THAPAR INSTITUTE
OF ENGINEERING & TECHNOLOGY
(Deemed to be University)

# TIET – VT CENTER OF EXCELLENCE IN EMERGING MATERIALS (CEEMS)

# NEWSLETTER

*(Vol.III November 2022)*

VirginiaTech
Invent the Future®

CEEMS

*A platform for the new materials age*

CEEMS
A platform for the new materials age

# Message From

## Chair Professor, CEEMS


**Dr. ROOP L. MAHAJAN**

**Department of Mechanical Engineering**
**Virginia Tech, Blacksburg, USA**


## Greetings from TIET-VT Center of Excellence in Emerging Materials (CEEMS)!

Continuing our tradition of sharing important news with you twice a year, I am pleased to share with you an important strategic change in our research portfolio. Since its inception on July 1, 2019, we had focussed our efforts on establishing a culture of interdisciplinary research among faculty members across different academic units at TIET in four of our thrust areas: Coal-derived Graphene+, Bio-X, Graphene+ - Polymer Nano-composites, and U2R (Untargeted and Unencumbered Research), where + stands for graphene quantum dots, graphene oxide and other derivatives, Fig. 1. We had selected these areas to fulfil the vision of CEEMS - To be a premiere national hub for pioneering research and education in design, manufacture and application of emerging materials for a sustainable future.

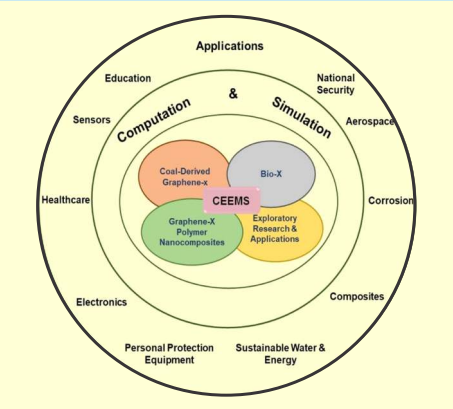
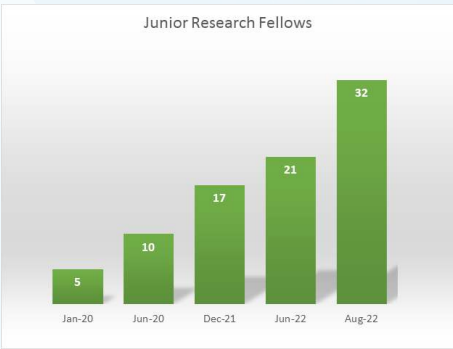



**Figure 1:** Thrust areas of CEEMS including applications

Thanks to our talented faculty, we have made significant progress in first three years, see the charts below.

