भारतीय प्रौद्योगिकी संस्थान मण्डी

Indian Institute of Technology Mandi

भारतीय प्रौद्योगिकी संस्थान रोपड़

Indian Institute of Technology Ropar

# IIT Ropar - IIT Mandi PhD Joint Degree Program

# Information Brochure

ADMISSIONS 2023

# Contents

## About IIT Mandi

The Indian Institute of Technology Mandi (IIT Mandi), one of the premier technical institutes in India. IIT Mandi was established in 2009 with the aim of providing world-class education and cutting-edge research in engineering, science, and technology. Since its inception, the institute has strived to achieve excellence in education, research, and innovation.

Located in the scenic town of Mandi in the Himalayan foothills, the institute offers a unique learning experience to its students. With state-of-the-art facilities and world-class faculty members, IIT Mandi provides a conducive environment for research and learning. The institute offers undergraduate, postgraduate, and doctoral programs in various disciplines of engineering, sciences, and humanities.

At IIT Mandi, we believe in fostering an environment of innovation and creativity. Our faculty members are renowned experts in their fields and are committed to providing their students with the best possible education. With our multidisciplinary approach to education, we aim to produce graduates who are well-rounded and equipped to solve real-world problems.

We take pride in our research culture and encourage our students to engage in cutting-edge research in various fields. Our research facilities are equipped with state-of-the-art equipment and resources, providing our students with ample opportunities to explore their interests and pursue their passions.

Institute Webpage: www.iitmandi.ac.in

## About IIT Ropar

Indian Institute of Technology Ropar, an educational institution created by an Act of Parliament andhaving its principal address at The Indian Institute of Technology Ropar, Rupnagar, Punjab, 140001, India ("IITRopar").IIT Ropar is committed to provide state-of-the-art technicaleducation in a variety of fields. The Institute is facilitating transmission of knowledge in keeping with thelatest developments in pedagogy. At present, the Institute offers the degree of Bachelor of Technology in 7 Departments and offersthe MSc degree in 3 Departments. It also offers the degree of Master of Technology in 7 Departments. The institute also offers doctoral programmes in Engineering, Science, Humanities and Social Sciences.

**Mission:**To foster a transformative learning environment and a culture of excellence enablingcreation of knowledge and development of socially responsible, enterprising leaders contributing significantly to national progress and humanity.

Institute Webpage: https://www.iitrpr.ac.in/

## About PhD JDP

The Joint Degree Program (JDP) offers PhD students enrolled in both institutions the chance to collaborate on a multidisciplinary research project with faculty members and research teams from IIT Mandi and IIT Ropar, as well as to take advantage of the facilities and professional development opportunities offered by both institutions.

## Important Guidelines for PhD Application

1. Please read theinstructions given in the brochure carefully before filling up the applications.
2. **Online** Application form & Information brochure (Including the admission schedule along with the important dates) isavailable on the institute website at the following link:https://alliance.iitmandi.ac.in/iitrpr
3. You are required to submit the application form ONLINE. No Downloadable Forms will be available after filling the form, you are advised to take a print of your application for your records.
4. For each project, candidate should submit a separate application with the application fee.
5. The application fee is as follows:

| Category | Amountin ₹ |
|---|---|
| General/EWS/OBC/OBC(NCL)/Transgender/Foreign Nationals | 200 |
| Women/SC/ST/PD | 100 |

   a. ***Mode of Payment: SBI Collect Portal.***

   b. i) Go to onlinesbi.com

      ii) Select SB Collect

      iii) Tick the terms and conditions and continue

      iv) Select state--Punjab

      v) Select educational institute--IIT Ropar

      vi) Select the option for payment category

      vii) Select the option- Application Fees for PhD admission

      viii) Pay the requisite fee.

   c. One applicationfee isvalidforthe single application.The applicationfee is **NON-REFUNDABLE**.

6. OBC candidates may note that the limit for annual income is Rs. 8 Lakhs for determining the creamy layer among Other Backward Classes (OBCs) candidates. The OBC (NCL) certificate issued for the financial year 2022-23 by the Competent Authority in the prescribed format must be uploaded in the ONLIINE application form.

7. Economically Weaker Sections (EWS) candidates may note that the limit for annual income is Rs. 8 Lakhs for determining the eligibility for benefit under Economically Weaker Sections (EWS) reservation. The EWS certificate issued by the Competent Authority in the prescribed format must be uploaded in the ONLINE application form and submitted at the time of admission.
8. Seats are reserved for Economically Weaker Sections (EWS)/Other Backward Class Non-Creamy Layer (OBC-NCL)/Schedules Caste (SC)/Scheduled Tribe (ST) and Person with Benchmark Disability (PwD) categories as per Government of India norms.
9. You should check Institute website for results/important announcements.
10. You should check emails sent to your email address provided in your application for all important communications and announcements if any.
11. Merely fulfilling eligibility criteria does 'not entitle a candidate to be called for the written test/interview. Decision of Institute authorities will be final. Admission is based on GATE/Written test/Interview performance in addition to general eligibilitycriterion,the applicantsmustalso satisfythe eligibilitycriteriaspecifiedfor therespective Departments / Centres / Schools / Interdisciplinary Groups.
12. Candidates, if called for written test/interview should show/ bring with them (i) Photo ID Card, (ii)Printedcopyoftheapplicationsubmittedonline, (iii)Thesis/dissertation/report/ publications (iv) copyof certificates and mark-sheets.

