. student Mr. Rohit Kothari to present paper in 16th International Conference on Nanochannels, Microchannels and Minichannels (ICNMM), Croatia, 2018.
- SERB International Travel grant awarded to Ph. D student Mr. Avadhesh Sharma to present papers in 26th International Conference on Nuclear Engineering, 2018.
- CSIR International Travel Grant awarded to Ph. D. student Mr. Vishal Nirgude to present paper in 25th International Conference on Nuclear Engineering, 2017.
- Mr. Rohit Kothari has been awarded DST Inspire fellowship.
- Mr. Rohit Kothari has been awarded SERB overseas vesting doctoral fellowship (SERB-OVDF) to carry out doctoral research at Purdue University, USA for one year.

20 **Dr. Indrasen Singh** (Mechanical Engineering)

- Prof. B K Subba Rao Medal (Gold Medal)

21 **Dr. Shanmugam Dhinakaran** (Mechanical Engineering)

- Delivered a Keynote Lecture on 'Applications of Porous Media in Biomedical Engineering' at the 6th International Conference on Applications in Porous Media, July 6-9, 2017 at Tianjin, China.
- Conducted a Global Initiative of Academic Networks (GIAN) Course titled 'Energy, Education and Innovation' during March 12-16, 2018. Course Instructor was Prof. Yunus A. Cengel, Professor

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| | Emeritus, University of Nevada, USA - widely known author of text books on 'Engineering Thermodynamics, Heat Transfer, Fluid Mechanics and Differential equations'.<br>• Received approval from MHRD for conducting a Global Initiative of Academic Networks (GIAN) Course titled 'Porous and Granular Materials: Applications in Modern Science and Technology'. Course instructor: Prof. Arzhang Khalili, Professor, Max Planck Institute for Marine Microbiology, Germany. |
| 22 | **Dr. Sandeep Chaudhary** (Civil Engineering)<br>• "Natural-coloured functionally graded rubberised geopolymer system: A cement-less solution for optimised concrete paver manufacturing" funded by DST, GOI. Indo-UK Project. (2018-2020). Collaborating Institute: University of Edinburgh, UK.<br>• Appointed Chair of Technical Committee 1 of Asian Concrete Federation, Thailand. |
| 23 | **Dr. Neelima Satyam** (Civil Engineering)<br>• Chairman, Selection Panel for MONBUKAGAKUSHO: MEXT Scholarships of Japanese Government (for selecting PhD/MS students from India) in Earthquake / Civil Engg stream. |
| 24 | **Dr. Manish Kumar Goyal** (Civil Engineering)<br>• Recipient of American Society of Civil Engineers (ASCE)-Best Theoretical-Oriented Paper Award 2018<br>• NVIDIA GPU Research Grant 2018<br>• MOEF &CC funded Project "Identification hydropower sites and critical glacial lakes for sustainable water resources management in Himachal Pradesh"under NATIONAL Mission on Himalayan Studies (NMHS) (April 2018-March 2021) |
| 25 | **Dr. Lalit Borana** (Civil Engineering)<br>• Received "Outstanding Reviewer Award" from the journal of " Computers and Goetechnics" by ELSEVIER, Netherlands<br>• Appointed as a Guest Editor for "International Journal of Distributed network sensors" by Sage Publishers (UK). |
| 26 | **Dr. Munir Ahmad Nayak** (Civil Engineering)<br>• Early Career Research Award from SERB-DST, Approval date: 12-Feb.-2018<br>• Visiting Fellow Award, Institute of Advanced Studies, Award date: 17-Nov.-2017<br>• Recipient of American Society of Civil Engineers (ASCE)-Best Theoretical-Oriented Paper Award 2018<br>• NVIDIA GPU Research Grant 2018<br>• MOEF &CC funded Project "Identification hydropower sites and critical glacial lakes for sustainable water resources management in Himachal Pradesh" under NATIONAL MISSION ON HIMALAYAN STUDIES (NMHS) (April 2018-March 2021)<br>• Outstanding Reviewer Award from Journal of Hydrology (Impact factor 3.727). |
| 27 | **Dr. Mohd. Farooq Azam** (Civil Engineering)<br>• Received UNESCO project "Himalayan Glaciers and risks to local communities" under IGCP scheme as Indian collaborator. |
| 28 | **Dr. Biswarup Pathak** (Chemistry)<br>• Indo-Australia Early/Mid-Career Research Award from Indian National Science Academy, 2017-18<br>• Hosted Prof. Rajeev Ahuja from Uppsala University, Sweden under GIAN (Global Initiatives of Academic Networks) program to IIT Indore for lectures. |
| 29 | **Dr. Chelvam Venkatesh** (Chemistry)<br>• Hosted Professor Prof. Ram Mohan from Illinois Wesleyan University, Bloomington, USA and Prof. Fabian Pfrengle, Max-Planck Institute for Colloids and Interfaces, Potsdam, Germany under GIAN (Global Initiatives of Academic Networks) program to IIT Indore for lectures and probable joint research collaboration.<br>• Two Ph.D. students Mr. Premansh Dudhe and Ms. Mena Asha Krishnan were awarded Commonwealth Fellowships to work at Loughborough University, United Kingdom with Prof. Paul Roach for a period of 12-months. |

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| | • OverseasesVisting Doctoral Fellowship (OVDF) SERB-DST research grant is awarded to research student Ms. Mena Asha Krishnan to work at Purdue University, USA for 12-months under the supervision of Prof. Kavita Shah in Cancer therapeutics.<br>• Mr. Chetan Sharma, a Master's student of Dr. Venkatesh was awarded DAAD fellowship to work at Leibniz University of Hannover, Germany with Prof. Andreas Kirschning for 7-months in cancer therapy. |
| 30 | **Dr. Sanjay K. Singh** (Chemistry)<br>• Ms.Vanitha Reddy, a Master's student of Dr. Singh was awarded DAAD fellowship to work at Institute of Catalysis Research and Technology (IKFT), Karlsruhe Institute of Technology, Germany with Prof. Silke Behrens for 7-months. |
| 31 | **Dr. Rajneesh Misra** (Chemistry)<br>• Hosted Prof. Dr. Francis D'Souza from the University of North Texas, Texas under GIAN (Global Initiatives of Academic Networks) program to IIT Indore for lectures. |
| 32 | **Prof. Pradeep Mathur** (Chemistry)<br>• Hosted Professor Prof. Pierre Braunstein, University of Strasbourg, France under GIAN (Global Initiatives of Academic Networks) program to IIT Indore for lectures. |
| 33 | **Dr. Shaikh M. Mobin** (Chemistry)<br>• Hosted Prof. Janet R. Morrow from University at Buffalo, State University of New York under GIAN (Global Initiatives of Academic Networks) program to IIT Indore for lectures. |
| 34 | **Dr. Santanu Manna** (Mathematics)<br>• International Award ICM-2018, Open Arms from International Mathematical Union.<br>• Organized one Continuing Education Program (CEP), 11- 14th December2017 (Convener).<br>• Delivered an Invited Talk at 4th International Conference EPSCICON-2018, Kerala.<br>• Delivered an Invited Talk at National Conference on Emerging Trends in Applied Sciences (NCETAS 2017), New Delhi.<br>• Delivered a couple of talks in one day workshop (TECH-Vaishnav-2018) on "Differential Equations: Modelling of Physical Systems", at, Shri Vaishnav Vidyapeeth Vishwavidyalaya, on 05 February, 2018.<br>• Delivered a couple of talks for a one day Workshop on "Applications of Mathematics in Engineering", REC Rewa, March 2018.<br>• Delivered a couple of talks at the Refresher Course for College Teachers, Devi Ahilya Vishwavidyalaya (DAVV), Indore, on 28th July and 14th August 2018. |
| 35 | **Dr. M. Tanveer** (Mathematics)<br>• IEEE Senior Member.<br>• Awarded IEEE Computational Intelligence Society Professional Travel Award.<br>• Special Session Chair of IEEE SSCI 2018 (Top-ranked conferences).<br>• Invited as Visiting Professor at UFMG, Brazil.<br>• Section Editor: Smart Science, Taylor & Francis (Scopus and ESCI).<br>• Delivered an Invited Talk at Department of Computer Science, UFMG, Brazil.<br>• Delivered two talks at WCCI 2018.<br>• Awarded Science & Engineering Research Board (SERB) Foreign Travel Grant.<br>• Delivered an Invited Talk at Winter School on Deep Learning and AI (DLAI) at Bangkok.<br>• Delivered a talk and chair three special sessions at IEEE SSCI 2018.<br>• Recommended research project under DST - ICPS - Data Science Research Initiative Scheme.2018: Recommended research project under CSIR - Extra Mural Research (EMR) Scheme. |
| 36 | **Dr. Ashisha Kumar** (Mathematics)<br>• Indore region coordinator for "Madhava Mathematics Competition"<br>• Local Organiser for "Mathematics Training and Talent Search Programme held at IIT Indore" |
| 37 | **Dr. Niraj Kumar Shukla** (Mathematics)<br>• Awarded a project funded by CSIR |

38 **Dr. Sk. Safique Ahmad** (Mathematics)
- Awarded a project under SERB MATRICS Scheme.
- Visited MIAMI University for the research Collaboration with Dr. Kumar Vikram Singh during September and December 2017.
- Contributed talk in the AMS conference held in UCF, Orlando in September 2017.
- Delivered an invited plenary talk in International Conference on Power, Control, Signal, and Computations (EPSCICON18), Organized by Vidya Academy of Science and Technology, Thrissur, Kerala.

39 **Dr. Subhendu Rakshit** (Physics)
- Awarded with a DST-DAAD bilateral collaboration project entitled "Flavour physics and dark matter: Reconnecting the dots" with TU-Dortmund, Germany.

40 **Dr. Preeti Anand Bhobe** (Physics)
- Awarded the "Indo-U.S. Fellowship for Women in STEMM (WISTEMM) Women Overseas Fellowship 2018" supported by the Department of Science and Technology (DST), Govt. of India and implemented by the Indo-U.S. Science & Technology Forum (IUSSTF) to conduct research work at Texas A & M University, Texas, U.S.A.

41 **Dr. Rajesh Kumar** (Physics)
- Appointed as Associate Editor of journal " Advances in Materials Processing and Technology (Taylor & Francis)"

42 **Dr. Raghunath Sahoo** (Physics)
- Mr. Sushanta Tripathy, a Ph.D. student in Dr. Sahoo's group received the Quark Matter-2018, Venice, Italy best poster flash talk award, which was selected among 389 posters presented in this highest conference in the field.

43 **Dr. Pankaj R. Sagdeo** (Physics)
- Mr. Vikash Mishra, a Ph.D. student working under the guidance of Dr. Sagdeo has been awarded best poster prize for his work entitled "Experimental and theoretical Investigation of Optical Spectroscopy on BaTiO3", at International conference on systems and process in physics, chemistry and biology (ICSPPCB 2018) held at the Department of Physics, Assam University, Silchar.

44 **Dr. Parasharam M. Shirage** (Metallurgy Engineering & Material Sciences)
- Organized 'International workshop on advanced nanoscience and engineering (IWANE-2017)' at the Discipline of Metallurgy Engineering and Materials Science in IIT Indore on 1st Dec. 2017.
- Organized '3-Day short course on Advanced Surface Science and Engineering,' (TEQIP sponsored)' at the Discipline of Metallurgy Engineering and Materials Science in IIT Indore during 26th-28th Mar. 2018.
- Visited Toyota Technological Institute, Nagoya, Japan in May 14 -27, 2018.
- Delivered Invited talk at Toyota Technological Institute, Nagoya, Japan in May 16, 2018.
- Visited National Institute of Advanced Industrial Science and Technology (AIST), Japan in May 27-June 3, 2018
- Delivered Invited talk at National Institute of Advanced Industrial Science and Technology (AIST), Japan. May 28, 2018
- Approved two GIAN courses for 2018.
- Completed 4 Ph.D. students' and 8 master students' theses.
- Editorial Advisor to IoP Materials Research Express
- Delivered numerous invited talks in International and National conferences
- Reviewer for Ph.D. and Materials thesis all over India.

45 **Dr. K. Eswara Prasad** (Metallurgy Engineering & Material Sciences)
- Belt and road Overseas expert, School of Materials Science Engineering, Xi'an Jiaotong University (XJTU), China (December 2017)

46 **Dr. Rupesh S. Devan** (Metallurgy Engineering & Material Sciences)
- "Excellent," grade for INSPIRE Research Project from 'Department of Science and Technology (DST)' (June. 2017).
- 'Editor,' 'Chinese Journal of Physics' Elsevier publishers (Jan. 2018)

- Organized 'International workshop on advanced nanoscience and engineering (IWANE-2017)', Discipline of Metallurgy Engineering and Materials Science, IIT Indore, 1st Dec. 2017.
- Organized '3-Day short course on Advanced Surface Science and Engineering,' (TEQIP sponsored)', Discipline of Metallurgy Engineering and Materials Science, IIT Indore, 26th-28th Mar. 2018.
- Delivered invited talk on "1D nano-architectures: potential candidates for hybrid photovoltaic applications", in the Global Photovoltaic Conference 2018 (GPVC 2018), Kimdaejung Convention Centre, Gwangju, S. Korea, 14th -16th March 2018
- Visited Chonnam National University (CNU) Gwangju, KITECH Gwangju, and SungKyunKwan University (SKKU) Seoul, during 16th, 20th and 21st March 2018 and delivered invited talk on "Mechanics of 1D Nano-materials for engineering applications"
- Delivered invited talk on "X-ray Photoelectron Spectroscopy (XPS): New Way for Chemical Analysis of Nanomaterials," Short term Program in Advances in Nanoscience and Nanotechnology, A.S. Mandals, Arts & Commerce College Trust's Shaikshnik Sankul, Talod, Nandurbar, 22nd - 27th December 2017.
- Delivered a plenary talk on "Nanomaterials: Development, Expectations, and Challenges in the 21st Century", National Seminar on Recent Trends in Synthesis and Applications of Nanomaterials (RTSAN-2017), Dada Patil Mahavidyalaya, Karjat, Karjat, India 8th - 9th December 2017.
- Delivered an invited talk on "Xps and field electron emission investigations of 2D MoS2@ 1D brookite $TiO_2$ nanorods hetero- architectures" in the International Conference on Advanced Materials Development and Performance (AMDP), Savitribai Phule Pune University, Pune during 11th -15th July 2017.

**47** **Dr. Mrigendra Dubey** (Metallurgy Engineering & Material Sciences)

- Young Scientist Award, International Academy of Physical Sciences, Allahabad- 2017.
- Invited Scientific Visitor at ENS-Lyon, University of Rennes, Grenoble and Burgundy, France -2017.
- Invited talk "Multi-stimuli responsive metallogels" at Osmania University Hyderabad- 2017.
- Invited teacher- Indian Academy of Sciences, Bangalore meeting held at BHU Varanasi- 2018.

**48** **Dr. Sunil Kumar** (Metallurgy Engineering & Material Sciences)

- Early Career Research Award (ECRA) – Awarded by Science and Engineering Research Board, Department of Science and Technology, Government of India

**49** **Dr. Akshaya Kumar** (Humanities & Social Sciences)

- Two journal articles published, one in *Social Text* (Duke University Press) and another in *Contemporary South Asia* (Taylor and Francis).
- Presented three academic conference papers: one at De La Salle University, Manila; and two in India – UNESCO, New Delhi and IIT Bombay.