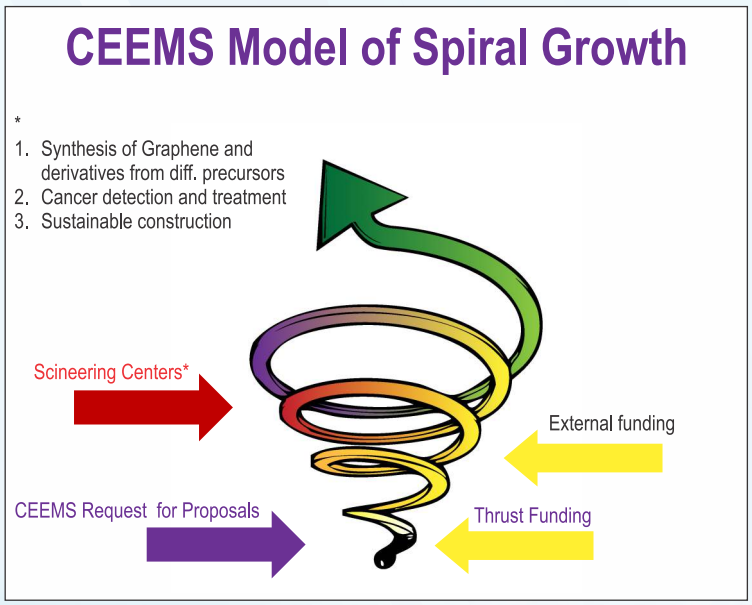





CEEMS
*A platform for the new materials age*


Based on their accomplishments and active engagement, we have identified two areas primed for growth and national prominence. These are: Scineering of Cancer Diagnostics and Treatment, and Scineering of Sustainable Construction Materials. These belong to two of our thrust areas: Bio-X and Graphene+ Polymer Nanocomposites. Our plan is to have a team of 16-20 faculty members supported by at least the same number of junior research fellows in each of these two areas with an overall objective of enhancing scholarship, reputation, and externally funded sponsored research. I note that this strategy is consistent with our spiral growth approach outlined in our strategic plan and shown schematically below.

**Financial Self-sufficiency Large, prestigious**




awards from Funding agencies, DST, DBT…..

## CEEMS Model of Spiral Growth

I am also pleased to report that since the last newsletter of February 2022, our new home in ACIRD is fast becoming a central place where our researchers including Junior Research Fellows and Postdoctoral Fellows are pooling their talents together to push the envelope of science and engineering in their areas of research, with an eye on solving major problems facing society. We hope you will enjoy reading the Newsletter, made possible by the contributions of our faculty and research teams. A special thanks to Professor Rajeev Mehta, Coordinator, CEEMS and Ms. Mrinmoyee K. Chakroborty for their untiring efforts in pulling this newsletter together. Please send your feedback for us to continue improving this Newsletter as a vehicle of communication with you.

**Thanks and warm regards.**
**Roop L. Mahajan**

# POST-DOCTORAL FELLOW
# DR. PIYUSH SHARMA

***About me:***

I am working as a PDF under the supervision of Dr Roop Mahajan (Virginia Tech., USA) and Dr O.P. Pandey (TIET, India) at CEEMS, TIET, Patiala, India. I have a handful of experience to operate sophisticated instruments such as UV-Vis spectroscopy, Dilatometer, TGA/DTA, DSC, Galvanaostat/Potentiostat, Glove Box, Ball Mill, FTIR, and high-temperature furnaces, and have also developed skills to analyze and interpret the X-ray Diffraction (XRD), UV-Vis spectroscopy, Raman, FE-SEM, TEM, TGA/DTA, DSC, FTIR, XPS, BET, and Electrochemical data. I was awarded a prestigious CSIR-SRF direct national fellowship in the year 2018 which widened my field of vision. I have 24 international peer-reviewed articles and two book chapters to my credit. I am also an active member of the American Ceramic Society (ACers) and the European Ceramic Society (ECerS).

Currently, I am working on the synthesis of MAX phases. These phases are nano-laminated carbides or nitrides with the general formula $M_{n+1}AX_n$, where M is an early transition metal, A is a group of 13 – 16 elements, X is either C or N and n is an integer. MAX phases possess properties of both metals and ceramics such as high thermal and electrical conductivity, good machinability, great damage tolerability, and outstanding thermal shock resistance. These phases also act as precursors for the synthesis of two-dimensional MXenes. Selective etching of MAX phases results in the formation of tuneable 2D MXenes, which have shown promise for a wide range of applications, including wastewater treatment, energy storage & conversion, EMI shielding, and sensing. My target is to obtain a larger 2D flake of MXene by using soft chemical routes for the elimination of A layer from MAX phases. An important goal is to get a better knowledge of the relationship between the synthesis protocol of MXenes and their electrochemical and photochemical responses. I am also exploring novel pathways for the synthesis of unexplored MAX phases and MXenes.

In addition, I am working on an exciting but technically challenging project to convert woody biomass, anthracite and bituminous coals into activated carbon with high surface area. Activated carbon has been an ideal material for the separation of a variety of chemical pollutants from water. Therefore, it is important to investigate the photochemical response of activated carbon with different surface areas on the removal of various chemical pollutants from water. The attempt will be made to investigate photochemical and electrochemical response of composites or hetero-structure based on activated carbon and other 2D materials. The prime motto is to develop 2D MXenes/activated carbon hetero-structures for the application in wastewater treatment and energy conversion & storage. These efforts will bring numerous opportunities to alter the properties of MXenes/activated carbon hetero-structure for targeted applications.