## Important Dates for Admission

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| Startingdatefor fillingOnlineApplication | 26th May, 2023 |
| Lastdate for fillingOnlineApplication | 18th June, 2023 |
| Declaration of shortlisted candidates list | Will be Published on IIT Mandi and IIT Ropar website |
| Shortlisted candidates will be informed by email | |

## Contact Details

In case of any query related to the Ph.D. Programme admission process you may contact respective school/Centre, the contact details are:

## IIT Mandi

| Name of School/Centre | Email ID | Contact No. |
|---|---|---|
| CentreArtificialIntelligenceandRobotics (CAIR) | cairoffice@iitmandi.ac.in, | ---- |
| SchoolofBiosciences&Bioengineering | sbboffice@iitmandi.ac.in | 01905-267061 |
| School of Chemical Sciences | scsoffice@iitmandi.ac.in | 01905-267277 |
| SchoolofCivil&EnvironmentalEngineering | scene_admissions@iitmandi.ac.in | 01905-267180 |
| School of Computing and Electrical Engineering | sceeoffice@iitmandi.ac.in | 01905-267071 |
| School of Humanities & Social Sciences | shssoffice@iitmandi.ac.in | 01905-267719 |
| Indian Knowledge System and Mental Health Application (IKSMHA) | iksmha@iitmandi.ac.in | --- |
| School of Management | somoffice@iitmandi.ac.in | 01905-267119 |
| SchoolofMathematical&StatisticalSciences | smssoffice@iitmandi.ac.in | 01905-267929 |
| School of Mechanical and Materials Engineering | smmeadmissions@iitmandi.ac.in | 01905-267138 |
| School of Physical Sciences | spsoffice@iitmandi.ac.in | 01905-267812 |

## IIT Ropar

| Name of School/Centre /Department | Email ID | Contact No. |
|---|---|---|
| Academics Section | phdadmissions@iitrpr.ac.in<br>academicspg@iitrpr.ac.in | 01881-231167,<br>01881-231169 (from 9 am to 5 pm) |

# Academic Structure

## Program management

A Doctoral Advisory Committee (DC) shall be set up for each JDP Scholar to support and monitor progress of the JDP Scholar throughout the candidature until the thesis has been submitted. The DC shall consist of the following members.

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| Chair/Head of the School/Department of the Home Institute or his/her nominee | Chairperson |
| Supervisor from the Home institute | Member |
| Supervisor from the Host institute | Member |
| Co-supervisor (s), if any with justification | Member (s) |
| Subject Expert from the Home Institution | Member |
| Additional members may be appointed to meet the requirements | Members |

## Coursework Requirements

The JDP Scholar shall satisfy the minimum academic coursework requirements of the Home Institution. Additional courses may be taken when recommended by the DC. If a JDP scholar credits a course in one institution, the credits will be automatically transferred to the other institution and will be counted towards the degree requirement.

## Joint Degree Program Structure

- Candidates have a **"Home Institution"** where they begin their studies and spend the majority of time. The expectation is that candidates will spend a minimum of 12 months at the other, **"Host Institution"** the timing and duration of this will depend on the program of research but in general will be in the second or third year of the degree. Travel to and study at the Host Institution will be subject to the usual requirements of the institute.

- As a condition of enrolment on the PhD JDP, candidates are required to:
  - Spend a minimum of one year* (two semesters) enrolled at each institution.
    *Candidates registered as part-time PhD or under External Registration program need to spend the minimum residential requirement criteria of both the institute as mentioned in their ordinances and regulations.
  - Undertake a program of progress monitoring and examination that meets the requirements of both institutions.
  - Comply with the rules, regulations, policies, codes and procedures of both institutions.
  - Write and submit a thesis for defense by oral examination at the home Institution.

- Candidates for the PhD JDP will be enrolled in a PhD program in parallel at both institutions. The supervisory team will comprise academics from both institutions who will provide guidance and support throughout the doctoral program. Candidates will benefit from the research community, networking, and collaborations of the IIT Mandi – IIT Ropar. Through enrolment at both institutions, candidates will have access to services and support provided at IIT Mandi and IIT Ropar, including a variety of professional and personal development opportunities for researchers.

- The primary supervisor shall be from the Home Institution. There must be a Joint supervisor from the Host Institution.

- The PhD JDP includes a tailored program of progress monitoring to fulfil the requirements of both institutions. On successful completion of the program requirements, candidates will be awarded a PhD degree jointly by both the Institutions.