**50** **Dr. Ananya Ghoshal** (Humanities & Social Sciences)

- Received travel support (chosen among fourteen scholars globally) to participate in the "New Scholars Seminar" at the Digital Humanities 2017 pre-conference co-organized by McGill University and the Université de Montréal in August 2017.
- Co-authored *An Anthropocene Primer,* an innovative born-digital (http://anthropoceneprimer.org/), Open Access, Open Peer Review publication that guides learners through the complex concepts and debates related to the Anthropocene, including climate change, pollution, and environmental justice. This work emerged from the "Anthropology of the Anthropocene: Structures, Theories, Practices" workshop hosted by the IUPUI Arts and Humanities Institute, Indianapolis in May 2017 which Dr. Ghoshal was a part of. *An Anthropocene Primer* has been shortlisted in the EU for the 2018 Best Climate Solutions Award with the Centre Euro-Mediterraneo sui Cambiamenti Climatici (CMCC) in the category of "Education and Media."
- Invited to teach two Film Appreciation Workshops at The Maharaja Sayajirao University of Baroda on representation of gender in Indian cinema (September 2017 and January 2018) organized by Women's Studies Research Center (WSRC), MSU.

51 **Dr. Nirmala Menon** (Humanities & Social Sciences)

- Won an Australian Grant and was a visiting Research Fellow at Edith Cowan University, Australia.
- Keynote speaker for two national and two international Digital Humanities conferences.
- Invited speaker for Academia Europaea's Knowledge Hub Series on "New Frontiers in Humanities Research".
- Co-founded DHAI (Digital Humanities Alliance of India) and organized the inaugural DHAI conference in collaboration with IIM Indore in June 2018.
- Co-PI for the Samagra Documentation project in partnership with UNICEF, India.

52 **Dr. Ruchi Sharma** (Humanities & Social Sciences)

- Research Scholar, Aparna Sharma, was selected for Govt. Of Taiwan, TEEP internship program at National Cheng Kung University (NCKU), Taiwan.
- Organized a GIAN course, "Economics of Science, Technology and Innovation: Empirical Approaches and Randomized Control Trials (RCTs)," 10-14 January 2018 with Dr. Ina Ganguli as resource person from the University of Massachusetts Amherst, USA.

53 **Dr. Sanjram P. Khanganba** (Humanities & Social Sciences)

- Secured conference registration and accommodation for the 20th Triennal Congress of International Ergonomics Association, August 26-30, 2018. Mr. Sajad A. Najar (doctoral research scholar) presented research findings in the area of Automotive Human Factors.
- Delivered an invited talk titled, 'Human Factors & Applied Cognition Research: Development of D3 Paradigm' at IIT Kanpur on February 22, 2018.
- Member of steering committee for a course on 'Human Factors and Ergonomics' that IDC, IIT Bombay is developing. The course is a part of Open Design School at IDC School of Design, IIT Bombay which will be hosted online on 'Swayam' (a platform under MHRD, Government of India).

54 **Dr. Shomik Dasgupta** (Humanities & Social Sciences)

- Invited Departmental Lecture, Presidency University Calcutta,
  Title of Lecture: 'New approaches to the global history of Bengal: Reflections from the thought of Martin Heidegger'
- Invited Departmental Lecture, Vishvabharati University, Santiniketan
  Title of Lecture: 'The Political thought of Rammohun Roy'
- Invited to teach a 4 credit compulsory course on Business History at IIM Indore, Jan-March 2018.

55 **Dr. Hem Chandra Jha** (Biosciences & Biomedical Engineering)

- A Ph.D. research scholar won Best Poster Award in international conference "Emerging Areas in Biosciences and Biomedical Engineering (eBBT) 2018'' organized by IIT Indore from January 5-6, 2018
  *Tiwari D, Jhakhmola S, Jha HC. Epstein Barr Virus as an inducer of neurodegeneration. Poster presentation.*

56 **Dr. Kiran Bala** (Biosciences & Biomedical Engineering)

- SERB Early Career Research Award - 2018.
- International Travel Support by DST, Delhi to attend 11th International Phycological Congress, held at Szczecin, Poland from 13th – 19th August, 2017.

57 **Dr. Debasis Nayak** (Biosciences & Biomedical Engineering)

- Established a milestone of "Reverse Genetics System" for recombinant RNA virus recovery. This platform generates customized viruses for vaccine research and development.
- Secured a grant from Dept. of Biotechnology (DBT) to develop next generation vaccine against Chikungunya virus infection.

58 **Dr. Parimal Kar** (Biosciences & Biomedical Engineering)

- SERB Early Career Research Award - 2018.

59 **Dr. Sushabhan Sadhukhan** (Biosciences & Biomedical Engineering)

- Early Career Research Award from Department of Science & Technology (DST), Govt. of India, 2018.

| | |
|---|---|
| 60 | **Dr. Mirza S. Baig** (Biosciences & Biomedical Engineering)<br>• INSA-International Bilateral Award for the year 2018 to visit Koç University, Turkey for an International collaboration |
| 61 | **Dr. Avinash Sonawane** (Biosciences & Biomedical Engineering)<br>• Alexander von Humboldt Fellow for Experienced Researcher (2017-2020), Leibniz Center for Medicine & Biosciences, Borstel, Germany.<br>• Educational Leadership Award, Odisha for contribution in promoting education in Odisha state (2017) |
| 62 | **Dr. Bhargav Vaidya** (Astronomy)<br>• CSIR Research Grant of INR 20 Lakhs.<br>• Member of International Astronomical Union (IAU).<br>• Awarded IAU travel grant to attend the IAU symposium 342 titled "Perseus in Sicily: from black hole to cluster outskirts" in Noto, Italy. |
| 63 | **Dr. Abhirup Datta** (Astronomy)<br>• ECR award from DST-SERB of about INR 40 Lakhs.<br>• Member of International Astronomical Union (IAU).<br>• Organized EoR/Cosmology-School at NCRA-TIFR.<br>• SOC member for EoR/Cosmology Conference at Presidency University, Kolkata<br>• Awarded IAU Travel Grant to attend meeting IAUS333. |
| 64 | **Dr. Siddharth S. Malu** (Astronomy)<br>• Member of International Astronomical Union (IAU). |
| 65 | **Dr. Saurabh Das** (Astronomy)<br>• DST-INSPIRE Faculty Fellow Award - transferred to IIT Indore |

# Sophisticated Instrumentation Centre (SIC), IIT Indore: A National Facility

Sophisticated instrumentation centre (SIC) was established in September 2011 with institute funding to expedite the research program at IIT Indore. The SIC mission is to support and foster the research enterprise in the School of Basic Science, at the Indian Institute of Technology (IIT) Indore, as opportunities exist, by providing state-of-the-art instrumentation and ancillary equipment, and expertise in its use and application. The SIC in the School of Basic Science at IIT Indore 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 sector and external commercial organizations.

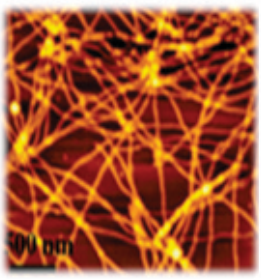
SIC has now emerged as one of the first such centers in the country providing extensive support to the users across the country. It has become a self sustained centre by generating funds from service provided to external users from academia and industry.

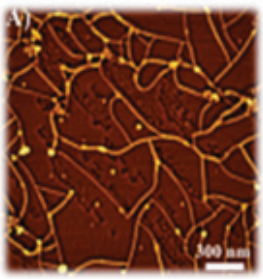
A major advantage of SIC is its accessibility to the students within the Institute, a very healthy ratio of students to the time availability on instruments.

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

### Atomic Force Microscopy (AFM)

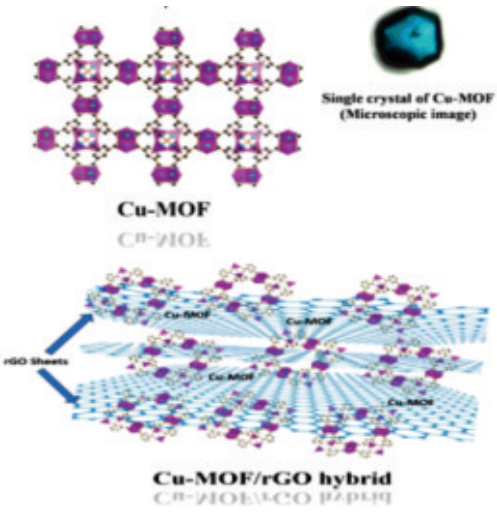




Atomic Force Microscopy (AFM) (SPM) AIST-NT Smart SPM 1000 and Park Systems NX10, is one of the first 100% automated systems that offers its cutting-edge technology of ultra-fast, metrological and high resolution measurements for the most advanced materials research at the nano scale in all AFM and STM modes. Various Measuring modes, Contact AFM in air/liquid; Semi-contact AFM in air/liquid; Non-contact AFM; Phase Imaging; Magnetic Force Microscopy (MFM); Kelvin Probe (Surface Potential Microscopy); Electric Force Microscopy (EFM); Piezo Response Force Microscopy; Force curve measurements; Nanolithography; Conductive AFM; Scanning Tunneling Microscopy STM (optional); Photocurrent Mapping; Volt-ampere characteristic measurements.

## Single Crystal X-ray Diffraction

Single Crystal X-ray Diffraction Facility at SIC is equipped with state- of –the- art dual core Agilent Technologies (Oxford Diffraction) Super Nova CCD System. It gives access to micro-focus Cu and Mo sources which allows even small size crystals data collection and fairly good structure solutions. It is also equipped with Oxford cryo systems which enable temperature range from 90 to 400 K. There are also high definition microscopes for separations and mounting of crystals.




**Services provided include:**

- Crystal screening and mounting, including air-sensitive samples.
- Diffraction data collection under various conditions, including temperatures as low as 90 K.
- Structure solution, refinement, and interpretation upto publication level.
- Cambridge Structure Database searching.

Single Crystal X-ray Diffraction Facility is an independent National Facility. Currently, it is offering service to School of Basic Science within the Institute, other academic institutes and industries throughout India for X-ray Crystallographic Studies.

## Single Crystal X-ray Diffraction

### Dual Ion Beam Sputtering Deposition (DIBSD)

The goal is to encourage and foster the research initiative in the School of Engineering, at Indian Institute of Technology Indore, by providing state-of-the-art research facility, and expertise in its use and application. The diverse novel researches performed by this unique facility will be a platform to attract top-seeded researchers and experimentalists in key semiconductor opto-electronic and nanotechnology industries, research laboratories, and academic institutions across the entire globe to establish a strong collaborative research programme with IIT Indore. Research activities, boosted by the DIBSD facility, are mainly focused on growth of novel nanostructures and high-quality thin films having enormous applications in semiconductor opto-electronics, sensors, solar photovoltaics, detectors, biotechnology, microelectro-mechanical systems (MEMS), nanoelectro mechanical systems (NEMS) etc.

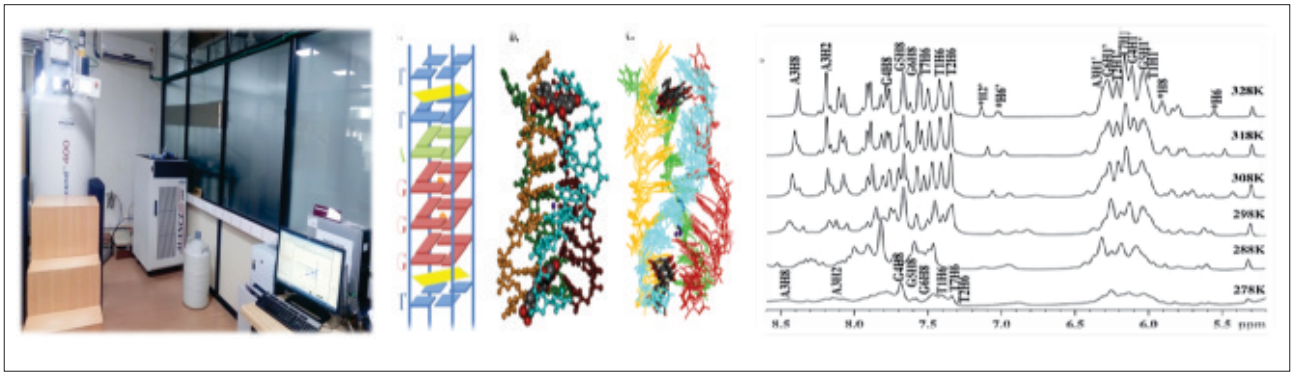
In a broad sense, the research work accomplished by this facility would be extremely beneficial to showcase our expertise in the emerging areas of current research and development.

Diverse novel research activities would have major impact on following industries:

- Automobile
- Pharmaceutical (Nano-Bioelectronics)
- Chemical
- Nanotechnology
- Electronics
- Renewable Energy

## Nuclear Magnetic Resonance 400 MHZ (NMR)

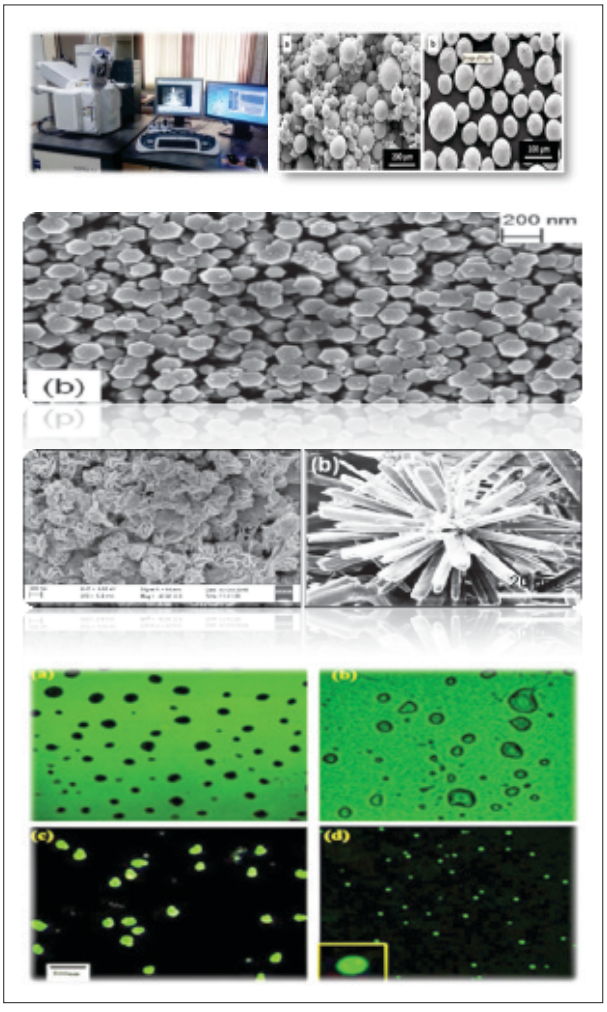
NMR spectrometer: Fourier transform Nuclear Magnetic Resonance spectrometer, Model AVANCE III 400 Ascend Bruker BioSpin International AG, Switzerland. Magnet: 8.96 Tesla (Superconducting), 50 mm bore Probes Available: For Solution State NMR 5 mm Broad Band Fluorine Observe Probe with gradient along Z-axis and Automated Tuning & Matching (ATM) accessory. 5 mm Broad Band Inverse Probe with gradient along Z-axis and Automated Tuning & Matching (ATM) accessory. Console: The state of the art Avance III 400 NMR console with digital lock and 2 independent RF channels providing 60 W 1H/19F transmitter and 150 W transmitters and broad band Preamplifier. In addition, 5 W 2H transmitter for deuterium observe and decoupling.