Finally, I am investigating ways of synthesizing composites of the matrix (plastics or selected metals such as Al) with uniformly dispersed loading of graphene/graphene oxide. These research efforts have been directed toward producing graphene/graphene oxide composites for functional and structural applications. The nature of the dispersion problem for graphene/graphene oxide is rather different from other conventional fillers, such as spherical particles and carbon fibres, because graphene/graphene oxide is characteristic of 2D sheets and thus, have an extremely large surface area. We believe that this work will promote the production of clean energy and the purification of wastewater. The outcome of the projects will result in the development of next-generation composites for functional and structural applications. The societal impact will be large.

Research Areas: Synthesis of 2D MXenes, preparation of activated carbon, dispersion of CNTs, thermal kinetics, supercapacitors, wastewater treatment.

# RESEARCH FELLOW CORNER

## ANUSHKA GARG

**(Senior Research Fellow)**

Department: School of Chemistry & Biochemistry
Research area: Synthesis of graphene oxide and multilayer graphene from different ranked coals using an environment-friendly approach and scale-up of the process.
TIET, Patiala along with Virginia Tech, USA has set up a Center of Excellence in Emerging Materials (CEEMS) which has provided numerous researchers and scholars the facilities to carry out their goals with the mark of excellence. It has been two years working as a JRF in CEEMS which was no less than a roller-coaster ride to bring about a great scientific contribution in the field of graphene. During this journey, my supervisors and other associated faculty have been a constant support of motivation and guidance during my lows and highs. I am very thankful for some excellent facilities at CEEMS such as Ball mill, Tubular furnace, FTIR, Fume-hood, Spin coater, Hot-air oven, Centrifuge, Sonicator, Freeze-dryer, Refrigerator, Homogenizer, Distillation unit, and chemicals which are essential requirements for my research work. The facility and the faculty at CEEMS surely set up a great research environment to fulfill our dreams.
**Thank you**

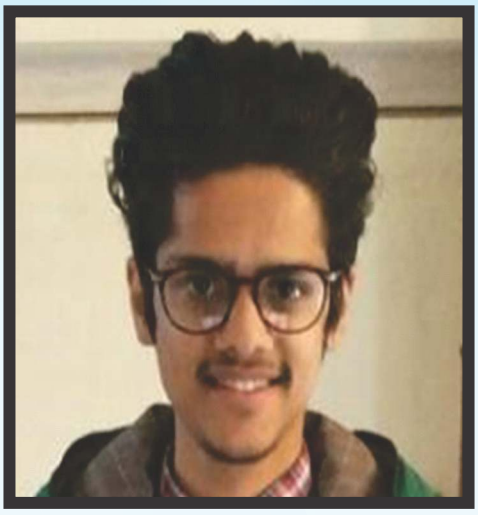
---

# RESEARCH FELLOW CORNER

## AAYUSHI KUNDU

**(Senior Research Fellow)**

Department: School of Chemistry & Biochemistry
Research area: Synthesis of GQDs and CQDs from different precursors for fluorometric detection of biomolecules/metal ions: A detail comparison study.
TIET-VT has set up a collaborative interdisciplinary research venture that is the Center of Excellence in Emerging Materials known as CEEMS. It offers an excellent research platform to all researchers from different fields. I am thankful to CEEMS for giving us such a positive environment to perform well. I am currently using the CEEMS facilities like FTIR for knowing the functional groups in my compounds, a sonicator for deagglomeration of my sample, a distillation unit for ultrapure water, and a hot air oven for drying. I hope we will take this center to new heights in the coming future.
**Thank you**



# RESEARCH FELLOW CORNER

## NIKHIL SHARMA

**(Senior Research Fellow)**

Department: Civil Engineering Department
Research area: Epoxy coatings nano-modified using nano-fillers like graphene-based derivatives, nano-clays, and self-healing microcapsules.
After working two years in the TIET-VT research collaboration venture, I can credulously recommend to fresh researchers having quality research here. Not only because of the facilities available in the CEEMS department but also the continuous and consistent guidance of highly experienced faculties, which helped us to reach our goal very efficiently. Presently, we have a complete set-up to synthesize different types of coatings in the research lab of the Center of Excellence in Emerging Materials (CEEMS), for the above-mentioned project. Also, other equipment viz. Ultrasonicator, FTIR, spin coater, and fume-hood are readily available for CEEMS students. I am very grateful to the department to allow me to work with experienced research faculties.
**Thank you**