## Admissions are currently open under the following research projects

<table>
<tr><td rowspan="2">1.</td><td colspan="2">Design of Phase locked loop IC for 5G applications<br><br>An integer-N phase-locked loop is to be designed for better phase noise and lesser jitter requirement in 5G applications. An architecture based on improved precharged-based PFD and differential ring oscillator-based PLL is to be designed with different noise cancellation utilizing a duty cycle correction circuit. The project aims to have less power requirement with better parametric attributes for 5G applications. The complete design process's target includes a detailed literature survey, circuit modifications for meeting the specifications, its schematic and layout preparation, test board preparation, testing of recieved PLL IC, and write up.</td></tr>
<tr><td>Home Institute:IIT Ropar<br>Supervisor:Mahendra Sakare<br>School/Dept.:Electrical Engineering</td><td>Host Institute:IIT Mandi<br>Supervisor:Dr. Hitesh Shrimali<br>School/Dept.:School of Computing and electrical Engineering</td></tr>
<tr><td rowspan="2">2.</td><td colspan="2">Design, Tapeout and Characterization of Application Specific Integrated Circuit (ASIC) for Chip-scale Atomic Clock<br><br>Ultra-precise timing signal generator requires extremely stable oscillators with typical long-term stability requirements well below a few parts-per-billion levels for accurate determination of position in military applications. Such a level of stability cannot be provided by electromechanical oscillators. Atomic oscillators can achieve such stability but are unsuitable for portable applications. In the literature, chips-scale atomic clocks have emerged as a suitable option. However, several challenges need to be addressed before their widespread adoption. Such systems consist of 1) Quantum Package; and 2) Interfacing electronics. In this project, we intend to design, tapeout and characterize the CMOS Analog and Mixed Signal Circuits for interfacing the Quantum Package, which consists of modules such as Power conditioners, Drivers, Transimpedance Amplifiers, etc.</td></tr>
<tr><td>Home Institute:IIT Ropar<br>Supervisor:Dr. Devarshi Mrinal Das<br>School/Dept.:Electrical Engineering</td><td>Host Institute:IIT Mandi<br>Supervisor:Dr. Hitesh Shrimali<br>School/Dept.:School of Computing and Electrical Engineering</td></tr>
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| 3. | **Machine Learning Driven Channel Coding**<br><br>Typical channel coding schemes are developed accounting for channel dynamics which are modeled as some stochastic process. These models, however, are based on multiple oversimplified assumptions of the channel and signal reception. In this work, we propose to develop schemes for realistic channels by employing machine learning (ML). As the realistic channels exhibit large variations, we propose to use ML to learn channel dynamics and apply the same in optimizing channel coding. Outcomes of the project would be ML based channel coding algorithm and its proof-of-concept implementation on software defined radio. The results will be compared against existing coding schemes. | |
| | **Home Institute:**IIT Ropar<br>**Supervisor:**Dr. Satyam Agarwal<br>**School/Dept.:**Department of Electrical Engineering | **Host Institute:**IIT Mandi<br>**Supervisor:**Dr. Satyajit Thakor<br>**School/Dept.:**School of Computing and Electrical Engineering |
| 4. | **Development of functional materials for sustainable production of solar fuels and fine chemicals**<br><br>The global energy demand is rapidly increasing, and at the same time, the primary energy resources are depleting with time. Furthermore, pollution and climate change present undesirable side effects of the extensive use of fossil fuel-based resources. Consequently, sustainable production of clean fuel and value-added chemicals is highly desired. In this project, we indent to develop functional materials with optimal properties for an efficient generation of solar fuels, H2, CH4, and fine chemicals (Methanol, Ethanol, etc.) by utilizing renewable sources like water, sunlight, and biomass. The project involves synthesis, characterization, and catalytic investigation of materials/nanomaterials for energy applications. | |
| | **Home Institute:**IIT Ropar<br>**Supervisor:**Dr. C. M. Nagaraja<br>**School/Dept.:**Chemistry | **Host Institute:**IIT Mandi<br>**Supervisor:**Prof. Venkata Krishnan<br>**School/Dept.:**School of Chemical Sciences |
| 5. | **Spintronics in Memory Devices**<br><br>This project aims to develop a spintronic device for non-volatile memory applications through a combination of simulation and fabrication efforts. The simulation part involves the development of a quantum transport model to predict the behavior of electrons and their spin in the device, and their interaction with magnetic tunnel junction stacks. On the other hand, the fabrication part involves the creation of various magnetic tunnel junction stacks using thin films of magnetic and non-magnetic materials in a layered structure. These stacks will be analyzed for their performance using various techniques such as electrical measurements, magnetic characterization, and imaging methods. By bringing together these two fronts of simulation and fabrication, this project has the potential to contribute to the development of new and improved non-volatile memory technologies. | |
| | **Home Institute:**IIT Ropar | **Host Institute:**IIT Mandi |

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| | **Supervisor:**Abhishek Sharma<br>**School/Dept.:**Electrical Enginneering | **Supervisor:**Prof. Satinder Sharma<br>**School/Dept.:**School of computing and electrical engineering |
| 6. | **Telestroke network for diagnosis of stroke and immediate interventional support at the point of care**<br><br>Telestroke network for diagnosis of stroke and immediate interventional support at the point of care Stroke is one of the commonest causes of morbidity and mortality worldwide. It is debilitating not only for the survivors of stroke but also for the caregivers. Globally, stroke seems to have a very high incidence rate and also continuously increasing due to the ageing population and intense social pressure. The Indian stroke scenario is quite concerning with a comparatively higher rate of incidence and prevalence owing to poor management of risk factors and a lack of public awareness (Pandian JD et al., 2013). Stroke-related mortality and morbidity in India are higher than they should have been mainly due to the lack of availability and the affordability of quality stroke management facilities in many parts of the country, especially in the rural areas (Kamalakannan S et al., 2017). Also, speed is of the utmost essence in ensuring the favorable clinical outcome of stroke patients. This necessitates rapid stroke diagnosis modalities (Banerjee TK and Das SK, 2016). Stroke can be broadly classified into two major categories: ischemic stroke, with an incidence rate of around 85- 87 %, and hemorrhagic stroke, with around 13-15 % incidence rate (Donnan GA et al., 2008). Ischemic cerebrovascular accident results from a lack of sufficient blood flow to the brain due to the formation of a clot, whereby the brain is unable to meet its metabolic demands (Radic B, 2017). The consequent deprivation of oxygen and nutrient supply to the brain leads to the death of brain tissues, thereby rendering parts of the brain non-functional or poorly functional (Radic B, 2017). Hemorrhagic cerebrovascular accident occurs due to a ruptured cerebral blood vessel and the resultant bleeding into the head, whereby the brain is damaged by the impairments in blood flow due to rupture of blood vessel, which is basically bleeding outside of the brain tissue, precisely between the arachnoid mater and pia mater of meninges, into the cerebrospinal fluid containing sulci, fissures, and cisterns. A current work involves rapid diagnosis and classification of stroke at or near the point of care and communicating the data to the secondary health care centers at a remote location, seeking suggestion for the immediate follow up and treatment. The work involves developing a device to detect and classify stroke at the point of care and communicating the data with appropriately developed protocols to a remote location so as to seek immediate clinical advice and interventional guidance needed as a first aid to save the life of the subject. | |
| | **Home Institute:**IIT Ropar<br>**Supervisor:**Dr. Sujata Pal<br>**School/Dept.:**Computer Science and Engineering | **Host Institute:**IIT Mandi<br>**Supervisor:**Dr. Shubhajit Roy Chowdhury<br>**School/Dept.:**School of Computing and Electrical Engineering |
| 7. | **Support-less additive manufacturing of complex components**<br><br>Additive manufacturing is one of the important components of future smart industries. It is almost known to all the experts that additive manufacturing is going to play the most important role in the future manufacturing sector and that is the reason it is attracting a large number of researchers across the globe. One of the most important challenges is the additive manufacturing of complex components. | |