## Field-Emission Scanning Electron Microscope (FE-SEM)

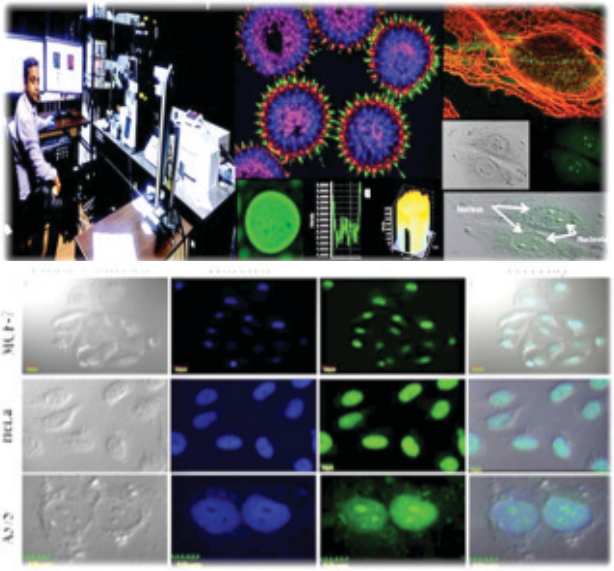
Supra55 Zeiss, provides excellent imaging properties combined with analytical capabilities makes this high end FE-SEM suitable for a wide range of applications in materials science, life science and semiconductor technology. The large specimen chamber for the integration of optional detectors and accessories enables the user to configure the SUPRA for specific applications without sacrificing productivity or efficiency.

- GEMINI Technology with high efficiency in-lens detector and no magnetic field at specimen level
- Superb resolution and image quality at high and low operating voltages
- Extremely wide operating voltage range from 0.02-30kV
- Designed-in ease of use with minimal adjustments required when changing operating conditions
- Short analytical working distance of 8.5 mm for simultaneous high resolution imaging and X-ray analysis
- High probe current (up to 100 nA) with high stability (better than 0.2%/h) for precise analytical results
- Multi-User friendly with Windows® based SmartSEM control software



## Confocal Laser Scanning Microscope (CLSM)

IIT Indore confocal microscopy facility is located at sophisticated instrument center (SIC) building, Simrol campus, IIT Indore. The facility has a state of the art imaging system with a fully motorized inverted microscope based multiphoton system capable of confocal imaging, fluorescence lifetime imaging microscopy (FLIM), fluorescence correlation spectroscopy (FCS), IR imaging, live cell imaging. The microscope is also fitted with Mai Tai DeepSee femtosecond tunable laser.



- Confocal laser scanning microscopy
- Two-photon laser scanning microscopy
- Fluorescence lifetime imaging microscopy
- Fluorescence correlation spectroscopy
- Live cell imaging

## BET Surface Area Analyzer

Surface Area Analyzer quantachrome, Autosorb iQ2, BET Surface Area & Pore Volume Analyzer is an instrument to determine the specific surface area of powders, solids, and granules. Analyses: Single- and Multipoint BET (Brunauer, Emmett, and Teller) surface area, thickness, pore area distributions (BJH method), pore volume, and pore surface area Langmuir surface area, Temkin and Freundlich isotherm analyses.

Unique Features:

Physisorption: The shape of the typical isotherm provides various useful information on the large uptake of nitrogen at low P/Po indicating filling of the micropores. The linear portion of the curve represents multilayer adsorption of nitrogen on the surface, and the concave upward portion of the curve represents filling of meso-and macropores. An entire isotherm is needed for one to calculate the pore size distribution of the material

Chemisorption: Some surfaces, especially catalysts, are sufficiently reactive to form chemical bonds with certain gases. In contrast to physisorption, chemical adsorption (chemisorption) involves the formation of strong bonds between adsorbate molecules and specific surface locations known as active sites. Chemisorption is thus used primarily to evaluate quantitatively the number of surface active sites which are likely to promote (catalyze) chemical reactions. Both static adsorption isotherms and dynamic pulse titrations yield monolayer uptake, metal area, nanocluster (crystallite) size and active metal area of heterogeneous catalysts. Isothermal results can be used to map surface energetic heterogeneity via heat of adsorption calculations.

# Gas Chromatography – Mass Spectrometry (GC-MS)

Gas Chromatography – Mass Spectrometry (GC-MS), is a versatile analytical tool for separation and identification of non-polar / mid polar compounds in the reaction mixture. Presently SIC is equipped with GC-MS QP 2010 Ultra mass spectrometer from Shimadzu Analytical India Pvt. Ltd. The machine can be configured into 3 types of configurations viz. GC-MS, GC-TCD, GC-FID. GC-MS uses Electron Ionization (EI), Chemical Ionization (CI) since it has the capability to perform positive and negative ionization for molecular weight information of more complex samples. GC-MS uses helium as inert carrier gas. It is very sensitive instrument, and can detect upto PPM level masses. The mass range is 10-1000 Da, which allows analysis over a wide range of low and high molecular weight compounds. NIST Mass spectra library is available for separation/ identification of organic compounds and molecules. GC-TCD can be used for Gases samples analysis such as Hydrogen, Nitrogen, Carbon Monoxide, Carbon Dioxide, and Methane effectively. The GC-FID is well suited for analysis of hydrocarbons such as methane, ethane, acetylene, etc., but also for organic substances containing hydrocarbons and for volatile organic compounds.

*Scientific Publications:*

*Upcoming Instruments*
:
**500 MHz NMR, DSC,**

## 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 Dev University, 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)
Pune University
Pinnacle Biomedical Research Institute (PBRI), Bhopal
Devi Ahilya Vishwavidyalaya, Indore
Shri Govindram Seksaria Institute of Technology and Science
NMU Jalgaon
RD University Jabalpur
Central University Sagar
Guru Ghasidas Vishwavidyalaya Central University, Bilaspur
SRM University
University College Trivandrum
Tumkur University, Karnataka
Thapar University, Patiala
Punjab University
Awadhesh Pratap Singh University, Rewa
University of Hyderabad, Telangana
Pondicherry University, Puducherry
Vikram University, Ujjain
Mewar University, Rajasthan
Raja Ramanna 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
SRF Ltd., Indore
M.P. Dye Chem., Indore
Rupak Enterprises, Indore
Sprint Testing Solutions, Mumbai
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

# People at SIC

**Dr. Shaikh M.Mobin**
Associate Professor
In-charge SIC
xray@iiti.ac.in

**Archana Chaudhary**
Instrument: CHNS-O, TGA/DSC

**Kinny Pandey**
Instruments: NMR, AFM, PXRD, FESEM/EDAX/WDX, FT-IR, TCSPC, UV- Vis, Polarimeter, Fluorimeter, LB-Film, CD, BET

**Ghanshyam A. Bhavsar**
Instrument: LC-MS, HPLC, HRMS, GC-MS, FT-IR

**Manish Kushwaha**
Instrument: CD

**Ravinder**
Instrument: Confocal Microscope

# 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.

Ms. Monika Gupta presently heads the counseling cell. After completing her Masters in Psychology from Delhi University, Ms. Gupta received her professional training as a Clinical Psychologist from NIMHANS, Bangalore.

The Counseling Cell also has a visiting consultant psychiatrist Dr. Ashutosh Singh (MBBS, DNB Psychiatry). It works in close association with the office of Dean of Students Affairs through its student mentors and volunteers.

Its focus is on early identification & intervention, as well as prevention of mental health problems of students. Individual counseling sessions are also conducted for any student who seeks help on their own or are referred by Institute Medical officers, academic office, peers, parents or faculty members. Individual counseling assists students with a wide range of concerns -be it academic, personal, emotional, family or peer-related; as well as a wide range of psychological concerns including clinical depression, anxiety spectrum difficulties and suicidal tendencies.

Its activities begin with organising a volunteers' help desk during the registration and orientation programme of newly admitted students. Its peer tutoring and mentoring programme facilitates a culture of student solidarity and group learning.

An expert talk by Dr. Shekhar Seshadri on "The Individual and the institution - the nature and scope of student growth" was organized by the counseling cell. Dr. Seshadri is Professor and Head, Department of Child and Adolescent Psychiatry,(NIMHANS), Bangalore. The Cinephiles Club screened a short film "Suicide- it is not an option" and the Drama Club members performed a street play. Literary Club and Kalakriti Club organised a poetry and poster competition respectively.

Dr. Abhishek Srivastava, Dean, Student Affairs with a team of student mentor

Expert Talk by Dr. Shekhar Seshadri

Prof. N. K. Jain with Prof. Shekhar Seshadri

### Other major roles played by the Counseling Cell include:

- Rapport building and bonding with all the students
- Peer tutoring and peer mentoring program
- Greater support for students coming from the underprivileged background and persons with disability.
- Facilitate various policies for students having academic concerns
- Parent and family counseling sessions in person and interaction with parents over the phone as per the need.
- Creating a good liaison with various departments and services at the institute to facilitate the implementation of the intervention plan.
- De-stigmatising counseling services to a considerable extent & enhancing the positive perception of the cell.

### Central Library

- The Central Library began with a small number of books in 2009. At present, the Library has a collection of 33751 books.
- The Library also boasts of a select collection of fiction, literature, and general interest books such as sports, films, etc.
- The Library has also developed special collections such as a Gandhian Studies collection, Hindi collection, and children's books collection.
- At present, the Library functions from two locations: School Building and Academic POD CSE 02. Users can avail of all services at both locations.

## Library at a Glance:
## Collection (As on 31.03.2018)

| Books | E-Journals | E-Books | Print Journals | Magazines Newspapers |
|---|---|---|---|---|
| 33751 | 7685+ | 7600 approx. | 03 | 2609 |

### Books added during FY 2017-18: 2196

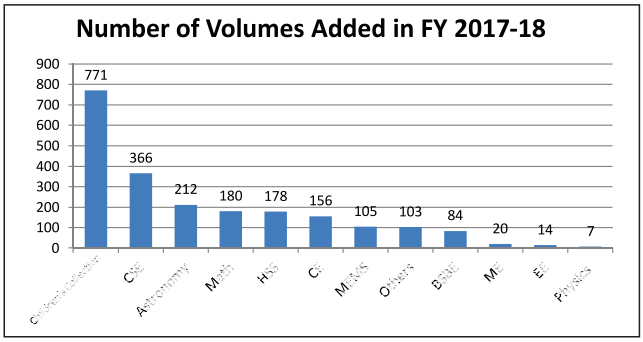



Figure 1. Number of volumes added in FY 2017-18

### User category wise book issue:

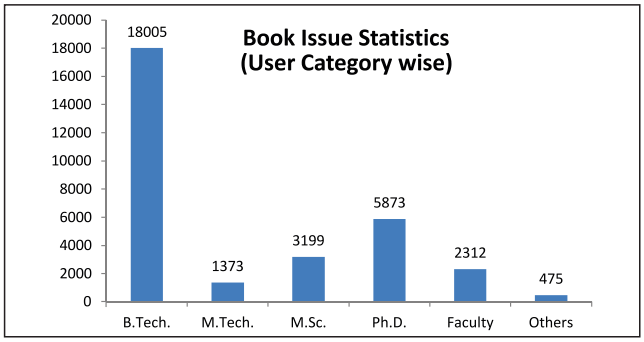



Figure 2. Book Issue Statistics (Apr.2017 to Mar.2018)

## Library Usage: (April 2017 to March 2018)

| Books Issued | Reading Room Usage per month |
|---|---|
| (Average)31237 | 4000 users p.m. approx |

### Department wise book issue:

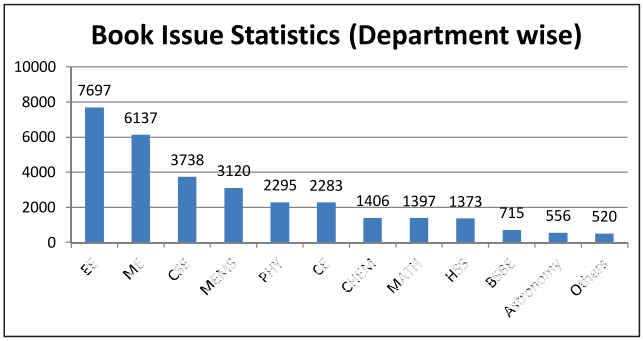



Figure 3. Book Issue Statistics (Apr. 2017-Mar. 2018)

**Periodicals and Newspapers (in print):** At present, the Library subscribes to 3 Journals, 26 Magazines, and 9 newspapers.

**Electronic Resources:** Access to electronic information resources is critical for research. The Library has developed a collection of electronic resources which include journal articles, 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 hyperlinks is available on the Library's web page at the Institute website.

**Library Services:**

At present, the Library offers the following services:

- **Lending facility:** Undergraduate students can borrow 8 books for 15 days, whereas Ph.D. students can borrow up to 8 books for one month. Faculty members can borrow up to 40 books for a semester.
- **Overnight Lending:** Overnight lending facility is provided to students who wish to borrow a book from the reserved section, or have crossed their entitlement limit. Books on overnight 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 is not available in our Library.
- **Book Bank:** Under the Book Bank scheme, textbooks are provided to SC/ST students for a semester.
- **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 Program:** The Library conducts orientation programs for new students to make them aware of the Library facilities and services and to help them 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 RemoteXs.

**Library Automation:**

**ILMS:** The Library has successfully migrated from Libsys7 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 the resource. After the trial is over, the Library Committee discusses the possibility of subscription based on the recommendations/ feedback received from users.

**Other Activities:** The Library organizes various Training Programs/ Informative Sessions for E-Resources and also for Print Resources. The most recent training program was conducted in September 2018 which included Web of Science, Journal Citation Reports and EndNote.

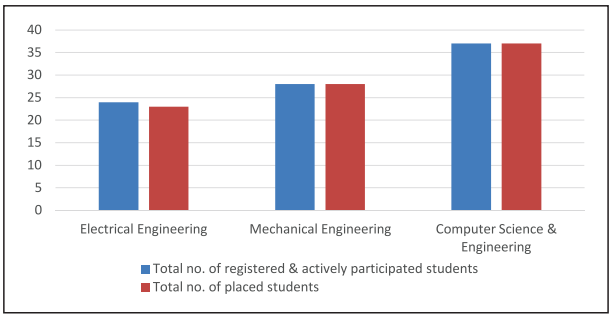
# Annual Placement Report

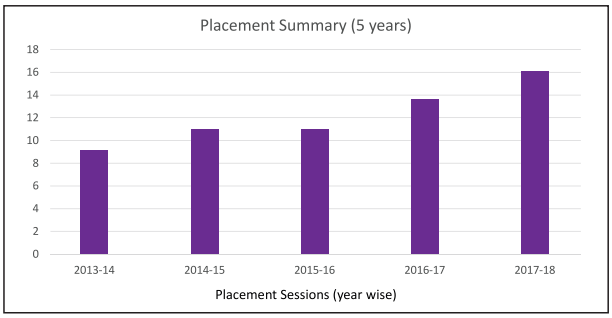
The final placements at the IIT Indore have been successfully completed for the 2017-2018 session. The placement office has always strived to build a strong mutual association with the recruiters and create better opportunities for the students. This has reflected in our results, as IIT Indore has achieved 99% placements in the 2017-18 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.