---

# RESEARCH FELLOW CORNER

## AKANKSHA RANADE

**(Senior Research Fellow)**

Department: School of Chemistry and Biochemistry
Research area: Chemical sequestration of carbon dioxide to yield degradable terpolymer.
I have completed a whole year in CEEMS and I can say, for sure, that I have gained a lot this year. Being a polymer student, many instrumentations and tools were required, and I was provided with all of them. I can now run my experiments smoothly. We are also provided with an FTIR instrument within our lab, so we can verify our samples instantly through IR characterization. Also, my safety has always been the priority of the center while working with high-pressure instruments, and sufficient measures were always provided for safe and sound research. Both of my guides have been extremely diligent and have always paid attention towards my hurdles and guided me to solve them. The working environment is immensely positive, contributed by healthy relationships among peers. I am really thankful to this center to provide me with an opportunity to carry out a career in research.
**Thank you**

# RESEARCH FELLOW CORNER

## VIKASH RANJAN

**(Senior Research Fellow)**

**Department:** Electrical and Instrumentation Engineering Department

**Research area:** Design and fabrication of smart humidity sensor using graphene oxide and anodic aluminium oxide for condition monitoring of power transformer and SF6 Circuit breaker

Center of Excellence in Emerging Materials (CEEMS) is the collaboration between two institutes, Thapar Institute of Engineering and Technology, Patiala and Virginia Tech, USA. It's been approximately nine months in CEEMS, working as a JRF. My research area is based on the "Design and Fabrication of Humidity Sensor for Power transformers and SF6 Circuit Breaker". For this, CEEMS provided me with excellent working facilities and equipment such as Humidity and Temperature Generator, Hygrometer, PPM/DEW Point Generator, Desiccator, Sonicator, Regulated Power Supply, etc. These types of equipment are very helpful to perform my experiments smoothly and efficiently.

**Thank you**

---

# RESEARCH FELLOW CORNER

## NITIKA SHARMA

**(Senior Research Fellow)**

**Department:** Electronics and Communication Engineering Department

**Research area:** Design and Development of Graphene-based Lens/Double Spiral) Antennas for RF Hyperthermia Treatment.

TIET Patiala, in collaboration with Virginia Tech in the United States, has established a "Center of Excellence in Emerging Materials (CEEMS)", which has offered various researchers and academics the resources they need to achieve their objectives. I am grateful for CEEMS's outstanding facilities like Computational LAB and the different materials that are required to fabricate our prototypes (Antennas). Moreover, CEEMS infrastructure, as well as its professors, provide an excellent research environment in which we can realize our ambitions. I am incredibly glad for the opportunity to be a member of CEEMS and conduct research that will benefit society.

