Department	Research Domains
Biosciences and Bioengineering	
1	**Nanomaterial Synthesis for Biosensors and Device Development:** The position requires background in nanomaterial synthesis and characterization along with mammalian cell culture.
2	**Host-pathogen interactions through GPCRs:** The project will involve integrative molecular biology, molecular pharmacology, and structural biology approaches. Requires cell-molecular biology background and experience in mammalian cell culture and protein purification will be preferred.
Chemical Engineering	
1	**Heterogeneous catalysis, Nanoscale Advanced Materials for Process Intensification and Reactor Design**
2	**Intensification of chemical processing applications using high pressure reactors.**
3	**Bioengineering applications including bio-degradable packaging films and biosensor**
Civil Engineering	
1	**Application of stabilisation measures in improving the mountainous infrastructure**(requires background of M.Tech. in geotechnical engineering/rock engineering/tunnel engineering/mining engineering and B.Tech. in Civil Engineering)
2	**Remote Sensing applications, Microwave InSAR , Polarimetry, AI/deep learning in RS**
3	**Waste Valorization** using Green Technologies
4	**Development of prestressing anchorage system using UHPC**: This study involves understanding the stres state at the anchorage zone in a prestressed concrete element and developing a new system with UHPC to resist the high stresses. The work involves both experimental and numerical studies.
5	**Evaluation of High Strength Steel for Steel-Concrete Composite bridges**: Study aims to explore the use of high strength steel for construction of steel-concrete composite bridges. It will involve analytical and experimental study of these girder. The candidates having good analytical and experiemntal background are encouraged to apply.
6	**Acoustic monitoring of RC panels under dynamic loading**
Chemistry	

1	**Physical Chemistry**
2	**Organic Synthesis**
3	**Inorganic Chemistry and Materials**
Computer Science and Engineering	
1	**Automated Map Labeling**: Point feature labeling problem on a Map is NP-hard, however there are several efficient algorithms for special cases of label placement. Due to the advancement of newer viewing devices & modes (tab, mobiles) with various capacity of computing, there is a need to revisit the point feature labeling problem. This project will investigate the Point feature labeling problem with some specialization on Zooming, Overlay labeling, incremental labeling - and along with their their parallel and distributed algorithms. The project will also try to investigate suitable data structure for preprocessing, storing, transmitting - so that faster label placement can be achieved at the viewing end.
2	**Computer Vision, Multimedia Quality Assessment, Visual Perception**
Electrical Engineering	
1	**Design and development of Converters for Electric vehicle charger and Renewable energy**
2	Topic: **VLSI Design**. Low-Power CMOS Mixed-Signal IC for Implantable Pacemaker with SCL180nm Technology. Brief: Low power consumption is crucial for medical implant devices. A single-chip, very-low-power interface IC is needed in the implantable pacemaker systems. The proposed Integrated circuit will contain low power amplifiers, filters, ADCs, battery management system, voltage multipliers, high voltage pulse generators, programmable logic and timing control.
3	**Underwater Acoustic Communication Channel** Modeling using Artifical Intelligence and Machine Learning, Joint Radar and Communication using ML, ML for Drone Control and Applications

4	Topic: **RF and Microwaves**. Brief: Due to its simple formulation, the error estimation and perfoemance control of the FDTD methods is relatively easier, accurate, efficient and developed technique for the homogeneous, frequency-independent and homogeneous medium. However, for the lossy, frequency-dependent and inhomogeneous medium; the error estimation and performance control techniques are not very acurate and effitient, and still in devloping phase. In the proposed thesis, various techniques will be developed and applied for the lossy, frequency-dependent and inhomogeneous medium, so that the algorithms needed to simulate the current and future microwave device can be made more accurate and efficient. Reconfigurable intelligent surfaces are the subwavelength structures that manipulate the electromagnetic waves by controlling the amplitude, phase, and polarization of the wave. These structures will have applications in enhancing the coverage area in wireless communication systems. The main focus will be on designing the RIS strucures in microwave and millimetre frequency range.
Mathematics	
1	**Finite Fields and Their Applications**
2	**Number Theory (Modular forms and associated Galois representations)**
Materials Engineering	
1	**Material Processing and structure property correlation**
2	**Nanostructured material**
Mechanical Engineering	
1	**Multicomponent boiling:** Boiling is an effective way to transport heat from a hot source and dump it to another location. Multi-fluid boiling provides an extra cushion as high heat transport can be achieved at a much lower temperature. This method can be deployed in cooling of electronic devices such as lasers, high speed cameras, and other similar units.

2	**Solar Energy:** As the demand for power and water is expected to rise exponentially along the coastal areas and islands, water supply is scarce/ erratic, and seawater desalination appears to be the only mode of overcoming the situation. Small-scale solar-driven desalination processes promise freshwater production in most island regions with poor infrastructure, unskilled workforce, and insufficient conventional energy resources. Solar desalination based on the Multi-Effect Desalination (MED) process is considered an efficient means of producing fresh water for these regions. Solar thermal power plants exploit the Sun as a source of heat. A typical CSP plant captures the thermal radiation that falls on the ground and uses it as a heat source for a thermodynamic heat engine to generate electric and thermal energy.
3	**Liquid rocket injectors: Atomization and Combustion** - Experimental investigation of the atomization processes in liquid rocket engine injectors Currently, the space industry is pushing for the development of reusable liquid rocket engines considering the operational cost and high thrust requirements. In this regard, the development of advanced injection systems for such rocket engines requires fundamental experimental investigations to capture the atomization and combustion processes in detail. The proposed work aims to develop a novel injector concept focusing on deep throttling and reusability of the engine. Laser diagnostic experiments are planned to quantify various primary and secondary atomization processes and mixing.
4	**Advanced manufacturing of stretchable materials and interconnects** Stretchable materials with interconnects can be used as Robotic skin and used for energy harvesting in robots at remote locations.
5	**Shape Memory Alloy actuated Auxetic Structure**
6	**Additive manufacturing of metals for high temperature applications**

7	**Area: Mechanical and Tribological design of FGM composite.** Topic: Mechanical and tribological behavior of nano particle induced functionally graded materials**.** Brief summary: In many application such as defence area, biomedical application etc,, various components requires the variation of the mechanical and tribological properties as per designed thickness. To serve the purpose several FGMs have been developed. The inclusion of the nano-particles in the FGM processing assist to improve its mechanical tribological properties. The proposed work aims to characterize the mechanical and tribological behavior of various nano-particle induced FGMs and establish the mathematical modelling for the same.
Physics	
1	**Research area:- <u>Solar Cells, Solar water purification</u>Topic 1:** Our group primarily focused on utilizing solar lights for electricity and freshwater production. Photovoltaics and photothermal are the two leading technologies used for solar energy utilization. We work on finding new stable, nontoxic materials for solar energy harvesting and then modify the device structure to improve efficiency. We also work on the conduction mechanism in oxide interfaces and their application in resistive switching memory.
2	**Topic 2: Energy storage materials**
Humanities & Social Sciences	
1	**Science and Values, Ethics of AI**