Companies from various sectors visited IIT Indore. These include: (i) Microsoft, (ii) Amazon, (iii) DE-Shaw, (iv) Goldman Sachs, (v) Reliance Jio, (vi) Arcesium Works Applications, (vii) ISRO, (viii) HPCL, (ix) Salesforce, (x) Razorpay, (xi) Intel, (xii) TESCO, (xiii) Cognizant, (xiv) Oracle, (xv) MathWorks, (xvi) Capgemini, (xvii) CodeNation, (xviii) L&T, (xix) Seagate, (xx)Analog Devices, (xxi) STMicroelectronics, (xxii) Mentor Graphics, (xxiii)Bharat Seats, (xxiv) Maruti Suzuki, (xxv) MAQ Software, (xxvi) Innovaccer Analytics, (xxvii) Wipro, (xxviii) TCS, (xxix) Tata Motors, (xxx) Quantile Analytics, (xxxi) Evalueserve, (xxxii) KPIT Technologies, (xxxiii) Go-Jek, (xxxiv) Finisar, and many more.

The average salary package is INR 16.06 lakh p.a. and highest package received is INR 36.5 lakh p.a. (domestic) and 6 million ¥ (overseas). Many companies offered internship opportunities. The highest stipend offered was 1.25 lakh per month. 10% of students opted for higher education at IIMs, IITs, and universities abroad while others are inclined to prepare for competitive exams. A few showed enthusiasm to start their own ventures.




## Placement Statistics & Key Highlights for Session 2017-18 (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 2017-18** | 116 | 89 | 88 | 99 % | 52 | 16.06 | 6 million ¥ (International) 36.5 LPA, INR (Domestic) |

# Administration

## 1. General Administration:

### 1.1 About the Organization:

IIT Indore is 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 IIT's, 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 the overall governance, superintendence and control.

The Senate is the apex body to decide on academic policies and matters of the Institute which approves and administers the 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 the Chairman of the Senate. Members of the Senate are listed in the Appendix.

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 Report.

**Meetings of the Decision making Bodies:**

| Sl. No. | Name of Meeting | No. of Meeting |
|---|---|---|
| 1. | Senate: | Three Meetings -<br>(I) 10.07.2017 (ii) 13.10.2017 (iii) 20.02.2018 |
| 2. | Board of Governors: | Three Meetings–<br>(I) 21.07.2017 (ii) 27.09.2017 (iii) 09.12.2017 |
| 3. | Finance Committee: | Five Meetings –<br>(I) 20.06.2017 (ii) 12.07.2017 (iii) 13.09.2017<br>(iv) 01.12.2017 (v) 07.03.2018 |
| 4. | Building and Works Committee: | Six Meetings –<br>(I) 22.04.2017 (ii) 17.06.2017 (iii) 04.07.2017<br>(iv) 05.09.2017 (v) 26.10.2017 (vi) 15.02.2018 |

### 1.2 Staff position:

| | |
|---|---|
| Faculty members | 115 |
| Visiting Faculty | 04 |
| Group A Officers | 18 |
| Technical staff | 35 |
| Other Administrative Staff | 40 |

The Number of faculty/staff members appointed during the year 2017-18 is as under:

Professors - 09, Associate Professor - 12, Assistant Professor (Grade I) - 16, Assistant Professor (Grade II) - 09, Non-teaching staff – 07, No. of faculty members relieved due to resignation or other reasons of separation-03, No. of staff relieved due to resignation / other reasons - 02

**1.3. The list of faculty/staff appointed between 1st April 2017 and 31st March 2018 are as below:**

| Sl. No. | Name of Employee | School/Discipline /Centre | Position/ Designation | Qualification | Date of Joining |
|---|---|---|---|---|---|
| 1. | Dr. Sumanta Samal | Metallurgy Engineering and Materials Science | (Assistant Professor (Grade I) | Ph. D. | 10-04-2017 |
| 2. | Dr. Indrasen Singh | Mechanical Engineering | (Assistant Professor (Grade II) | Ph. D. | 12-01-2017 |
| 3. | Dr. Santosh Sattappa Hosmani | Metallurgy Engineering and Materials Science | Assistant Professor (Grade I) | Ph. D. | 17-04-2017 |
| 4. | Dr. Mrigendra Dubey | Metallurgy Engineering and Materials Science | Assistant Professor (Grade I) | Ph. D. | 11-05-2017 |
| 5. | Dr. Bhargav Pradeep Vaidya | Astronomy | Assistant Professor (Grade I) | Ph. D. | 15-05-2017 |
| 6. | Dr. Subbareddy Daggumati | Mechanical Engineering | (Assistant Professor (Grade I) | Ph. D. | 15-05-2017 |
| 7. | Dr. Munir Ahmad Nayak | Civil Engineering | (Assistant Professor (Grade I) | Ph. D. | 16-05-2017 |
| 8 | Dr. Sandeep Chaudhary | Civil Engineering | Associate Professor | Ph. D. | 17-05-2017 |
| 9. | Dr. Sushabhan Sadhukhan | Biosciences and Biomedical Engineering | (Assistant Professor (Grade I) | Ph. D. | 19-05-2017 |
| 10. | Dr. Mohan Santhakumar | Mechanical Engineering | Associate Professor | Ph. D. | 30-05-2017 |
| 11. | Dr. Jayaprakash Murugesan | Metallurgy Engineering and Materials Science | (Assistant Professor (Grade I) | Ph. D. | 12-06-2017 |
| 12. | Dr. Eswara Prasad Korimilli | Metallurgy Engineering and Materials Science | (Assistant Professor (Grade I) | Ph. D. | 27-06-2017 |
| 13. | Dr. Abhishek Srivastava | Computer Science and Engineering | Associate Professor | Ph. D. | 28-08-2017 |
| 14. | Dr. Dhirendra Kumar Rai | Metallurgy Engineering and Materials Science | (Assistant Prof -essor (Grade I) | Ph. D. | 29-09-2017 |
| 15. | Dr. Ajay Kumar Kushwaha | Metallurgy Engineering and Materials Science | (Assistant Prof -essor (Grade I) | Ph. D. | 29-09-2017 |

| | | | | | |
|---|---|---|---|---|---|
| 16. | Dr. M. Tanveer | Mathematics | (Assistant Professor (Grade I) | Ph. D. | 29-09-2017 |
| 17. | Dr. Sanjeev Singh | Mathematics | (Assistant Professor (Grade II) | Ph. D. | 29-09-2017 |
| 18. | Dr. Kapil Ahuja | Computer Science and Engineering | Associate Professor | Ph. D. | 10-10-2017 |
| 19. | Dr. Abhirup Datta | Astronomy | Associate Professor | Ph. D. | 13-10-2017 |
| 20. | Dr. Lalit Borana | Civil Engineering | (Assistant Professor (Grade I) | Ph. D. | 27-10-2017 |
| 21. | Dr. Abhijit Ghosh | Metallurgy Engineering and Materials Science | (Assistant Professor (Grade II) | Ph. D. | 01-11-2017 |
| 22. | Dr. Manish Kumar Goyal | Civil Engineering | Associate Professor | Ph. D. | 29-11-2017 |
| 23. | Dr. Neelima Satyam Devarakonda | Civil Engineering | Associate Professor | Ph. D. | 29-11-2017 |
| 24. | Dr. Mohd. Farooq Azam | Civil Engineering | (Assistant Professor (Grade II) | Ph. D. | 01-12-2017 |
| 25. | Dr. Prabhat Kumar Upadhyay | Electrical Engineering | Associate Professor | Ph. D. | 05-12-2017 |
| 26. | Dr. Ram Bilas Pachori | Electrical Engineering | Professor | Ph. D. | 18-12-2017 |
| 27. | Dr. Abhinav Kranti | Electrical Engineering | Professor | Ph. D. | 18-12-2017 |
| 28. | Dr. Vimal Bhatia | Electrical Engineering | Professor | Ph. D. | 18-12-2017 |
| 29. | Dr. Srivathsan Vasudevan | Electrical Engineering | Associate Professor | Ph. D. | 18-12-2017 |
| 30. | Dr. Mukesh Kumar | Electrical Engineering | Associate Professor | Ph. D. | 18-12-2017 |
| 31. | Dr. Subhendu Rakshit | Physics | Professor | Ph. D. | 18-12-2017 |
| 32. | Dr. Sarika Jalan | Physics | Professor | Ph. D. | 18-12-2017 |
| 33. | Dr. Krushna R. Mavani | Physics | Professor | Ph. D. | 18-12-2017 |
| 34. | Dr. Anand Parey | Mechanical Engineering | Professor | Ph. D. | 18-12-2017 |
| 35. | Dr. Rajneesh Misra | Chemistry | Professor | Ph. D. | 18-12-2017 |
| 36. | Dr. Suman Mukhopadhyay | Chemistry | Professor | Ph. D. | 18-12-2017 |
| 37. | Dr. Parimal Kar | Centre of Biosciences and Biomedical Engineering | (Assistant Professor (Grade I) | Ph. D. | 18-12-2017 |

| | | | | | |
|---|---|---|---|---|---|
| 38. | Dr. Hemant Borkar | Metallurgy Engineering and Materials Science | (Assistant Professor (Grade I) | Ph. D. | 18-12-2017 |
| 39. | Dr. Yuvraj Kumar Madhukar | Mechanical Engineering | (Assistant Professor (Grade II) | Ph. D. | 20-12-2017 |
| 40. | Dr. Akshya Kumar | HSS | (Assistant Professor (Grade II) | Ph. D. | 22-12-2017 |
| 41. | Dr. Shomik Dasgupta | HSS | (Assistant Professor (Grade II) | Ph. D. | 11-01-2018 |
| 42. | Dr. Ananya Ghoshal | HSS | (Assistant Professor (Grade II) | Ph. D. | 12-01-2018 |
| 43. | Dr. Devendra L. Deshmukh | Mechanical Engineering | Associate Professor | Ph. D. | 25-01-2018 |
| 44. | Dr. Usha Udaar | HSS | (Assistant Professor (Grade II) | Ph. D. | 19-02-2018 |
| 45. | Dr. Sanjram P. K. | HSS | Associate Professor | Ph. D. | 13-02-2018 |
| 46. | Dr. Ashok Kumar Mocherla | HSS | Assistant Professor (Regular) | Ph. D. | 05-03-2018 |
| 47. | Mr. Suresh Chandra Thakur | MMS, Housekeeping, Estate | Administrative Officer | PGDBM, MA, BA, (Honours) | 03-04-2017 |
| 48. | Mr. Ram Phal Dwivedi | Registrar Office | Registrar | LLB, Master in Personnel Mgt, MCA, BA | 08-05-2017 |
| 49. | Mr. Raju Singha | Mechanical Engineering | Lab Incharge | Diploma in M.E. | 11-05-2017 |
| 50. | Mr. Mahesh Jhade | Mechanical Engineering | Lab Incharge | BE (ME), Diploma in M.E. | 18-05-2017 |
| 51. | Mr. Sunil Kumar | Administration / Academics / Students Affairs | Deputy Registrar | M.Sc., BE (Mech) | 08-06-2017 |
| 52. | Mr. Pooran Mittal | Computer Centre | IT Officer (On Contract-for one year) | M.E., AMIE(I), B.Sc. | 28-07-2017 |
| 53. | Ms. Pooja Tiwari | Health Centre | Pharmacist | M. Pharm, B. Pharm | 15-12-2017 |

### 1.4 Faculty members on Sabbatical Leave/Deputation:

1. Dr. Narendra S. Chaudhari (on Deputation to VNIT Nagpur)

### 1.5 Staff Welfare

The IIT Indore Cooperative Society Limited, is a society registered under the category of adds value to Institute residents and members.

The Society oversees the functioning of the convenience store (La Fresco) and members are entitled to avail a discount.

Installation of one additional State Bank of India ATM in campus has helped employees and students. Canara Bank also started functioning in campus.

Residential accommodation facility at Faculty Housing inside the campus has become fully functional.

Several food kiosks have begun operations on campus.

#### 1.5.1 Human resource development

The Institute plans and implements programs for providing opportunities to technical and administrative staff to update and upgrade their knowledge and skills so that they may perform their duties more efficiently. During this financial year, staff members have been sent for training, workshops, seminars, etc. All employees are encouraged to upgrade their educational qualifications and professional skills through voluntary participation in part-time training/degree/diploma courses. The Institute also enables these opportunities through Library facilities, English language courses, and computational facilities. Staff members have been encouraged to pursue higher education.

### 1.6. Reform measures undertaken:

- The Board in its 22nd meeting held on July 21, 2017 considered and approved the Dynamic Assured Career Progression (DACP) scheme's Senior Administrative Grade (SAG) level.
- The first Statutes of the Institute have been received from MHRD. The Statutes were notified by the Government of India in the Gazette of India Extraordinary Part-II Section 3 Sub-section (i) on 31.07.2017. The Board vide agenda item no. BoG/23/5 in its meeting held on September 27, 2017, adopted the same for implementation with immediate effect.
- The Board considered establishing a Kendriya Vidyalaya on IIT Indore campus and a proposal has been forwarded to the MHRD.
- The Board accorded approval for the creation of the 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, Greater Kailash, Rajshree Apollo have been renewed and medical facilities can now be availed by producing Smart Card. A referral letter is not required by faculty members, staff and dependent family members.
- Administration section has taken an initiative of developing HRMS Software (Human Resource Management System) for IIT Indore.
- A committee has been constituted to coordinate all the activities related to start a Crèche facility inside the Institute campus.

- All grievances/RTI have been responded to in a timely and hassle-free manner.
- An online portal has been developed for recruitment of faculty positions.
- Minimum Central wages have been successfully adopted for all employees and deputed by manpower agencies after due approval from the Board.
- A contract has been awarded for providing facility management services inside the campus thus resulting in a reduction of housekeeping staff deputed by manpower agency.
- Shifting of hostel facility of students from rented flats at Silver Springs to the newly constructed Hall of Residence at Simrol was completed successfully. With this move, all the students have now shifted to the campus (except a few who have leased premises near Gate no. 1 of the campus). All efforts have been made to hand over the leased units within deadline mentioned to respective owners without payment of any additional rent.