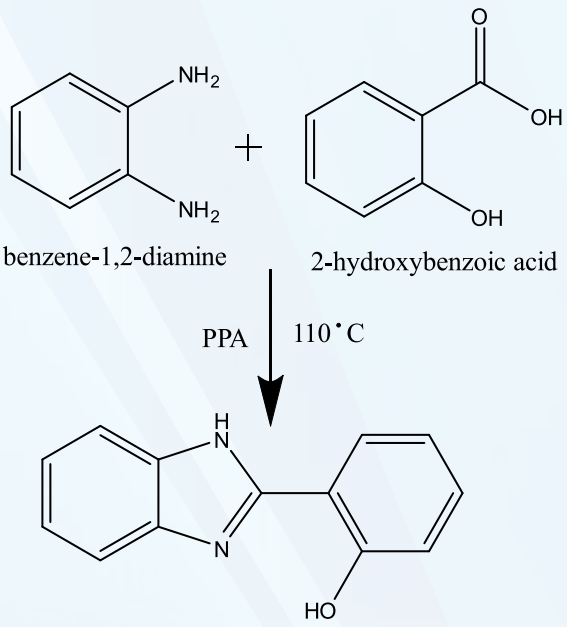
**Thank you**

# RESEARCH FELLOW CORNER

## SONIA RANI

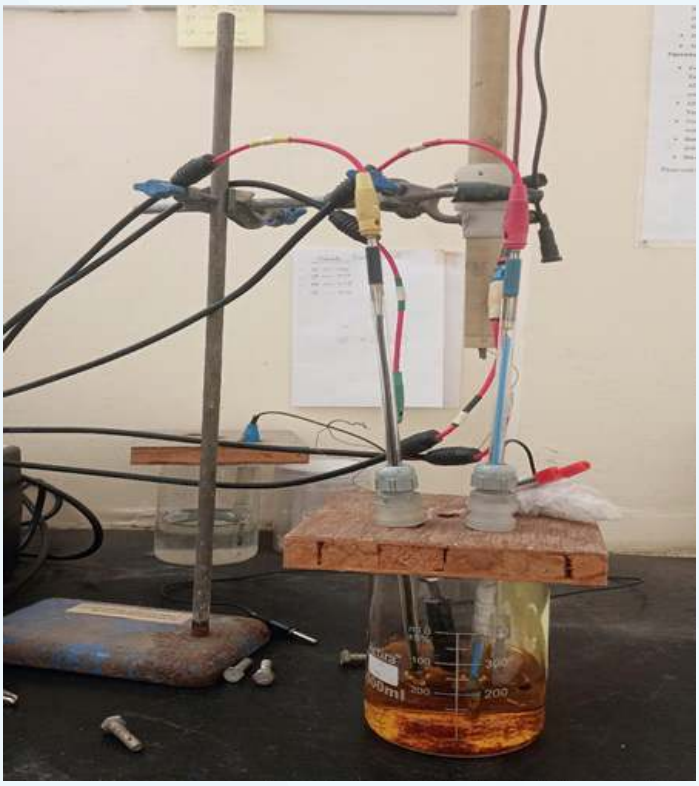
**(Junior Research Fellow)**

**Department:** School of Chemistry and Biochemistry
**Research area:** Synthesis of organic compounds with effective functional groups to act as migratory corrosion inhibitors for rc structures
**P.I.** Dr. Shweta Goyal (CED) & **Co P.I.** Dr. Vijay Luxami (SCBC)
I have been working as a Research Scholar under the supervision of Dr. Vijay Luxami and Dr. Shweta Goyal in the School of Chemistry and Biochemistry and as a JRF in Center of Excellence in Emerging Materials TIET- Virginia Tech, under the project "Synthesis of Organic Compounds with Effective Functional Groups to act as Migratory Corrosion Inhibitors for RC Structures." Synthesis Pore Solution




benzene-1,2-diamine + 2-hydroxybenzoic acid

2-(1*H*-benzo[*d*]imidazol-2-yl)phenol



**Electrochemical test setup**

**Epoxy coated Rebar**

Corrosion is a natural process that converts a refined metal into a more chemically stable oxide causing gradual destruction of materials by chemical or electrochemical reaction with their environment. This topic is of high interest because of extensive impact of corrosion on the global economy. The global cost of corrosion is experienced to be US$2.5 trillion which is equivalent to 3.4% of the global GDP (2013). There are various corrosion control methods which could be helpful to achieve savings of 15–35% of the cost of corrosion. The aim of this project is to synthesize organic compounds specifically Benz- a zole based compounds for its use as migratory type corrosion inhibitors for chloride and carbonate induced corrosion. To achieve our goal, we have synthesized a molecule having Benzimidazole ring, as this compound is fluorescent in nature so it can be used as

"Corrosion on – off sensor". Further, we will perform some real-life application to check the practical applicability of this compound as corrosion inhibitor and will use different substituents on this moiety to examine the change in inhibition at different concentration of pore solution.