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| | Complex shapes need multiple orientations and support structures. It results in slow and costly production of the components. This project will focus on giving a feasible solution to this problem by developing robotic based additive manufacturing. | |
| | **Home Institute:**IIT Ropar<br>**Supervisor:**Ravi Kant<br>**School/Dept.:**Mechanical Engineering | **Host Institute:**IIT Mandi<br>**Supervisor:**Mrityunjay Doddamani<br>**School/Dept.:**School of Mechanical and Materials Engineering |
| 8. | **Next Generation Material for Hydrogen Storage**<br><br>With the increasing demand of energy upon increase in urbanization, the world is moving towards the search of alternate and clean energy. The present resolution setup by India is to achieve zero net carbon emission by 2050. In this regard, hydrogen is considered to be a green and alternate fuel for the next generation. Unfortunately, the direct use of hydrogen for fuel cell vehicles, power plants, hydrogen based internal combustion engine based vehicles etc., possess several challenges such as volumetric and gravimetric storage capacity. Therefore, we will explore the next generation materials such as complex metal hydrides, MoFs, and other porous materials. | |
| | **Home Institute:**IIT Ropar<br>**Supervisor:**Dr. Kishant Kumar<br>**School/Dept.:**Department of Chemical Engineering | **Host Institute:**IIT Mandi<br>**Supervisor:**Dr. Harsh Soni<br>**School/Dept.:**School of Physical Sciences |
| 9. | **Quantum emitters in two-dimensional materials**<br><br>Here, we propose to fabricate two-dimensional materials with isolated quantum emitters. We aims to its physical properties to identify its prospects in quantum technologies. The systems would be studied using Raman spectroscopy, confocal imaging at the level of single photon. The 2D materials would then be embedded into photonic structures to amplify its quantum optical properties. | |
| | **Home Institute:**IIT Ropar<br>**Supervisor:**Dr. Rajesh V Nair<br>**School/Dept.:**Physics | **Host Institute:**IIT Mandi<br>**Supervisor:**Dr. Viswanath Balakrishnan<br>**School/Dept.:**School of Engineering |

**10.**

## Comprehensive landslide risk assessment for the Himachal Pradesh regions

Landslides on hillslopes cause significant damage to life and properties, and the landslide risk assessment can help identify the landslide hazard zones at vulnerable sites. The primary goal of this study is to investigate landslide susceptibility zones using geotechnical and geophysical investigation and estimate their hazard index for risk assessment. This research focuses on analysing the prevailing susceptibility conditions of the hillslopes and evaluating landslide hazards by integrating geographic information systems (GIS), geotechnical, geophysical, and slope stability analysis. A landslide susceptibility map of the area will be developed using high-resolution terrain model. Finally, the risk assessment will be carried out by incorporating the population density and infrastructure for the identified hazard zones.

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| **Home Institute:**IIT Ropar<br>**Supervisor:**Dr. Naveen James, Dr. Reet Kamal Tiwari<br>**School/Dept.:**Department of Civil Engineering | **Host Institute:**IIT Mandi<br>**Supervisor:**Dr. Kala Venkata Uday<br>**School/Dept.:**School of Civil and Environmental Engineering |

**11.**

## Heterostructure of 2D materials and its phonon dynamic studies for broadband photodetectors

This project will be focused on the growth of 2D materials and their heterostructures at IIT Ropar. The heterostructures and their interface engineering will be performed at IIT Ropar. The detailed investigation of phonon dynamics of individual 2D material and their heterostructures will be performed at IIT Mandi. Finally, the heterostructures will be utilized for broadband photodetection.