**1.7 Activities held as per MHRD instructions:**

1. Activities observed during the celebration of 70 years of India's freedom and 75 years of Quit India movement include:
   - ✓ Pledge taking ceremony
   - ✓ 70th Independence Day Celebration
   - ✓ New India Manthan
2. The Celebration of International Yoga Day 2017
   - ✓ Seva Yoga
   - ✓ Gyan Yoga
   - ✓ Karma Yoga
3. Observing the Birth Anniversary of Sardar Vallabh Bhai Patel on 31st October 2017, "Rashtriya Ekta Diwas."
   - ✓ Unity Run
   - ✓ Essay writing and elocution
   - ✓ Pledge taking by Institute community members

## 2. Finance and Accounts

**2.1 Income and Expenditure in 2017-18:**

(in crores)

| S. No. | Particulars | 2017-2018 Current Year |
|---|---|---|
| 1. | Income | |
| 1.1. | Grants<br>Total Grant received: 386.44<br>Less –Allocated for the creation of Capital assets: 327.00<br>For Recurring Purpose: 59.44 | 59.44 |
| 1.2. | Academic Receipts | 10.51 |
| 1.3. | Interest Earned | 13.70 |

| | | |
|---|---|---|
| 1.4. | Other Income | 1.30 |
| 1.5. | Total of 1 | 84.95 |
| 2. | Expenditure | |
| 2.1. | Staff Payments & Benefits | 40.24 |
| 2.2. | Academic Expenses | 12.36 |
| 2.3. | Administrative & General Expenses | 18.78 |
| 2.4. | Transportation Expenses | 0.92 |
| 2.5. | Repairs and Maintenance | 1.82 |
| 2.6. | Other Expenses | 0.41 |
| 2.7 | Total of 2 (Expenditure before depreciation) | 74.53 |
| 3 | Depreciation | |
| 3.1 | Depreciation | 59.53 |
| 4 | Total of (1+2+3) | 134.06 |

**2.2 Creation of Capital assets:**

(in crores)

| **S. No.** | **Particulars** | | **2017-2018** |
|---|---|---|---|
| 2.1 | Opening Balance of Grant-in-Aid Plan | | -27.73 |
| 2.2 | Grant received during the year | | |
| | - For Creation of Capital Assets | 327.00 | |
| | - For Revenue Expenditure | 59.44 | 386.44 |
| 2.3 | Internal Revenue Generation | | 25.52 |
| 2.4 | Total funds available at the disposal of the Institute | | 384.23 |
| 2.5 | Revenue Expenditure excluding Depreciation (134.07-59.54) | | 74.53 |
| 2.6 | Plan Grant after adjusting utilization for Income & Expenditure (386.44 -27.73-74.53) | | 284.18 |
| 2.7 | Utilized for developing infrastructure | | |
| | - Buildings & Works | 80.93 | 106.41 |
| | Utilized for Equipment's and other Assets | 25.48 | |
| 2.8 | Unspent balance as on 31.03.2018 | | 177.77 |

**2.3 Fund availability and status of utilization thereof:**

During the financial year 2017-18, against the sanction of Revised Detailed Project Report (DPR) of INR 1,902 crores, a sum of INR 386.44 crores was released by Ministry of Human Resource Development. The Internal income of the Institute reckoned during the year was INR 25.52 crores, and after considering the unspent balance as on 01.04.2017 of INR -27.73 crores, the total funds available at the disposal of the Institute was of the order of INR 384.23 crores.

A sum of INR 106.41 crores has been utilized for the creation of Capital assets, and a sum of INR 74.53 cores (which excludes Depreciation of INR 59.54 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 INR 25.52 crores transferred to Corpus Fund.

**2.4 Reforms, measures and initiatives undertaken during the year include:**

During the year under review the following reforms, measures, initiatives were initiated from Finance & Accounts:

**2.4.1** Tuition fees for the undergraduate students joining from Academic Year 2017-18 is revised and subsequently MHRD has introduced Vidyalaxmi scheme vide MHRD letter No. 24-2/2016 TS 1, dated July 14, 2016, for 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 2017-18 is INR. 6,34,743/-.

**2.4.2** Public Finance Management System (PFMS) is a platform for all DBT payments.

**2.4.3** The Institute has developed payment gateway on IIT Indore website with State Bank of India as channel partner bank for the facility. The Institute has also started online payment through State Bank of India using Corporate Payment Portal to encourage the initiative taken by Government of India for digitization and cashless economy. This facility has been obtained from the State Bank of India without any financial burden to the Institute.

**2.5. Education assistance for children:**

During the financial year 2017-2018, the Institute reimbursed a sum of INR 18,01,904- to 86 faculty and staff members against for educational assistance as per Government of India norms.

**2.6. 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.

**2.7. Advances:**

During the reporting year, a total sum of INR 17.91 lakh was sanctioned as personal advances for the following.

| Sl. No. | Nature of Advance | No. of Beneficiaries | Amount Sanctioned (in Rs.) | The amount outstanding as on 31.03.2017 (in Rs.) |
|---|---|---|---|---|
| 1 | House Building Advance | - | - | 12,76,488 |
| 2 | Car Advance | - | - | 1,27,000 |
| 3 | Two-wheeler advance | 3 | 80,000 | 3,13,212 |
| 4 | Personal computer advance | - | - | - |
| 5 | Festival advance | 31 | 1,39,500 | 73,800 |
| | | **Total** | **2,19,500** | **17,90,500** |

**2.8 Insurance:**

Group Medical Insurance cover of INR 1.50 lac is provided to all students of the Institute for In-Patient treatment. Expenses towards insurance is INR 14,09,882/-. Care of Out-patient treatment is taken care mainly by the Health Centre internally.

**2.9 Fellowships/scholarships:**

**2.9.1. To Research Students:**

During the financial year 2017-18, the Institute has disbursed Fellowships for the following category of Students:

| S. No. | Category of Students | No. of Student | Fellowship (per month) |
|---|---|---|---|
| 01. | Institute Funded through MHRD grant-Ph.D. | 253 | JRF- Rs. 25,000/- + HRA @ 20%<br>SRF- Rs. 28,000/- + HRA @ 20% |
| 02. | DST Funded (Ph.D.) | 25 | |
| 03. | CSIR Funded (Ph.D.) | 31 | |
| 04. | UGC Funded (Ph.D.) | 51 | |
| 05. | Institute Funded through MHRD grant- M. Tech. | 56 | Rs. 12,400/- + HRA @ 20% |

**2.9.2. Merit cum Means Scholarship:**

Institute has disbursed Rs. 2,15,24,203/- as Merit cum Means Scholarships to B. Tech & M.Sc. Students who are meeting the eligibility criteria set by the Institute under various categories:

| S. No. | Category | Course | No. of Students | Amount of Scholarship (in Rs.) |
|---|---|---|---|---|
| 01. | General | B.Tech. | 89 | 1,14,48,690 |
| | | M.Sc. | 15 | 2,03,046 |
| 02. | General (PD) | B.Tech. | 1 | 35,454 |
| | | M.Sc. | 0 | 0 |
| 03. | OBC | B.Tech. | 49 | 58,83,380 |
| | | M.Sc. | 8 | 1,10,550 |
| 04. | SC | B.Tech. | 15 | 5,31,736 |
| | | M.Sc. | 3 | 1,06,336 |
| 05. | ST | B.Tech. | 9 | 3,19,054 |
| | | M.Sc. | 1 | 35,445 |
| | **Total** | | | **2,15,24,203** |

**2.9.3. Remission of Tuition Fees to Depraved Class of Students:**

Institute has Remitted/disbursed Rs. 1,26,72,282/- as Remission of Tuition fees of Under Graduate Students of Depraved Class admitted in Academic Session 2017-18 as per Ministry of HRD letter F. No. 24-2/2016 TS 1 dated April 04, 2016. Students now are meeting the eligibility criteria under various categories as below:

| S. No. | Category | No. of Students | Amt. of Fees Remission (in Rs.) |
|---|---|---|---|
| 1. | General | 21 | 33,88,533 |
| 2. | OBC | 58 | 92,83,749 |
| 3. | SC | - | - |
| 4. | ST | - | - |
| 5. | PWD | - | - |
| | **Total Rs. ⟶** | | **1,26,72,282** |

### 3. Material Management Section (MMS):

Statement of activities of Material Management Section for the Financial Year 2017-18

| Sl. No | Equipment/Services | Estimated Amount | Prebid Date |
|---|---|---|---|
| 1 | Glove Box Workstation | 35 Lac | 19/05/2017 |
| 2 | Hele-Shaw Apparatus | 20 Lac | 12/07/2017 |
| 3 | Solar Cell Simulator | 43.75 Lac | 09/05/2017 |
| 4 | MEMS Tender (Total 23 indents merged) | 3.31 Crore | 14/06/2017 |
| 5 | Lease Line Internet Connection of capacity 400 Mbps | 23 Lac | 09/08/2017 |
| 6 | Integrated High Resolution Raman Microscope | 1.40 Crore | 26/07/2017 |
| 7 | NIT for End to End Cleaning & Sanitation Solution | Service | 24/05/2017 |
| 8 | Civil Engineering Lab Development | 42.19 Lacs | |
| 9 | Dining Facility - I | Service | 19/09/2017 at 11.00AM |
| 10 | Installation of VCR Setup | 8 Lac | 13/10/2017 at 11.00 AM |
| 11 | RF Magnetron Sputtering | 26 Lac | 13/10/2017 at 2.30 PM |
| 12 | Event Management Services for Convocation 2017 | 15.52 Lac | 16/10/2017 at 11.00 AM to 1.00 PM |
| 13 | Master Node & Computer Node | 26 Lac | 16/10/17 at 2.30 PM |
| 14 | 10-14" Optical Telescope, GPS Accessories & CCD Camera | 15 Lac | 17/10/17 at 2.30 PM |
| 15 | AMC for Pest Control | 30 Lac | 26/10/2017 at 2.30 PM |
| 16 | Electric Operated Brick Making Machine | 23.50 Lac | 24/10/2017 at 11.00 AM |
| 17 | Repir of AFM | No Estimate | 31/10/2017, 11.00 AM |
| 18 | Rate Contract for Supply of Medicines & Dressings. | RC | 26/10/2017 at 11.30 AM |
| 19 | Furnitures & Fixture for Department, Lab, Faculty Seating & Conference hall | 50 Lac | 10/11/2017 |
| 20 | Port access system | 26 Lac | 07/11/2017 at 3.00 PM |
| 21 | Dining Facility for students - II | Service | 23/11/2017 at 11.00 AM |
| 22 | Compute Rack server | 12 Lac | 14/11/2017 at11 am |
| 23 | FESEM-EDs-EEBSD (Indent 378) | 200 Lac | 21/11/2017 at11 am |
| 24 | Contact Angle Measurement System | 22 Lac | 24/11/2017 at 11 am |
| 25 | High Temperature wear Testing Machine | 20 Lac | 23/11/2017 at 11 am |

| | | | |
|---|---|---|---|
| 26 | Electric Operated Brick Making Machine | 23.50 Lac | 28/11/2017 at 11.00 AM |
| 27 | Impact testing machine & Fatigue testing Machine | 26 Lac | 30/11/2017 at 3.00 |
| 28 | Vacuum Induction Melting cum Casting Unit | 25 Lac | 07/12/2017 at 11.00 AM |
| 29 | Differential Scanning Calorimetry | 25 Lac | 08/12/2017 at 3.00 PM |
| 30 | Noise Figure Analyzer | 45 Lac | 12/12/2017 2.30 pm |
| 31 | Street Light Pole and LED Street Light | 12 Lac | 13/12/2017 11.00 AM |
| 32 | C&F - Custom clearance and Freight Services | Service | 20/12/2017 at 2.30 |
| 33 | UTM – Universal Testing Machine | 63 Lac | 14/12/2017 11.00am |
| 34 | AFM | 80 Lac | 14/12/2017 11.00am |
| 35 | Customized Ebeam Evaporator-MEMS Project | 18 Lac | 15/12/2017 at 11.00 AM |
| 36 | Portable Permeability Tester etc. | 2075000 | 15/12/2017 at 2.30 PM |
| 37 | Hydrogen System | 23 Lac | 19/12/2017 11.00 am |
| 38 | Rheometer | 3450000 | 18/12/2017 at 11.00 AM |
| 39 | End to End solution for EME & MHE | SC | 20/12/2017 at 11.00 Am |
| 40 | Medicine & dressings for Healthcare | Rate Contract | 20/12/2017 2.30 PM |
| 41 | Induction Grudging Machine | 21 Lac | 12/01/2017 at 2.30 PM |
| 42 | Empanelment of firm for furniture | Empanelment | 09/01/2018 at 11.00 AM |
| 43 | Dynamic Mechanical Analyzer | 32 Lac | 15/01/2018 at 11.00 AM |
| 44 | Brazing machine & CMT | 15 Lac | 23/01/2018 at 3.30 Pm |
| 45 | Fatigue Testing Machine | 1.05 Crore | 09/02/2018 at 11.00 AM |
| 46 | Friction Stir Welding Machine | 20 Lac | 26/02/2018 11:00 |
| 47 | Server | 29 Lac | 12/03/2018 |

| Sl. No. | Details | 16-17 | Amount in Rs. | 17-18 | Value |
|---|---|---|---|---|---|
| 1. | **Total Indent Issued** | 687 | - | 1047 | |
| 2. | **Total Purchase Order Issued** | 619 | 19,32,04,477.00 | 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 |
| 3. | **Total Import Order issued** | 45 | 3,80,57,542.00 | 73 | 9,92,67,949.00 |
| 4. | **Total Indigenous Order** | 574 | 15,51,46,935.00 | 865 | 19,77,45,510.00 |
| 5. | **Total Advertisement** | 38 | 23,84,154.00 | 28 | 17,89,203.00 |
| 6. | **Total CDEC** | | 180 | | 176 |
| 7. | **Total EDEC** | | 78 | | 25 |
| 8. | **Total GST Certificate Issued** | - | - | 298 | Rs. 4,29,05,971.00 |
| 9. | **Stock Entries** | | 7016 | 6572 | |

## Service Contracts

1. **Comprehensive Security and Surveillance Solution Services at IIT Indore**- Work order for Service and Gadgets issued separately for services and gadgets. Delivery of gadgets done and installation is in process.
2. **End to End Cleaning & Sanitation Solutions**- Orders issued to two firms building wise and the review of the performance is done every three months.
3. **Chemical & Glassware**- Draft Proposal sent to committee for finalization of scope of supply and the specification of requirement in month of May 2017.
4. **Engagement of Travel Agency for Ticket Booking**: Service Order extended for service till 24/04/2018. Received requisition for processing order.
5. **Manpower Outsourcing**: Service order extended for service till 15/04/2018.
6. **Hiring of Vehicle**- Order placed on 04 Firms for multiple options and vehicles.
7. **Fuel to Automobiles**: Fuel card issued to transport as part of the service order on credit with distant structure. System streamlined with discount, credit supply and regulated supply.
8. **Courier Service**- New tender is initiated to improve the service quality in the remote location.
9. **Disposal of Vehicle**- Proposal for disposal of surplus and old vehicles placed before FC for approval.
10. **Zero Waste Campus at IIT Indore**-Proposal to engage Start-up Swahha, was approved by BoG. Process streamlined for in-house waste disposal.
11. **Smart Card based Bicycle Sharing System**- Trial period of OFO cycle started as part of green campus initiatives.
12. **Food Court Complex**: Kiosks installed, and new Service providers started operating on different business models.

## Value Added Services

1. **Bus Service**- Proposal for AICTSL Bus services till IITI Campus has been submitted to AICTSL. The Operation manager AICTSL visited IITI Campus for discussing the operational part for bus services. The proposal considered at AICTSL and bus facility is made operational to IITI campus.
2. **Milk Parlour**- Order placed for supply of milk at La Fresco for catering the daily requirements of IITI Community. The service is operated through the IITI Coop Society Store.
3. **Registration of Cooperative society & student convenience center**- Proposal approved by BoG and new bank account opened for the Society. The society oversees the La Fresco store.
4. **Installation of Boards from Tejaji Square till Talai Naka:**
   - MMS team visited MPRDC for approval for installation of IITI boards.
   - S.K. Manwani, Assistant General Manager, MPRTC visited IITI on 11/09/2017 for site visit and approval for installation of IIT Boards.
   - On receipt of approval, the MMS team with service provider marked the location for installation of IITI Boards from Tejaji Nagar till Gate no. 2 and 08 boards were installed with distance & direction signage on 29/09/2017.