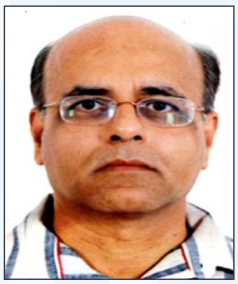
# RESEARCH HIGHLIGHT

***Characterization and Performance Evaluation of Styrene-Butadiene-Styrene (SBS) Modified Asphalt Reinforced with Nanomaterials***

India has second largest road network in the world with road length reported as 62,15,797 km by MoRTH in 2020-21. Due to rapid increase in axle load and temperature variations, performance limit of conventional bituminous pavements has been reached. Thus, various distresses such as rutting (30-60°C) and fatigue cracking (0-30°C) have been developed earlier in the crust surface. This has initiated the search of sustainable bituminous binder with improved engineering properties. Styrene-Butadiene-Styrene (SBS) has been the most abundantly used polymer, but there have been various shortcomings associated including thermal storage instability, non-improvement of fatigue resistance and aging degradation. Scope of the present project is to eradicate the shortcomings of SBS modified binder by utilizing carbon-based nanomaterials. Reinforcement with carbon-based nanomaterials is expected to improve the thermal stability of SBS modified binder drastically. Physical, chemical and rheological properties may be improved which will reduce the occurrence of distresses. It might result in a potential sustainable binder for the future construction of bituminous pavements. The project is aligned with the GOI initiatives regarding green express highways development and Nano Mission.

# PROJECT INVESTIGATORS

**Dr. Tanuj Chopra**
Principal Investigator (PI)
Assistant Professor
Civil Engineering Department
Thapar Institute of Engineering & Technology, Patiala
Email: tchopra@thapar.edu
Phone No. +91-7837122924



Prof. Rajeev Mehta
Co-Principal Investigator (Co-PI)
Professor & Head
Chemical Engineering Department
Thapar Institute of Engineering & Technology, Patiala
Email: rmehta@thapar.edu
Phone no. +91-9815623714

Dr. Vivek Gupta
Co-Principal Investigator (Co-PI)
Assistant Professor
Civil Engineering Department
Thapar Institute of Engineering & Technology, Patiala
Email: vivek.gupta1@thapar.edu
Phone no. +91-9001685480

## Junior Research Fellow (JRF)

**Mr. Shubham Bansal**
Junior Research Fellow (JRF)
TIET–Virginia Tech. Center of Excellence in Emerging Materials (CEEMS)
Thapar Institute of Engineering & Technology, Patiala
Email: shubham.bansal161@gmail.com
Phone no. +91-8699898813

## *Investigation on the Self-Centering and Energy Dissipation Capacity of SMA Fiber Based Concrete for Retrofitting of Reinforced Concrete Structures*

Strengthening seismically vulnerable and deficient structures is based on different construction strategies and novel materials to enhance their performance under lateral load vibration. One of the most important objectives of any strengthening material used for the seismic rehabilitation of civil engineering structures is to improve the post-earthquake recovery capacity of the structure. Amongst several others, one of the emerging smart materials is the shape memory alloy (SMA). The SMA shows large inelastic deformation capacity without failure upon loading and regains its original shape during the unloading. The addition of the SMA bars along with conventional mild steel has been proved to improve the recentering, yet maintaining comparable energy dissipation capacity of structural elements, such as beam-column joints. However, the application of SMA as a reinforcing bar in a reinforced concrete structure is mostly limited for the construction of new structures, since it will increase the overall cost of construction. In this context, the SMA fiber mixed with the high-strength mortar/concrete may be a viable alternative to improve the seismic performance of the structure. Thus, the present project aims at determining the overall behaviour, strength, bond properties, and feasibility of the high-strength concrete using SMA fibres.

The PI (Dr. Trishna Choudhury) and the Co-PI (Dr. Dhirendra Kumar Pandey) presently hold the Assistant Professor position in the Department of Civil Engineering, TIET.