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| **Home Institute:**IIT Ropar<br>**Supervisor:**Dr. Mukesh Kumar<br>**School/Dept.:**Physics | **Host Institute:**IIT Mandi<br>**Supervisor:**Dr. Pradeep Kumar<br>**School/Dept.:**School of Physical Sciences |

**12.**

## Mechanical characterization of discontinuities in material's microstructure

Grain boundaries play a crucial role in the fracture behavior of materials. These boundaries can act as sites for the initiation and propagation of cracks, and therefore play a significant role in the fracture behavior of materials. In particular, the presence of impurities or defects at grain boundaries can significantly affect the material's fracture resistance. However, another important aspect of the GBs are that these regions deform differently in comparison to the material inside the boundaries and therefore influence the crack driving forces. A confirgurational force approach can calculate the effect of such influences and the same can be applied in presence of a complicated gradually changing inhomogeneities such as a heat affected zone, weld zone etc. Interfaces in welds and heat-affected zones (HAZ) play an important role in determining the mechanical properties of the joint. The interfaces between different materials or between different regions of the same material can create areas of stress concentration, which can lead to the initiation and propagation of cracks. Furthermore,

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| | the presence of residual stresses and microstructural changes in the HAZ can also affect the mechanical properties of the joint. Therefore, the proper design and characterization of welds and HAZ interfaces is critical to ensure the reliability and safety of welded structures. | |
| | **Home Institute:**IIT Ropar<br>**Supervisor:**Abhishek Tiwari<br>**School/Dept.:**Metallurgical and Materials Engineering | **Host Institute:**IIT Mandi<br>**Supervisor:**Dr. Himanshu Pathak<br>**School/Dept.:**School of Mechanical and Materials Engineering |
| **13** | **Design of polymer scaffold and polyoxometalate nanocluster as nanocarrier in drug delivery and study the dynamical cellular events by various sophisticated imaging techniques.**<br><br>We want to explore polymer embedded quantum dots as nanocarrier and polyoxometalate nanoclusters towards drug delivery systems. Recently, Polyoxometalates (POM) emerge as potential Next-generation metallodrugs in Cancer therapy. They possess a high potential for inhibiting various type of tumors; Although the antitumor activity of POMs is well documented, their mechanisms of action are still poorly understood. More importantly, their nonspecific interactions with biomolecules and toxicity impede their clinical usage. Our group works extensively on the POM and polymer. Prof. CK. Nandi at IIT Mandi is well established in drug delivery related Fluorescence Lifetime Imaging and Super-resolution microscopy of cellular cytoskeletonto to understand the dynamical cellular events under living conditions. Collaborative work would be promising to develop POMs as the next-generation anticancer drugs that selectively target cancer cells while sparing healthy cells. | |
| | **Home Institute:**IIT Ropar<br>**Supervisor:**Debaprasad Mandal<br>**School/Dept.:**Chemistry | **Host Institute:**IIT Mandi<br>**Supervisor:**C. K. Nandi<br>**School/Dept.:**School of Chemical Sciences |
| **14.** | **Experimental Investigation on Effect of EGR and Fuel Additive on Knocking and Emissions from Spark-Ignition (SI) Engine**<br><br>Spark-ignition (SI) engines are preferred for light duty vehicles. The Knock phenomenon in SI engines restricts the operating compression ratio and engine efficiencies. Furthermore, SI engine emits regulated and unregulated emissions in higher concentration. To meet the fuel standards and emission regulations for SI engine, knocking is one of the major factors. Exhaust gas recirculation (EGR) and fuel additives are effective ways to tackle with the challenge of knock. The project will investigate the thermal, chemical and dilution effect of EGR on knocking. Additionally, effect of fuel additives on regulated and unregulated emissions will be investigated to develop the optimized engine maps of SI engine. | |
| | **Home Institute:**IIT Ropar<br>**Supervisor:**Dr. Rakesh Kumar Maurya<br>**School/Dept.:**Mechanical Engineering | **Host Institute:**IIT Mandi<br>**Supervisor:**Dr. Atul Dhar<br>**School/Dept.:**Mechanical Engineering |

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| 15. | **Design of RSMA based Cooperative Vehicular Network for Deep Ocean Critical Missions**<br><br>Proposed project aims to incorporate next generation wireless techniques such as RSMA and co-operation in the deep ocean network nodes like AUVs, submersibles and robotic platforms for enhanced performance. o Prototype is to be tested using software defined radios first, then using AUVs inside a hyperbaric pressure chamber with the help of industry partner. | |
| | **Home Institute:**IIT Ropar<br>**Supervisor:**Dr. Sam Darshi<br>**School/Dept.:**EE | **Host Institute:**IIT Mandi<br>**Supervisor:**Dr. Satyajit Thakor<br>**School/Dept.:**SCEE |
| 16. | **3D printing of biofunctional bone implants**<br><br>It will involve use of 3d printer and bioprinter to develop custom made bone scaffolds that can both support the damaged bone mechanically as well as help in regeneration. | |
| | **Home Institute:**IIT Mandi<br>**Supervisor:**Dr. Sumit Murab<br>**School/Dept.:**School of Biosciences and Bioengineering | **Host Institute:**IIT Ropar<br>**Supervisor:**Prof. Navin Kumar<br>**School/Dept.:**Mechanical Engineering |
| 17. | **Advanced peptide/polymer based nanocomposite hydrogels for wound healing application**<br><br>Chronic wounds are a major healthcare challenge owing to their complex healing mechanism and number of impediments to the healing process, like infections. Current topical care strategies, such as surgical debridement, materials for absorption of exudates along with infection and inflammation management, slow the progression of wounds and reduce patient suffering but suffer from low overall cure rates. Therefore, there is still an urgent need for innovative and effective therapeutic approaches to address anomalies in wound repair and avoid long-term repercussions. The proposed work will focus on developing multifunctional peptide/polymer-based nanocomposite scaffolds with bactericidal, anti-inflammatory, and proangiogenic properties. | |
| | **Home Institute:**IIT Mandi<br>**Supervisor:**Dr. Garima Agrawal<br>**School/Dept.:**School of Chemical Sciences | **Host Institute:**IIT Ropar<br>**Supervisor:**Dr. Yashveer Singh<br>**School/Dept.:**Department of Chemistry and Department of Biomedical Engineering |
| 18. | **Design for Additive Manufacturing to achieve sustainability using Artificial Intelligence based tools** | |