5. **Scrap Disposal -**
   - Scrap Disposal has been done twice from April 2017 at Silver Springs & Simrol Campus.
   - Segregation of scarp is in process at Balda Farm.
   - Scrap Disposal at Silver Springs.
6. Arrangements for inauguration on short notice done for – Aladdin Kiosk, OFO- Bicycle, Tea Post-Kiosk etc.

## Policy Matters

1. **Implementation of GFR 2017**: Submitted proposal for implementation of GFR 2017 in toto and prepared matrix for highlighting the difference in GFR 2005, GFR 2017with GeM. Proposal approved by FC Committee and BOG for implementation.
2. **Implementation of GeM**: Detailed proposal with projecting the requirement for implementation of GeM was put up to the competent authority and approved vide note dated 11/08/2017. Proposal approved by FC Committee and BOG for implementation.
3. **Training**: Organized internal training on GeM by Mr. Rakesh Kumar, Director (QA) DGS&D on 21/07/2017 and 27 participants attended the training from various departments.
4. **Revised DSIR**: Coordinated with DSIR for issuance of revised DSIR certificate with permanent address of IITI and the revised DSIR received on 25/04/2017 valid till 31/08/2021.
5. **Storage Center**: The detailed requirement of space was put up to the committee for finalizing setting up of Storage Center. After rounds of discussion, site visit and meeting, the site and proposal was finalized for storage center and the same was put up in the BWC Meeting. The proposal has been approved by the BWC and is with Estate Section for floating of tender.
6. **Implementation of e-Procurement**: e-procurement was implemented from January 2018 and a total 16 proposals have been processed through e-tendering via CPPP.
7. **GST Notification**: GST notification was issued immediately after the issuance of notification and uploaded on website to avail the GST exemption as per notification 45/2017 & 47/2017 and followed up with DSIR.

## Miscellaneous- Time bound Task

1. Arrangement was done including housekeeping, guest house accommodation, hospitality, transportation, shifting of sofa, etc. and completed in midnight for smooth functioning of the event i.e. Industry Academic Conclave.
2. Physical verification: Physical verification of Phase- I has been completed and the report of the same will be submitted shortly.
3. Convocation 2017- Proactively involved in event management, printing of invitations/reports, medals, catering etc.
4. Set up of Classroom before new session July 2017.
5. Furnishing of Hostel/Studio Apartment for new Session July 2017.
6. Hiring of Apartment in Simrol for accommodating students.

## Others

1. CAG Audit- Facilitated the records, ledgers, files to CAG Auditor for the financial year 2016-17 for audit period i.e. August 02, 2017 to August 11, 2017 & January 2018. All the queries raised by the CAG auditor were replied by MMS.
2. Assistance in BOG, FC, BWC meetings- assisted in preparation of agenda and minutes, ATR etc. to the office of Registrar.
3. Export of equipment for repair and samples for research as the no. of export has been increasing day by day.

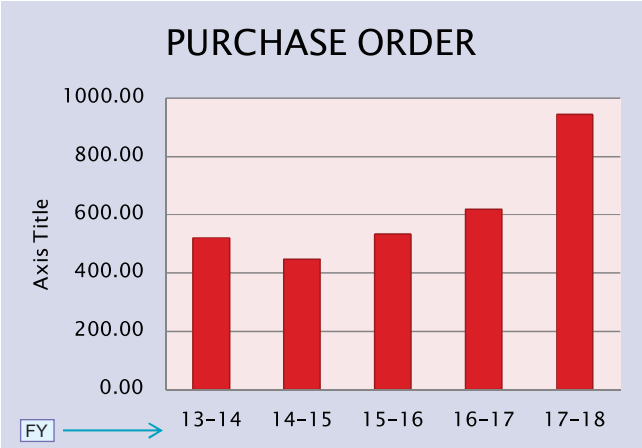
## Training / Upgradation

1. Mrs. Pooja Dutta , Manager (MMS) has enrolled for Post Graduate Diploma in International Business Operations from IGNOU for 17-18 Sessions.
2. Mr. Brajesh Dwivedi & Mr. Shiv Raghuwanshi have enrolled for Post Graduate Diploma in Materials Management.
3. Mr. Nilesh Jadhav has been pursuing MBA (Finance) from DAVV University.
4. Mr. Suresh C. Thakur, AO, was deputed to attend the Management Development Programme on Public Procurement from 28/08/2017 to 02/09/2017 organized by National institute of Financial Management (NIFM), Faridabad.
5. Mr. S.P. Hota, DRMM, was deputed to attended the training on GeM& GFR 2017 for 02 days i.e. 30/07/2017 to 01/08/2017 organized by National institute of Financial Management (NIFM), Faridabad.
6. Mrs. Pooja Dutta was deputed to attend the training on GFR & e-Procurement for 02 days during December 2017 organized by IIMM, Alwar.
7. Mr. Siba Prasad Hota has attended the National Conference on CPPP for 01 day during January 2018 organized by Ministry of Finance.
8. Mr. Siba Prasad Hota has enrolled for Diploma in Patent.
9. Mr. Brajesh Dwivedi represented India with the IITI tag in International Sports.
10. Internal Training on English Communication & Purchase procedure was done at MMS.
11. Entire MMS team attended training session on English by Ms. Alison Davies in different batches.

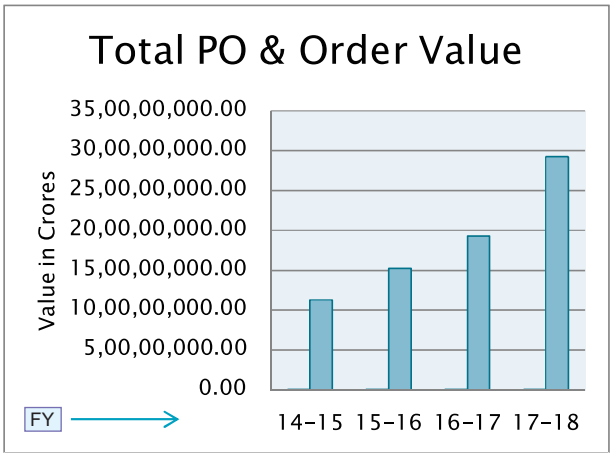
## Achievements

1. Go live Session of GeM.
2. E-procurement initiated on fast track and uploaded 16 NITs in 03 months Jan 18 to Mar 18.
3. IITI was appreciated at National Conference for Uploading NITs of PAC Item
4. Indents/contracts etc. Graph cart of order referring previous year is enclosed for reference.
5. Green Initiatives- Initiated the adoption of green inventory such as letter head, files etc.
6. Online EMD Submission to promote online transactions.

**Graph Chart: PURCHASE ORDER ISSUED YEAR WISE: (Increased by 52.6%)**




**Graph Chart: Order Value Wise: Increased by 53.7%**




## 4. Safety and Security Department

**4.1.1** Comprehensive security services are being looked after by M/S Security and Intelligence Services (India) Limited. A world-class security control room is headquartered at the Sodium Building. Here, 24x7 monitoring of CCTV cameras is being done by the security department. The security department is now equipped with a patrolling unit.

**4.1.2** More usage of technology is being introduced in the security setup of the Institute:

- Boom barriers have been equipped with RFID detection system for automated entry of the cars of IIT Indore community members.
- New web-based visitors' pass system is in place for facilitating visitors smooth entry to the campus.
- Periodic orientation program is being conducted for interns, faculty and staff members joining the Institute.
- CCTV surveillance system and biometrics access control have been installed to aid the manpower behind to ensure safety and security of the campus and its occupants.
- To spread awareness of fire safety, bio-safety, 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.
- The 24x7 emergency control room for responding to any on-campus/off campus emergency to any community member of IIT Indore has been established.

**4.1.3** Regular fire-fighting demonstration and training is conducted for security personnel. On-the-job training by the security agency and training on emergency rescue from lifts have been conducted for security staff. Students, faculty members, staff are also associated in training especially on fire-fighting along with security personnel. The security personnel are prompt in handling and controlling the fire at initial stages. The security department responded to 11 fire incidents and prevented loss of property by the prompt response.

**4.1.4** The security department arranged and co-ordinated safety and security-related activities during various Institute functions like Orientation, Convocation and public lecture of eminent dignitaries at the Institute.

(Security team @ IITI: Few Glimpses)

## 5. Transport Department

**5.1.1** IIT Indore has a full-fledged transport department that provides commuting services to students, faculty and staff members. The Institute provides transport facilities free-of-cost to students, and a nominal amount is charged from the staff and faculty members. The transport department has two 52-seater buses and two 20-seater buses. The Institute has two Grand Sumos to provide the transport for visiting faculty and guests for pickup and drop to the Airport, Railway station and Bus station. The Institute also has one tractor, two water tankers and two trolleys for maintenance of the garden area. Two motorbikes are also held by the Institute for office use and use by the security department. One truck facilitates logistics operations within the campus and transports materials. Two ambulances are present, out of which one is equipped with an advanced life support system.

**5.1.2** In addition to the above vehicles, the Institute has 10 Green Vehicles (4-seater, 6- seater and 14-seater capacity). These are provided for frequent commuters. The vehicles have been introduced to encourage/promote pollution control and save fuel. One battery cart is also used by the estate maintenance section.

**5.1.3** Transport department presently has a team of 20 well-experienced staff with 14 drivers, 6 Cleaners and 1 assistant. 2 drivers perform supervisory duties round the clock.

(Transport facility @ IIT Indore)

## 6. 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

**Activities**- An interactive session on 'Health and Young Women' was organized for the students.

| S. No. | O.P.D. | INPATIENT AND DAY CARE CASES | EMERGENCY CASES | TRAUMA/ MINOR SURGICAL CASES | ECG | LABORATORY TESTS (In-house) |
|---|---|---|---|---|---|---|
| 1 | 17053 | 240 | 264 | 324 | 201 | 287 |

## 7. Hall of Residence

The Halls of Residence employ a dedicated and professional housekeeping team for providing a hygienic environment.

### Residence on campus:

1. The Hall of Residence features large spacious rooms as standard.

A.P.J. Abdul Kalam Hall of Residence

J.C. Bose Hall of Residence

2. The kitchen is open late at night so that students can make their own tea or coffee.
3. A common hall and balcony feature in all units.
4. 24 × 7 internet facilities have been made available for students.
5. A range of essential facilities such as a refrigerator, sofa, RO water purifier, hot water, Intercom, study table, lights, fans, almirah and cot are provided.
6. Pest control services are also available on request.

**Recreation:**

7. Televisions are installed in the common areas.
8. Sports and gymnasium facilities are available.
9. Table-tennis tables feature in the hall common areas.
10. A Turf badminton court in the hall quadrangle for students is available.

11. A student facilities center (La'Fresco) is in the vicinity. Here; milk, food, vegetables, fruits and stationary and similar daily-needs can be bought. This is run by the IITI Coop. Society.

**Dining Hall:**

12. There are three spacious dining halls where students are served four healthy meals a day. The mess menu is finalised by the students and updated regularly.

13. Other than regular dining services, food kiosks such Café Zippy, Shiru Café, Tea Post, Aladeen and Taste Buds serve the student community.

Café Zippy

Shiru Café

Tea Post

Taste Buds

Aladeens

14. Night time canteen facilities are also available.

**Medical Facilities:**

15. The Institute Health Centre is located in the hall of residence and provides 24 x 7 medical services to students.
16. An advanced life support ambulance is always available in the vicinity of the hall for medical emergencies.
17. Mediclaim coverage to all students are vailable.

**Transport:**

18. Green vehicles, available for the movement within the campus, ply at regular intervals.
19. The Institute provides buses for the market every weekend.
20. Additional transport facilities for large group of students is made available on request.
21. "Ofo" bicycles are also available for transportation within the campus.

**Safety and Security:**

22. Dedicated security staff for their security and emergency related issues.
23. Biometric entry system in hall units for upgraded security system.
24. The Hall of Residence is completely secured with the CCTV surveillance.
25. Fire extinguishers are available on every floor to avoid any fire emergency.

**Laundry Facilities:**

26. Laundry facility is available for students.

**Banking Services:**

27. Canara Bank is situated inside the Institute campus for availing banking facilities.
28. Along with bank, ATM & Cash deposit machine of Canara Bank and State Bank of India ATM is also available.

**Hall Office:**

29. The office of Hall of Residence is open 24x7 for all residents.
30. The students voice their concerns and provide suggestions to the Hall office.
31. A counselling office for students is also present in campus.

## 8. Housekeeping:

### Cleaning and Sanitation Services

End to end cleaning and sanitation services are provided by two agencies namely, M/s Property Services (India) Ltd. and M/s Service Master Clean in order to maintain impeccable cleanliness and sanitation of the entire campus. The housekeeping team constantly strive to realize the dream of " Swachha and Zero Waste Campus". Despite the challenges posed by the ongoing construction activities, the housekeeping staff leave no stone unturned in keeping the campus spic and span. Additionally, the team also facilitates smooth shifting of materials and equipment as and when required. It is also worth mentioning that the team has been instrumental in successful conduct of various events viz Convocation, Industry –Academia Conclave, FLUXUS, Republic Day, Independence Day celebrations etc. by way of preparing the site before the conduct of the events. Post – event the trashes are disposed of by the team in a meticulous manner ensuring proper hygiene & sanitation.

A Start –up venture by IIT Indore Alumni "M/s SWAAHA" has also been engaged for methodical waste collection and its economic disposal and utilization. This ensures zero waste campus.

Training sessions are organized frequently to enlighten and equip the housekeeping staff with modern ways of cleaning and sanitation.

Installation of a Zero Waste Plant by M/s SWAAHA is also being set up to ensure that the campus is free from waste and the waste generated is recycled to produce useful products viz. paper, edible spoons, plates, file covers, envelopes etc.

Through the year, the housekeeping team has been performing commendable tasks in realizing the dream of "Swachha, Green and Zero Waste Campus".

Training sessions are organized to enlighten and equip the housekeeping staff.