**PI**
**(Dr. Trishna Choudhury)**

**Co-PI**
**(Dr. Dhirendra Kumar Pandey)**

## *Development of Smart Concrete with Self-Assessing Properties*

To prevent major durability problems in reinforced concrete structures, the damage needs to be repaired as soon as possible. This involves two main mechanisms i.e. early detection of damages and timely repair of the structure. An interesting idea to avoid labor-intensive manual repair work is to use Self-Healing Concrete (SHC), which has the ability to restore cracks itself without any human intervention. In addition, Structural Health Monitoring (SHM) is a great essential tool to detect early damages in the structure and estimate service conditions before it's too late to repair in terms of safety and cost. This has greatly attracted the attention of both researchers and engineers. Traditional SHM has limited use for large-scale concrete construction. To overcome these drawbacks, intrinsic Self-Sensing Cementitious Composites (SSC) have emerged as a new SHM method. The self-sensing mechanism of these sensors is based on the principle of piezoresistivity i.e. change in the reversible electrical resistivity with stress. The project will focus on developing smart concrete which has both self-healing and self-sensing properties. To induce a self-sensing mechanism, GO and rGO will be used and encapsulated polymers for self-healing the composite. Thus, the successful completion of the project will lead to the development of smart concrete which can itself detect damages and repair, negating the need for any external application.

**PI-Dr. Arpit Goyal**
**Assistant Professor**
**Civil Engineering Department**

**Co-PI: Dr Shruti Sharma**
**Professor**
**Civil Engineering Department**

# JUNIOR RESEARCH FELLOW CORNER

## SHEIKH HAZIM JAVAID

**(Junior Research Fellow)**

Sheikh Hazim Javaid is Junior Research Fellow in the project titled "Development of Smart Concrete with Self-Assessing Properties". He has completed his post-graduation in Infrastructural Engineering from Thapar Institute of Engineering and Technology (TIET), Punjab, India and under-graduation from SRM Institute of Engineering and Technology in Chennai, India in Civil Engineering. His master's thesis involves Sub-base layer stabilization using innovative technologies (nano-technological materials). During under graduation he worked on the LC3 concrete structures.

---

### *Retrofitting of Structures with Graphene-FRP composites*

Over the previous two decades, the yearly consumption of cement has climbed from 1.6 to 4.1 billion tonnes, contributing 7% of the world's carbon dioxide ($CO_2$) emissions. According to the Bureau of Energy Efficiency, due to an increase in population and the need for infrastructure, India's current annual cement production, which is 500 million tonnes, is expected to rise to 800 million tonnes by 2030. Thus, the construction of new buildings contributes significantly to the rise of greenhouse gases and global warming, making it difficult to lower the atmospheric carbon footprint. On the other side, the deterioration of concrete structures over time, defects in earthquake-resistant design, poor design, and subpar quality resulted in early degradation of concrete strength subsequent to a decrease in the structure's life span. The solution for this is either demolishing or retrofitting the existing structures. The former lead to constructing new structures, increasing carbon dioxide emission, and the latter imposes low $CO_2$ contribution. So, recycling existing structures will thus serve as a relief for the environment and a step towards sustainable construction.

The structural system of a civil infrastructure can be strengthened, modified, or repaired using the retrofitting process. It seeks to make the building safe and functional for the occupants under various load configurations and environmental risks, including earthquakes, wind, and floods. However, early detection of structural system degradation or deterioration is essential for effective retrofitting. One of the frequently used retrofitting techniques is externally bonded (EB) fiber reinforced polymer (FRP) to concrete to strengthen structural members against additional loads and improve structural seismic resistance as per the latest codal provisions. FRP emerged as a potential option to increase the structure's load-carrying capacity due to its high strength, lightweight, ease of installation, and corrosion resistance. However, current experimental research shows that FRP plate debonding significantly reduces the composite strength and can cause brittle (catastrophic) failures. Premature failure of the strengthening technique is due to the weak interface (adhesive) between the concrete and the FRP. Strengthening concrete structures also involves adding new concrete to an existing one or replacing deteriorated concrete with a new one to restore the strength and performance of structural members. For joining old and new concrete, epoxy adhesives are often used. However, this intermediate layer acts as a weaker junction and reduces the composite's load-carrying capacity.