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| | In this project, we first aim to select an appropriate AM technique for a given form. For this AI based algorithm will be utilised. Further the tools to assess the cost of the manufacturing will be developed. Additionally, the student will develop a way to assess the environmental impact that a product would generate in each phase of the product life cycle. This supporting tool would then provide multiple options to a manufacturer for different cost vs. environmental impact and quality of the product (surface finish, strength etc.)<br><br>**Desirable Background:**<br>Mechanical/Production and Industrial Engeering/Manufacturing/Production/Industrial engineeting/related areas. | |
| | **Home Institute:**IIT Mandi<br>**Supervisor:**Dr. Prateek Saxena<br>**School/Dept.:**School of Mechanical and Materials Engineering | **Host Institute:**IIT Ropar<br>**Supervisor:**Dr. Prabir Sarkar<br>**School/Dept.:**Department of Mechanical |
| **19.** | **Development and Analysis of Reconfigurable Intelligent Surface (RIS) Designed using Frequency Selective Surface (FSS) for 6G and Beyond.**<br><br>In the era of the next generation of communication systems based upon 6G-enabled Massive IoT deployments for smart scenarios, there is a need to develop the technique to enhance the coverage to the users in the areas where direct line-of-sight signals are not received (deep faded zones). As a solution, Smart Surfaces are gaining huge attention these days in the wireless communication research area but only from an analysis perspective. The proposed research work is related to the RIS hardware implementation which is not being realized till now. Only preliminary studies have been conducted from a hardware perspective. We propose to investigate novel FSS-based designs to realize RIS surface structure to achieve high-efficiency beam-forming toward intended users for enhancing the quality of communication. The application of RIS can be extended to energy harvesting, phased reflectors and tunable EM wave absorbers. These applications have huge potential towards commercialization especially in the communication and defense sectors. | |
| | **Home Institute:**IIT Mandi<br>**Supervisor:**G. Shrikanth Reddy<br>**School/Dept.:**School of Computing and Electrical Engineering | **Host Institute:**IIT Ropar<br>**Supervisor:**Ashwini Sharma<br>**School/Dept.:**Electrical Engineering Department |
| **20.** | **Effective Hamiltonian for multi-state problems**<br><br>Effective Hamiltonian is so far available for single potential energy surface and in general it is the ground electronic state and that too at lower energy (in comparison with bond dissociation energy). In this project we plan to consider the case where at least two potential energy surface is involved in the problem and we plan to construct the effective Hamiltonian and perform, subsequent analysis to understand the mechanism of energy flow from one potential to the other. | |
| | **Home Institute:**IIT Mandi | **Host Institute:**IIT Ropar |

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| | **Supervisor:**Aniruddha Chakraborty<br>**School/Dept.:**School of Chemical Sciences | **Supervisor:**T. J. Dhilip Kumar<br>**School/Dept.:**Chemistry |
| **21.** | **Exploring hybrid machining under sustainable environment for in-house developed polymer and bio composites**<br><br>Machining of composite materials is extremely difficult due to their anisotropic, non-homogeneous, and often abrasive structure that has a direct impact on the strength of the material. The machinability of the composite materials is expected to be enhanced using hybridised machining processes. In this regard this project may cover the following two major parts as- (a) Development of application-based fiber reinforced polymers (carbon FRP, glass FRP, Aramid FRP and natural wood fiber reinforced polymers) in varying densities, and (b) development of macro and micro cutting (with major focus on turning operation) with ultrasonic assistance under sustainable environments.<br><br>**Desirable Background:**<br>Mechanical/Production Engineering /Production/Manufacturing or related areas | |
| | **Home Institute:**IIT Mandi<br>**Supervisor:**Dr. Sunny Zafar<br>**School/Dept.:**School of Mechanical and Materials Engineering | **Host Institute:**IIT Ropar<br>**Supervisor:**Dr. Chandrakant K Nirala<br>**School/Dept.:**Department of Mechanical Engineering |
| **22.** | **Fabrication and mechanical reliability of nature inspired smart materials and composites**<br><br>Smart functional materials are of great importance for their intrinsic properties for electronic, optical sensing, memory and energy applications. The proposed joint research work is focused on fabrication and investigation of the mechanical behaviour of few interesting nature inspired smart materials and composites. It aims to explore the changes in mechanical properties due to defects, thermal stress, interface binding and phase transition at various loading conditions. Further, the environmental effect on the durability of smart materials and composites also would be investigated by conducting experiments in controlled environments. More emphasis will be given to address reliability issues and to develop strategies for improving the reliability for industrial applications. Some of the specific methodologies are as follows.<br><br>• Quasi static and dynamic mechanical testing with the use of UTM, Micro- Nanoindentation and Split-Hopkinson pressure bar<br>• Frictional/nanoscratch behavior of smart materials and composites<br>• Environmental effect on durability behavior of functional materials and composites<br>• Pre and post failure analysis with detailed materials characterization<br>• Theoretical investigation of mechanical behaviour in quasi static and dynamic loading conditions at different length scales using FEM simulations | |
| | **Home Institute:**IIT Mandi<br>**Supervisor:**Dr. Viswanath Balakrishnan | **Host Institute:**IIT Ropar<br>**Supervisor:**Prof. Navin Kumar |