## 9. Academic Activities:

| | | |
|---|---|---|
| 1 | Courses offered | a) Undergraduate Courses: 384<br>b) Postgraduate and Doctoral Courses: 279<br>c) Cross-listed courses: 95<br>Total: 758 |
| 2 | Doctoral Students Admitted in AY 2017-18 | 110 |
| 3 | Doctoral Students Graduated | 50 students have successfully defended their thesis and passed out (during 1 April 2017 to 31 March 2018) |
| 4 | Under Graduate Students Admitted in AY 2017-18 | 249 |

| | | |
|---|---|---|
| 5 | Under Graduate Students Graduated in AY 2017-18 | 118 B.Tech. students conferred the degree in the 5th Convocation held on 4 November 2017 |
| 6 | Post Graduate Students Admitted in AY 2017-18 | 90 (34 M.Tech. + 56 M.Sc. students admitted in 2017 Autumn Semester) |
| 7 | Post Graduate Students Graduated in AY 2017-18 | 25 M.Tech. and 22 M.Sc. students are graduated in the month of June-July 2017 conferred the degree in 5th Convocation 2017. |

**Academic Report for the period 1st April 2017 to 31st March 2018**

**Details of Doctoral Graduates (during 1st April 2017 to 31st March 2018)**

| S. No. | Roll No. | Discipline | Name | Date of PhD Viva | Ph.D. Thesis Title [Thesis supervisor(s)] |
|---|---|---|---|---|---|
| 1 | 11123104 | Chemistry | Jadhav Thaksen Vasant | 7-Apr-17 | Tetraphenylethylene Luminogens: Design, Synthesis and Applications **(Dr. Rajneesh Misra)** |
| 2 | 12123108 | Chemistry | Rohit Kumar Rai | 10-Apr-17 | Development of Nanoparticle Based Heterogeneous Catalysts for Important Organic Reactions **(Dr. Sanjay Kumar Singh)** |
| 3 | 12110212 | EE | Vishnu Awasthi | 26-Apr-17 | Investigation of Heterojunction Interface of CIGSe/doped ZnO for Solar Cell Applications **(Dr. Shaibal Mukherjee)** |
| 4 | 11120202 | EE | Bhupendra Reniwal | 8-May-17 | Variability Aware Design of SRAM in Conventional & Non-Conventional MOS Technologies: A Sense Amplifier Perspective **(Dr. S.K. Vishvakarma)** |
| 5 | 11123101 | Chemistry | Anupam Das | 11-May-17 | Liposome-DNA/Protein Interactions: Impacts on Anticancer Drug Molecules **(Dr. Anjan Chakraborty)** |
| 6 | 12116103 | HSS (English) | Bijaya Kumar Sethi | 15-May-17 | Caste, Gender and the Aesthetics of Experience in Dalit Autobiographical Narratives: A Dalit Literary Perspective **(Dr. Amarjeet Nayak)** |
| 7 | 12123112 | Chemistry | Deepika | 15-May-17 | Design, Synthesis and Characterization of Arene-Ru(II) Complexes Based on Nitrogen Donor Ligands: Catalytic Reactions and Mechanistic Investigations **(Dr. Sanjay Kumar Singh)** |
| 8 | 11126101 | HSS (Economics) | Sanjaya Kumar Lenka | 25-May-17 | Financial Development, Financial Inclusion and Economic Growth: Empirical Evidence from India **(Dr. Ruchi Sharma)** |
| 9 | 11114101 | Mathematics | Manas Ranjan Mohapatra | 26-May-17 | Geometric Properties of the Cassinian Metric **(Dr. Swadesh Kumar Sahoo)** |

| | | | | | |
|---|---|---|---|---|---|
| 10 | 11113108 | Chemistry | Shivendra Singh | 1-Jun-17 | Development of Metal-Free Based One-Pot Synthetic Protocol for the Facile Constructions of Indole and Coumarin Based Fused Heterocyceles **(Dr. Sampak Samanta)** |
| 11 | 11123102 | Chemistry | K Maruthi | 15-Jun-17 | Synthesis and Self-assembly Study of Hybrid Peptide Foldamers for the Development of Functional Supramolecular Architectures **(Dr. Apurba K. Das)** |
| 12 | 1301202010 | EE | Rangeet Mitra | 28-Jun-17 | Nonlinear Signal Processing for Visible Light Communications **(Dr. Vimal Bhatia)** |
| 13 | 12127102 | BSBE | Arpita Tawani | 30-Jun-17 | Structural and Molecular Insights of Naturally Available Small Molecule Modulators for their Anti-Cancer Activity via Targeting G-Quadruplex DNA **(Dr. Amit Kumar)** |
| 14 | 1301202006 | EE | Manish Mandloi | 6-Jul-17 | Detection Algorithms for Multiple-Input Multiple-Output Wireless Communication Systems **(Dr. Vimal Bhatia)** |
| 15 | 12110211 | EE | Tejendra Dixit | 18-Jul-17 | Investigations on the Effect of Surface Plasmon Resonance Towards Performance Improvement of Hydrothermally Grown ZnO/ZnCr2O4 Nanostructures Based Optoelectronic Devices **(Dr. Vipul Singh and Dr. I.A. Palani)** |
| 16 | 11110302 | ME | Kadam Sambhaji Tanaji | 10-Aug-17 | Studies on Heat Transfer in Microchannel **(Dr. Ritunesh Kumar)** |
| 17 | 12113104 | Chemistry | Manoj Kumar Manna | 14-Aug-17 | Supramolecular Construction of Optoelectronic π-Conjugated Peptide and Peptide-Inorganic Hybrid Materials **(Dr. Apurba K. Das)** |
| 18 | 1301131003 | Chemistry | Chandan Adhikari | 18-Aug-17 | Stimuli Responsive Drug Delivery Systems Composed of Biocompatible Materials for the Controlled Delivery of Chemotherapeutic Drugs **(Dr. Anjan Chakraborthy)** |
| 19 | 1301202008 | EE | Nagendra Kumar | 8-Sep-17 | Performance Analysis of Cooperative Relay Network for QAM Signals under Various Fading Channels **(Dr. Vimal Bhatia)** |
| 20 | 1301231002 | Chemistry | Arup Mahata | 11-Sep-17 | Atomic Scale Designing of Materials for Low-Temperature Fuel Cells **(Dr. Biswarup Pathak)** |

| | | | | | |
|---|---|---|---|---|---|
| 21 | 1301202003 | EE | Deepika Gupta | 21-Sep-17 | Analysis of Charge Trap NAND Flash Memory for Improved Reliability **(Dr. S.K. Vishvakarma)** |
| 22 | 11123103 | Chemistry | Sonam Mandani | 25-Sep-17 | Fluorescent Carbon dots and their Composites for Multifunctional Applications **(Dr. Tridib Kumar Sarma)** |
| 23 | 12115109 | Physics | Hari Mohan Rai | 29-Sep-17 | Observation, Evidence and Origin of Magnetodielectric Effect in Mn/Fe Doped LaGaO3 **(Dr. P.R. Sagdeo & Dr. Rajesh Kumar)** |
| 24 | 12110203 | EE | Deblina Biswas | 5-Oct-17 | Development of Photoacoustic Spectral Response Technique for Biomedical Applications **(Dr. S. Vasudevan)** |
| 25 | 1301103009 | ME | Shiva S | 11-Oct-17 | Laser Additive Manufacturing of Bulk Shape Memory Alloy Structures: Numerical Modeling and Experimental Investigation **(Dr. I.A. Palani and Dr. C.P. Paul)** |
| 26 | 1301202004 | EE | Devendra Singh Gurjar | 14-Oct-17 | Performance Analysis of Two-Way Relaying with MIMO and D2D Communications **(Dr. P.K. Upadhyay)** |
| 27 | 1301102004 | EE | Karthik Thirumala | 14-Oct-17 | Power Quality Monitoring in Emerging Power Systems Using Adaptive and Intelligent Techniques **(Dr. Amod C. Umarikar and Dr. Trapti Jain)** |
| 28 | 12120304 | ME | Vinod Kumar Singh | 23-Oct-17 | Measurement of CO2 Adsorption Isotherms and Kinetics of Activated Carbons Suitable for the Development of CO2 based Adsorption Cooling Systems **(Dr. E. Anil Kumar)** |
| 29 | 12113105 | Chemistry | Mriganka Das | 6-Nov-17 | Studies on Transition Metal Complexes of Flexible Polydentate Schiff Base Ligands **(Dr. Suman Mukhopadhyay)** |
| 30 | 1301102002 | EE | Abhay Upadhyay | 8-Nov-17 | New methods based on variational mode decomposition for speech signal analysis **(Dr. R.B. Pachori)** |
| 31 | 11123105 | Chemistry | Debashis Majee | 15-Nov-17 | Exploration of Five-Membered Cyclic Sulfamidate Imines as Nucleophiles in Various Organic Transformations **(Dr. Sampak Samanta)** |
| 32 | 1010702 | Mathematics | Istkhar Ali | 20-Nov-17 | Localization Theorems and Perturbation Analysis on Quaternionic Eigenvalue Problems **(Dr. Sk. Safique Ahmad)** |

| | | | | | |
|---|---|---|---|---|---|
| 33 | 12115106 | Physics | Priyadarshini Suchismita Behera | 27-Nov-17 | Exploring Correlation between Local Structure, Magnetic and Transport Properties of Multifunctional Cr-based Chalcospinels **(Dr. Preeti A. Bhobe)** |
| 34 | 1301231006 | Chemistry | Ramesh Maragani | 30-Nov-17 | Design, Synthesis and Characterization of Bisthiazole Based Donor–Acceptor Molecular Systems **(Dr. Rajneesh Misra)** |
| 35 | 1301103007 | ME | Naresh Kumar Raghuwanshi | 15-Dec-17 | Experimental Techniques for the Measurement of Gear Mesh Stiffness **(Dr. Anand Parey)** |
| 36 | 1301271002 | BSBE | Aparna Rai | 16-Dec-17 | Network topologies unraveling randomness and preserved patterns in disease complexome **(Dr. Sarika Jalan)** |
| 37 | 1301103010 | ME | Vikas Sharma | 20-Dec-17 | Gearbox Fault Diagnosis under Fluctuating Speed Conditions using Vibration Analysis **(Dr. Anand Parey)** |
| 38 | 12116101 | HSS (Economics) | Ab Qayoom Khachoo | 2-Jan-18 | FDI Spillovers on Innovation and Productivity: Evidence from Indian Manufacturing Sector **(Dr. Ruchi Sharma)** |
| 39 | 1301141002 | Mathematics | Kottapally Harish Kumar | 5-Jan-18 | Wavelet Methods for Solving a Class of Nonlinear Differential Equations **(Dr. Antony Vijesh)** |
| 40 | 12110208 | EE | Shivendra Kumar Pandey | 11-Jan-18 | Investigations on Ultrafast Electrical Switching Dynamics of In-Sb-Te Phase Change Memory Devices and Their Suitability for Multi-bit Data Storage Applications **(Dr. M. Anbarasu)** |
| 41 | 1301201005 | CSE | Robin Singh Bhadoria | 12-Jan-18 | Assessment of Data and Interfacing of Service-Oriented System with Sensors **(Prof. N.S. Chaudhari and Dr. Amod C. Umarikar)** |
| 42 | 12120103 | CSE | Neha Bharill | 15-Jan-18 | Investigations in Fuzzy Based Learning Algorithms with Application to Big Data Classification **(Dr. Aruna Tiwari)** |
| 43 | 1301103003 | ME | Ankur Saxena | 29-Jan-18 | Investigation of Mesh Stiffness and Modal Characteristics of Geared Rotor System with Defects **(Dr. Anand Parey and Dr. Manoj Chouksey from SGSITS)** |
| 44 | 11116102 | HSS (English) | Sagarika Chattopadhyay | 29-Jan-18 | The Novels of Amitav Ghosh: Interpretations in Literary Geography **(Dr. Amarjeet Nayak)** |

| | | | | | |
|---|---|---|---|---|---|
| 45 | 12113103 | Chemistry | Biju Majumdar | 31-Jan-18 | Development of Carbonaceous Nanomaterial Based Heterogeneous Catalytic Systems for Organic Transformations **(Dr. T. K. Sarma)** |
| 46 | 1301161003 | HSS (English) | I Watitula Longkumer | 2-Feb-18 | Women's Writing from North-East India: Narratives of Indigeneity, Ethnicities and Aesthetics **(Dr. Nirmala Menon)** |
| 47 | 12127103 | BSBE | Camellia Sarkar | 9-Feb-18 | Structural and spectral analysis of complex biological and social networks **(Dr. Sarika Jalan)** |
| 48 | 11120203 | EE | Pooran Singh | 22-Feb-18 | Ultra-Low Power High-Stability Robust SRAM Design for FPGA, IoT and Image Processing Applications **(Dr. S.K. Vishvakarma)** |
| 49 | 1301203009 | ME | Ram Bihari Sharma | 23-Feb-18 | Modelling of Acoustic Emission Generated in Spur Gear Pair and Rolling Element Bearing **(Dr. Anand Parey)** |
| 50 | 12110209 | EE | Smriti Sahu | 5-Mar-18 | Unravelling the Dynamics of Ultrafast Crystallization and the Evolution of Local Structure In Phase Change Materials **(Dr. M. Anbarasu)** |

**Merit-Cum-Means Scholarship:**

The Institute has disbursed Rs.1,32,79,099/- as Merit-Cum-Means Scholarship to B.Tech. and M.Sc. students who are meeting the eligiilbity criteria set by the Institute under various categories:

| S. No. | Program | Batch | Category | No. of students | Total Amount (Rs.) |
|---|---|---|---|---|---|
| 1 | B.Tech. | 2014 | (Gen and OBC) | 22 | 10,90,782 |
| 2 | | | (SC and ST) | 2 | 49,138 |
| 3 | | 2015 | (Gen and OBC) | 23 | 11,40,363 |
| 4 | | | (SC and ST) | 2 | 49,138 |
| 5 | | 2016 | (Gen and OBC) | 50 | 52,29,050 |
| 6 | | | (SC and ST) | 9 | 2,21,121 |
| 7 | B.Tech. | 2017 | (Gen and OBC) | 46 | 48,12,198 |
| 8 | | | (Gen-Pwd and OBC-Pwd) | 4 | 98,312 |
| 9 | | | (SC and ST) | 11 | 2,70,358 |
| 10 | M.Sc. | 2016 | (Gen and OBC) | 9 | 86,229 |
| 11 | | | (SC and ST) | 0 | 00 |
| 12 | | 2017 | (Gen and OBC) | 14 | 1,34,134 |
| 13 | | | (SC and ST) | 4 | 98,276 |
| | | | **Total Amount** | | **1,32,79,099** |

**Remission of Tuition Fees to Economically and Socially challenged students:**

The Institute has remitted/ disbursed Rs.62,33,350/- as remission of tuition fee of under graduate students of economically and socially challenged category students registered in academic session 2017-18 in compliance of Ministry of HRD letter F.no. 24-2/2016 TS 1 dated April 4, 2016.

| Sl. No. | Batch | Category | Amount to be refunded per student (Rs) | Number of students | Total Amount (Rs) |
|---|---|---|---|---|---|
| 1 | 2016 | (Gen and OBC-NC) | 1,00,000 (Full remission) | 14 | 14,00,000 |
| 2 | | | 66,667 (2/3 remission) | 23 | 15,33,341 |
| 3 | 2017 | (Gen and OBC-NC) | 1,00,000 (Full remission) | 15 | 15,00,000 |
| 4 | | | 66,667 (2/3 remission) | 27 | 18,00,009 |
| **Total** | | | | **79** | **62,33,350** |

## Student Activities

The period from April 2017 to March 2018 witnessed a buzz of activity across technical, cultural and sports domains. This year, many new clubs such as CAE (Computer Aided Engineering) Club, Aeromodelling Club, Cinephiles (Movie Club), Debating Society, Kalakriti (Fine Arts Club) and Dance Club have been founded.

The Robotics Club held workshops on basic electronics components and Arduino. They also organized a "Robo Race" competition which was attended by around 50 students; participated in the ASME student design competition held at Delhi Technical University' and secured the coveted 3rd position. They also participated in the Boeing Competition held at IIT Madras and were one of the top 60 teams who qualified for the second round.

The Electronics Club undertook projects on Food Waste Management and set up a ground station for satellite communication. The programming club organized the summer of code (IITI SOC) to promote web and android development projects during the summer vacation. They also organized workshops on Data structures and Algorithms and workshops on the Google Summer of Code and ACM ICPC. There were several competitive coding contests held including a month-long hackathon during the winter break. 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 over 10,000 students.

The newly established CAE club and Aeromodelling club organized monthly design competitions and a workshop on Matlab and gliders. Team IIT Indore also participated in the Inter IIT Tech meet and secured an enviable 11th rank. It also secured the 5th rank in the "Engineer's conclave" event and participated in the annual Robocon and Baja competitions.

On the cultural front, the first major achievement was a definitive victory in the IIT vs. IIM annual cultural competition. The Student Gymkhana celebrated Ganesh Chaturthi, Garba Night, Diwali, Friendship Day, New Year Eve, Lohri, Sankranti. On the occasion of Mental Health Awareness Day, a small cultural event was held. Activities included a poster making competition, a Street act by the Dramatics Club and a short movie made by the Cinephiles. We also observed the Swachhta Pakhwada which included an essay writing competition, group discussion and a competition regarding cleanest hostel rooms. Various cultural clubs held several other individual competitions and workshops. The Literary Club organized Ransense (a writing competition), a story writing competition, Cache of Lexis and Model United Nations

(first ever at IIT Indore). The Quiz Club organized several quizzes ranging from the Newbie Quiz to Obscura (puzzles), Sports quiz and a Game of Thrones quiz. The Dramatics Club performed a stage play for a residential community of Indore as a part of Navratri celebrations. It also participated in the Inter IIT Cultural Meet 2017 and secured an overall 9th position and got 3rd prize in the singing competition. Among the other cultural events, IIT Indore stood 4th in Turncoat, 4th in stand-up comedy, 4th in Hindi story writing, 6th in the movie making competition.

The sports teams participated in the Inter-IIT sports meet 2017 and bagged a silver medal in Shotput throw. Apart from that, they also organized the annual Intra IIT sports meet, an internal competition for the students of IIT Indore in various indoor and outdoor games. The cricket team organized a special girls' only cricket match as a part of the Intra IIT sports meet. The Yoga & Fitness Club celebrated the International Yoga Day on 21 June with many members of IIT Indore performing yoga together.

International Yoga Day 2017

The IIT vs. IIM meet

Inter IIT Sports Meet 2017

Ganesh Chaturthi Celebrations

Celebration of Navratri

# Summary of the Balance Sheet, Income & Expenditure

## A. BALANCE SHEET as of 31.03.2018

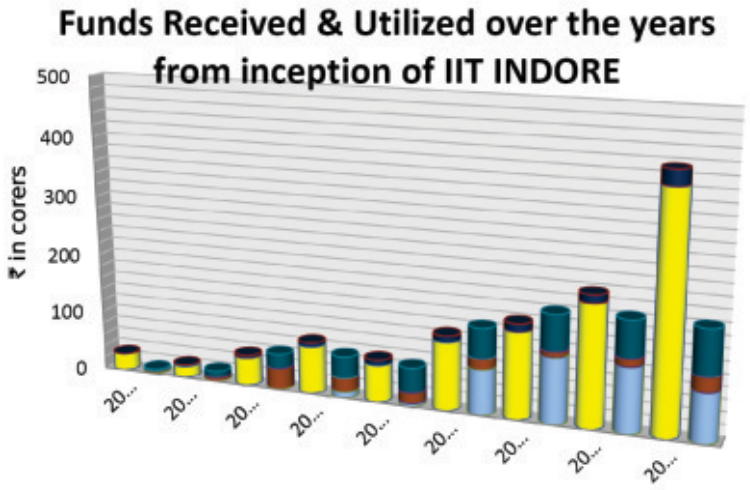
| SOURCES OF FUNDS | SCHEDULE | As of 31-03-2018 | As of 31-03-2017 |
|---|---|---|---|
| Corpus / Capital Fund | 1 | 5,03,82,13,629 | 4,31,10,83,703 |
| Designated / Earmarked / Endowment Funds | 2 | 6,47,28,918 | 4,87,01,472 |
| Current Liabilities & Provisions | 3 | 2,68,46,74,160 | 17,20,04,698 |
| **TOTAL** | | **7,78,76,16,707** | **4,53,17,89,873** |
| APPLICATION OF FUNDS | | | |
| FIXED ASSETS | 4 | | |
| A. Tangible Assets | | 3,18,70,71,686 | 78,96,85,559 |
| B. Intangible Assets | | 4,66,55,229 | 64,18,415 |
| C. Capital Work-In-Progress | | 92,66,81,862 | 2,89,40,68,390 |
| INVESTMENTS FROM EARMARKED / ENDOWMENT FUNDS | 5 | - | - |
| INVESTMENTS - OTHERS | 6 | - | - |
| CURRENT ASSETS | 7 | 1,93,23,39,170 | 40,19,88,331 |
| LOANS, ADVANCES & DEPOSITS | 8 | 1,69,48,68,760 | 43,96,29,178 |
| **TOTAL** | | **7,78,76,16,707** | **4,53,17,89,873** |

## B. Income And Expenditure Account For The Year Ended 31st March'2018

(Amount in Rs. Crore)

| PARTICULARS | SCHEDULE | 2017-2018 | 2016-2017 |
|---|---|---|---|
| **(A) INCOME** | | | |
| Academic Receipts | 9 | 10,50,85,940 | 7,68,68,731 |
| Grants & Subsidies 3,86,43,70,000 | 10 | 59,43,70,000 | 86,50,00,000 |
| (-) Capital Grants for Fixed Assets 3,27,00,00,000 | | | |
| Income from Investments | 11 | - | - |
| Interest Earned | 12 | 13,69,92,051 | 5,87,31,049 |
| Other Income | 13 | 81,63,126 | 68,67,242 |
| Prior Period Income | 14 | 49,23,972 | 9,10,013 |
| **TOTAL (A)** | | **84,95,35,089** | **1,00,83,77,035** |
| **(B) EXPENDITURE** | | | |
| Staff Payments & Benefits | 15 | 40,23,79,828 | 25,67,21,357 |
| Academic Expenses | 16 | 12,35,68,214 | 18,74,06,987 |
| Administrative and General Expenses | 17 | 18,77,87,357 | 12,93,65,637 |

| | | | |
|---|---|---|---|
| Transportation Expenses | 18 | 92,52,163 | 1,39,74,812 |
| Repairs and Maintenance | 19 | 1,81,76,908 | 1,03,18,184 |
| Finance Costs | 20 | 47,855 | 3,109 |
| Depreciation | 4 | 59,53,55,228 | 13,46,79,687 |
| Other Expenses | 21 | 7,71,091 | 60,19,564 |
| Prior Period Expenses | 22 | 33,59,615 | 37,19,495 |
| **TOTAL (B)** | | **1,34,06,98,259** | **74,22,08,832** |
| **Balance being excess of Income over Expenditure (A-B)** | | -49,11,63,170 | 26,61,68,203 |
| (-)(i) Transfer to Corpus fund towards Internal Revenue Generation of 2017-2018 (2016-17) (See Notes to Account - no.6) | | -25,51,65,089 | -14,37,30,372 |
| **Total** | | **-74,63,28,259** | **12,24,37,831** |
| Add: Amount transfer to Capital Fund | | 59,53,55,228 | 13,46,79,687 |
| Balance being Surplus (Deficit) Carried to Sche. | | | |
| 3C Unutilised Grant from Govt. of India | | -15,09,73,030 | 25,71,17,518 |




| SI. No. | Particulars | | 09-10 | 10-11 | 11-12 | 12-13 | 13-14 | 14-15 | 15-16 | 16-17 | 17-18 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | RECEIPT | GRANT | Rs. 27.78 | Rs. 19.15 | Rs. 47.47 | Rs. 80.00 | Rs. 62.00 | Rs. 113.45 | Rs. 142.80 | Rs. 200.00 | Rs. 386.44 |
| | | IRG | Rs. 0.97 | Rs. 2.65 | Rs. 4.68 | Rs. 6.58 | Rs. 9.10 | Rs. 10.51 | Rs. 13.24 | Rs. 14.37 | Rs. 25.52 |
| 2 | EXPENDITURE | BUILDING | Rs. 0.00 | Rs. 0.00 | Rs. 0.00 | Rs. 9.89 | Rs. 4.98 | Rs. 75.82 | Rs. 109.41 | Rs. 107.77 | Rs. 80.93 |
| | | EQUIPMENT | Rs. 3.99 | Rs. 5.98 | Rs. 36.36 | Rs. 23.54 | Rs. 17.29 | Rs. 17.39 | Rs. 8.46 | Rs. 12.54 | Rs. 24.48 |
| | | RECURRING | Rs. 3.50 | Rs. 11.47 | Rs. 24.06 | Rs. 36.14 | Rs. 42.15 | Rs. 49.32 | Rs. 59.51 | Rs. 60.79 | Rs. 74.53 |

## Centre for Innovation and Entrepreneurship (CIE)

**TEDx:** TEDx IIT Indore was the first TED event held at IIT Indore as a one-day event. It was organized as part of the annual e-week conducted by SESC (Student Entrepreneurship Support Cell). The event was conducted with a lot of fanfare after obtaining the first license from TED. The theme of the event was "IMPACT." Eight speakers were invited for the talk from diverse backgrounds who spoke about their personal experiences.

The speaker panel comprised of Mr. Karan Chitra Deshmukh (Professional Tabla Player), Ms. Rajini Thindiath (Editor of Tinkle), Mr. Gauranga Das (Divisional Director of ISKCON), Mr. Manan Desai (Stand-up comic), Mr. Samit Choksi (Founder of Ultachaata, Thinkphi), Mr. Sanjeev Newar (Author of AgniVeer), and Mr. Mahesh Bhat (Photographer). With such a wide variety of speakers, the event was conducted with the presence of a crowd of around 100.

**Industry Academic Conclave (IAC):** The 5th annual Industry Academic Conclave (IAC) was held on 6th September 2017 at IIT Indore. Since its inception in 2012, Industry-Academia Conclave has evolved into a forum where experts from both Industry and Academia discuss and address important concerns and galvanize their efforts towards forging successful partnerships that would prove mutually beneficial. IAC 2017, as an endeavor, focused on exploring research avenues between academic institutions and corporate organizations. The theme of the conclave was: 'Possibilities for Tomorrow.' IAC 2017 also presented an 'Innovation Pavilion.' IAC 2017, for the first time, presented an 'Incubation Centre & Centre for Excellence' where younger ideas are invited and a base is set for the technology of future. IAC 2017 witnessed 6 new startups, more than 60 research facilities and posters, 13 prototypes, 18 technical talks, a panel discussion, and a reinvented incubator and over a dozen sponsorships. It beckoned a footfall of over 400 people. This edition of IAC saw an influx of powerful speakers, who talked about how governmental, educational institutes and the Industry could interact so that the Industry and Academia can evolve together. The Chief Guest, Mr. Gurjit Singh, the former Indian Ambassador to Germany, talked about his prior experiences dealing with the overlap of Industry and Academia in Ethiopia and Japan. Dr. Vimal Bhatia, Convener of the Industry Relations Team, initiated the session by talking about the importance of IAC and how it has grown over the years.

Professor Pradeep Mathur, Director of IIT Indore, emphasized the role of IIT Indore as a catalyst in this simultaneous growth of industry and academia, especially long-term growth and inviting applications for setting up a center for excellence at IIT Indore. Dr. Debojit Chakraborty, Global Category Head of Technology and Applications at Keva Fragrance Innovation, spoke about the interest of private organizations in academic research. Dr. Kumar B Salui from ANSYS, India spoke about the implications of modern research in the field of computer aided simulations, and its usage in autonomous vehicles and efficient industrial production. Mr. Sandeep Saxena from TCS, Mumbai predicted the exponential growth of digital data in the near future and its management and utility. He briefly touched on the urgent need to create a more efficient workspace for employees and researchers.

**Innovation Entrepreneurship Development Centre (IEDC):** IEDC was the first externally funded center at the Institute formed to promote knowledge-based and technology-driven start-ups by harnessing young minds and their innovation potential in an academic environment. The center works to motivate, support and mentor students for identification, development, and commercialization of their innovative ideas.

It also arranges interaction with entrepreneurs, bankers, professionals, potential customers and creates an mentorship scheme for student innovators. IEDC has so far supported over 20 entrepreneurial student projects with support from DST. So far 8-patents have been filed by projects supported by DST-IEDC, and four student startups have been started from the center. Every year IEDC selects bright and self-sustainable ideas for support through its board meeting. IEDC has been able to garner a lot of innovative ideas and periodically reviews its progress.

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** works on Waste Management. 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 refers to the aim of eradicating poverty by economically empowering people. Presently operational in Indore, Swaaha has grown rapidly. It 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 Monjee Institute of Management Studies Indore.

2. **Esmartify Private Limited** is founded by Mr. Shikhar Bansal and Mr. Ravi Shankar Bharti. Esmartify provides location-based information to its users via a mobile app. Users can access local shopping offers when they visit a mall; and ratings, when they are close to a restaurant. They can also receive information on animals when they are near a zoo; and on paintings/artefacts, when are near a museum. Esmartify enabled the Indore Zoo to achieve the coveted status of the first Indian 'Smart Zoo'. They are currently testing their solutions in malls and retail.

**Interaction on Entrepreneurship & Innovation:** CIR team has been periodically organizing talks on how to start industries and secure government funding. The guest speakers of these talks are from the Ministry of Micro, Small & Medium Enterprises. These talks have been highly beneficial in preparing the students towards honing their skills of innovation.

## International Day of Yoga – 21 JUN 17

The Institute celebrated the International Day of Yoga to spread awareness of the positive effects of Yoga. The event was celebrated from 19 Jun to 21 Jun 17. Events were planned to draw the attention of the community towards Seva Yoga, Gyan Yoga and Karma Yoga. Due emphasis was give to the thought, 'Yoga is not just an exercise, it is a way of life'.

1. **19th Jun 17:** The day commenced with 'Seva Yog,' wherein the Institute donated a computer lab facility to the Government Middle School, Simrol. The facility was inaugurated by Prof Pradeep Mathur, Director, IIT Indore. The facility is intended to provide computer knowledge to the local community to improve the infrastructure of the school.

Inauguration of IT facility

Director explaining importance of internet

Students utilising the new IT facility

Team of IIT Indore & School

2. A lecture by Mrs. Uma Jhawar, on the importance of eye and organ donation was organised as part of the 'Gyan Yog' lecture series. It was attended by the students, staff, and faculty. Mrs. Jhawar is the Executive Director of MK International Eye Bank. She lectured on the impact of eye and organ donation on the disabled, particularly in rural India.

Awareness program on organ donation

3. **20 Jun 17:** Isha Foundation conducted a workshop on Inner Engineering as part of the 'Gyan Yog,' lecture series. The focus was on personal growth. The program emphasised the influence of yoga on mental health and offered suggestions for meaningful and fulfilling relationships in the workplace.

Awareness program on Inner Engineering

Awareness program by Isha Foundation

Felicitation of Speaker by the Registrar

4. **21 Jun 17:** The International Yoga Day was conducted in the Institute by Kumari Rachna Jani from Vivekananda Kendra, Kanyakumari. Along with the asanas, awareness of the advantages of Yog was also communicated to the participants. The attainment of peace, positive attitude, and exoneration of stress through Yog formed an integral part of the event.

Conduct of Yoga

5. The Yoga and Fitness Club has spread awareness through increasing participation of volunteers. The club, managed by Ph.D. students of the Institute, has also hosted a website on Yoga designed by Yash Krishan, B.Tech (CSE) student of the Institute. A link has been provided at IITI website under 'NEWS' section.

Conduct of Yoga

भारतीय प्रौद्योगिकी संस्थान इन्दौर
Indian Institute of Technology Indore
Khandwa Road, Simrol, Indore 453 552, India
Tel.: +91-7324-306935, Fax: +91-7324-306933, Website: www.iiti.ac.in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