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| | **School/Dept.:**School of Mechanical and Materials Engineering | **School/Dept.:**Mechanical and Biomedical Engineering |
| **23.** | **Development of Advanced Intelligent Optimizing ControlSchemes using BIG Data Analytics for Large Scale Systems**<br><br>This project aims in developing advanced automationtechniques for large scale processes using big-data analyticstechniques, where major focus is on developing robust modelidentification techniques, fault detection and advanced multi-variable feedback control approaches for processes subjectedto external/unknown disturbances. Here applications of thedeveloped algorithms will be focussed on both conventionaland non-conventional energy generation processes. | |
| | **Home Institute:**IIT Mandi<br>**Supervisor:**Tushar Jain<br>**School/Dept.:**School of Computing and Electrical Engineering | **Host Institute:**IIT Ropar<br>**Supervisor:**Jayaram Valluru<br>**School/Dept.:**Dept. of Chemical Engg. |
| **24.** | **Fracture and Fatigue Performance Prediction of Carbon-Polymer Composites for Aerospace Application**<br><br>Carbon fibre reinforced polymer composites (CFRPC) are widely used in the aerospace industry due to its high specific strength and ability to sustain impact and fatigue loads under thermo-mechanical loading conditions. The objective of this work is to analyses the CFRPCs against the fracture and fatigue performance. A robust and efficient computational model will be developed for the prediction of fracture and fatigue performance of carbon fibre reinforced polymer composites. The proposed model will be capable to predict damage initiation, crack growth and service life prediction of the composites under cyclic thermo-mechanical loading environment.<br><br>**Desirable Background:**<br>Mechanical/Aerospace Engineering/Machine Design/CAD/CAE/AppliedMechanics/Computational Mechanics/ related areas. | |
| | **Home Institute:**IIT Mandi<br>**Supervisor:**Dr Himanshu Pathak<br>**School/Dept.:**School of Mechanical and Materials Engineering | **Host Institute:**IIT Ropar<br>**Supervisor:**Dr Sachin Kumar<br>**School/Dept.:**Department of Mechanical Engineering |
| **25.** | **Glacier Lake Dynamics studies of NW Himalaya**<br><br>Due to climate change Glaciers are melting at rapid pace which creates many lakes. The number of lakes is increasing rapidly which can be mapped using Remote Sensing. However to estimate the volumetric changes, field observations are required where bathymetric survey and dynamic change modelling is required. This can be done by collaborating with IIT Ropar where the expertise of Dr Reet | |

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| | Kamal can be very effective. Detail objectives and methodology can be chalked out once the joint PhD program is finalised. | |
| | **Home Institute:**IIT Mandi<br>**Supervisor:**Dericks P Shukla<br>**School/Dept.:**School of Civil and Environmental Engineering | **Host Institute:**IIT Ropar<br>**Supervisor:**Reet Kamal Tiwari<br>**School/Dept.:**Civil Engineering |
| **26.** | **Looping of a long chain polymer molecule in solution**<br><br>We propose analytical models for looping problem in three dimension and we do simulation to see the validity of those analytical models. Polymer looping problem in solution is important to understanding protein folding problems as looping is one of the primary steps of the folding problem. so far most of the analytical models are in one dimensional. | |
| | **Home Institute:**IIT Mandi<br>**Supervisor:**Aniruddha Chakraborty<br>**School/Dept.:**School of Chemical Sciences | **Host Institute:**IIT Ropar<br>**Supervisor:**Sudipta Kumar Sinha<br>**School/Dept.:**Chemistry |
| **27.** | **Numerical and experimental investigation of Non-Newtonian drop impact dynamics**<br><br>Non-Newtonian drops are known to rebound suppression on superhydrophobic surfaces. The non-Newtonian features like normal stress, extensional viscosity and adsorption of polymer molecules on SH surfaces are responsible for slowing down retraction velocity and subsequent inhibition of drop rebound. This phenomenon has implications on reducing the wastage of insecticides on crop leaves which are generally superhydrophobic. One of the investigators (Dr. Devranjan -IIT Ropar) has prior experience in drop impact experiments and another (Dr. Parmod- IIT Mandi) has been engaged in droplet simulations for last few years. Both of our skillsets are complimentary and will be useful in probing this phenomenon by both experiments and numerical simulations.<br><br>**Desirable Background:**<br>Mechanical/Chemical/Aerospace/Thermal Engineering or related areas | |
| | **Home Institute:**IIT Mandi<br>**Supervisor:**Dr. Parmod Kumar<br>**School/Dept.:**School of engineering | **Host Institute:**IIT Ropar<br>**Supervisor:**Devranjan Samanta<br>**School/Dept.:**Mechanical Engineering |

**28.** **Understanding the Synthesis and Growth of Anisotropic Plasmonic Nanostructures**

This research project offers an exciting opportunity to explore the synthesis and growth of anisotropic plasmonic nanostructures. The primary objective of this project is to achieve shape-controlled synthesis of plasmonic metal nanostructures while gaining a comprehensive understanding of the underlying growth mechanisms through a combined experimental and simulation approach.The selected candidate will be involved in conducting cutting-edge research at the intersection of materials chemistry and nanotechnology. They will work closely with a multidisciplinary team of experts to design and fabricate anisotropic plasmonic nanostructures, investigate their optical and electronic properties, and analyze the growth processes using advanced characterization techniques. Additionally, computational simulations will be employed to complement the experimental findings and provide deeper insights into the growth mechanisms.Applicants with a background in materials science, chemistry, nanotechnology, chemical engineering, or related disciplines are encouraged to apply. The project offers a unique opportunity to contribute to the development of novel plasmonic materials and gain valuable experience in experimental techniques and computational modeling.

**Desirable Background:**
Chemistry/Materials Science/Nanotechnology/Chemical Engineering or related areas.

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| **Home Institute:**IIT Mandi<br>**Supervisor:**Dr. Amit Jaiswal<br>**School/Dept.:**School of Biosciences and Bioengineering | **Host Institute:**IIT Ropar<br>**Supervisor:**Dr. Santosh Kumar Meena<br>**School/Dept.:**Chemical Engineering Department |

**29.** **Zinc Air Battery for Energy Storage Application**

In current energy scenario, Zinc-air battery plays crucial role for the development of energy storage devices beyond lithium. Several strategies have been adopted to develop a single bifunctional electrocatalyst which can efficiently perform both ORR and OER as most of them suffer from the round- trip efficiency issues beyond 65%. Thus, it is important to develop a single bi-functional catalyst which can withstand long-term rechargeable cyclic stability and durability without compromising with the catalytic activity. This project aims to develop such metal oxide-based catalysts which can efficiently work in rechargeable Zinc air battery.

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| **Home Institute:**IIT Mandi<br>**Supervisor:**Dr Aditi Halder<br>**School/Dept.:**School of Chemical Sciences | **Host Institute:**IIT Ropar<br>**Supervisor:**Dr Tharamani<br>**School/Dept.:**Chemistry |

**30.** **Modelling of Semiconductor Devices**

Semiconductor device modelling is essential for device design and optimization. In this project, we will design advanced architecture silicon solar cells. In particular, we will focus on modelling the carrier selective contact solar cells in a tandem configuration. Specifically, we will use commercial simulator

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| | and simulate the electrical characteristics of the solar cell with both under illumination and without illumination. This will aid in the design and optimization of such solar cells. Depending on the availability of experimental facility, the modelled results may be compared with the experimental data. | |
| | **Home Institute:**IIT Mandi<br>**Supervisor:**Dr. Kunal Ghosh<br>**School/Dept.:**School of Computing and Electrical Engineering | **Host Institute:**IIT Ropar<br>**Supervisor:**Dr. Pardeep Duhan<br>**School/Dept.:**Electrical Engineering Department |

## General Qualifications

In the present call, the students for the PhD JDPwill be admitted only in the Regular category. An eligible student in this category works full-time and receives assistantship from the Institute.

The candidate should fulfil the minimum eligibility criteria of the Home institution of the respective projects as mentioned in the below link.

**IIT Mandi :**https://cloud.iitmandi.ac.in/f/f0ceb0cf45cb47319c4e/

**IIT Ropar:**https://www.iitrpr.ac.in/sites/default/files/PhD-Ordinances and Regulations-11.03.2022.pdf

***In addition to general eligibility criterion, the applicants must also satisfy the eligibility criteria specified for the respective Projects/Departments / Centres / Schools / Interdisciplinary Groups. Over and above the general eligibility criteria for admission, candidates need to satisfy additional criteria for financial support / fellowship, as specified under specific admission categories.***

Thefinalselectionprocessto Ph.D.JDP programmeforany project will be through written testand/or interview.

## Application and Admissions

The admissions process will be managed by the IIT Mandi - IIT Ropar Joint Admissions Sub-committee (JASC) constituted at the School/Department/Centre level and according to each Institution's admissions procedure. Candidates must meet the admissions requirements of both institutions. The eligibility criteria for enrolling in a joint PhD program will be same as that of a regular PhD program/ERP of the individual institute. The details of the same can be found in the PhD ordinance of the individual institute.

- IIT Mandi
- IIT Ropar

All applicants will be expected to apply through an online admissions portal.

## Fees, Scholarships and Funding

- The JDP Scholar shall pay tuition fees only to their Home Institution throughout the duration of the JDP including the duration of study at the Partner Institution as per its fee structure.

- Unless otherwise indicated, candidates who wish to be admitted onto the PhD JDP are entitled to receive fellowship meeting the eligibility criteria. The cost of fellowship will be borne by the Home Institute even during the candidate's stay in the Host Institute. No tuition fee will be charged by the host institution. However, the student needs to bear the boarding and lodging charges. Scholarships are awarded based on merit, and the value and conditions of any scholarship awarded will be in accordance with the terms and conditions of the awarding institution.

- Regardless of the scholarship awarded, students on the joint PhD program will be personally responsible for the following expenses unless otherwise advised:

    - Incidental fees and charges at either institution
    - Accommodation and living expenses at either institution
    - All personal expenses and non-compulsory additional fees at the host institution
    - All debts incurred by candidates during their stay at either institution
    - Any other debts incurred by candidates during the Joint PhD Program
    - Further the grants in respect of attending conferences will be provided only by the home institute.

## Fees details:

The selected candidate needs to pay the fee only to the Home institution and the details about the fee structure can be found below:

- **IIT Mandi**https://cloud.iitmandi.ac.in/f/248b95f143c8484c9a83/

- **IIT Ropar**https://www.iitrpr.ac.in/fee-details

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