Recent studies showed that incorporating nanofillers in epoxy improves epoxy's mechanical and durability properties. Graphene comes in one category with outstanding features, like enormously high surface

area, Young's modulus, ultimate strength, and electrical conductivity. Graphene oxide (GO) and reduced graphene oxide (RGO) are derivatives of pristine graphene. They act as a potential reinforcing filler for polymer composites due to various reactive oxygen-containing functional groups, which facilitate the dispersion in polymer matrices and provide anchor points for further surface modifications. The project aims to make a high-strength epoxy using graphene derivatives as nanofillers for improved bond strength, which helps to eliminate or delay premature failure in FRP-concrete and interface failure in old and new concrete. Thus, increasing the effectiveness of retrofitting techniques and, in turn, extending the life of existing concrete structures and being safe for the occupants.

Till now, different surface preparation techniques (Fig. 1) have been employed on the old concrete surface and applying neat and modified epoxy using various GO concentrations to increase the bond strength of old and new concrete. Split tensile, bisurface shear and slant shear tests have been performed to check the bond strength under various load conditions. The GO-modified epoxy shows an increase in bond strength and a shift in the failure pattern from the adhesive (failure of neat epoxy) to cohesive (failure in old concrete), which is the required failure (Fig. 2). The experimental investigation for FRP-concrete joint is under process.

**Fig.1 Different surface preparation techniques employed using wire brushing, application of CFRP layer and grooves**


**Fig. 2 Failure pattern observed in bisurface shear test with neat epoxy sample on the left and GO-modified epoxy sample on the right under surface preparation technique of wire brushing**

## *Application of Biochar to Develop Cementitious Composite for Various Building Materials*

The demand for concrete is increasingly growing because of the rising global population, urbanization, and living standards. Presently, concrete is manufactured in excess of 26.8 billion tons per year worldwide. Moreover, cement and concrete production is the world's largest industrial CO2 emitter, accounting for over 8% of worldwide CO2 emissions. 1.0 kg of cement produces approximately 1.0 kg of CO2. As a result, finding strategies to reduce the carbon footprint of this extensively used material is a critical task for the cement and concrete sector. Thus, alternative approaches that might lead to increased lifetime and functionality of cement-based composites are needed to facilitate the development of sustainable infrastructures with limited resources. Compared to conventional materials, composite materials provide various advantages, including reduced weight and improved mechanical and thermal properties. Biochar is one such material that has recently grabbed the attention of researchers. It is a carbon-rich, extremely porous substance made from various biomass sources such as wood, agricultural leftovers, leaves, etc. Thus, the project focuses on using biochar produced from stubble waste in cement-based composites to enhance its mechanical properties, durability properties such as thermal behaviour, resistance to corrosion and sulphate attack, reduced water permeability, and reduced embodied carbon.

**PI: Dr A.B. Danie Roy**
Assistant Professor
Civil Engineering Department

**Co- PI: Dr Arpit Goyal**
Assistant Professor
Civil Engineering Department

**Co-PI: Dr Manpreet Singh**
**Assistant Professor**
Civil Engineering Department

# LIST OF PROJECTS UNDER DIFFERENT THRUST AREAS

## I. Bio-x

1. Design and development of graphene based (lens/double spiral) antennas for RF hyperthermia

PI: Dr. Rajesh Khanna (ECED); Co-PIs - Dr. Amanpreet Kaur (ECED), Dr. Hari Shankar (ECED) and Dr Mayank Agarwal (ECED)

2. Treatment of gastric cancer by activation of natural immunity using helicobacter pylori coated with iron-oxide nanoparticles: in silico, in vitro, and in vivo approaches

PI: Dr. Diptiman Choudhary (SCBC); Co-PI: Dr. Amrik Sen (SOM)

3. Computational and experimental investigation for optimizing the magnetic nanoparticles hyperthermia

PI: Dr. Neeraj Kumar (MED); Co-PIs - Dr. B.N. Chudasama (SPMS) and Dr. Pramod K Avti (PGIMER)

4. Design and development of graphene derived antimicrobial composite system to resist air and water borne infection in under-developed areas of India

PI: Dr. Anoop Kumar (SEE); Co-PI - Dr. Diptiman Choudhury (SCBC)

5. Miniaturized bio-implantable MICS and ISM band antennas for biomedical devices

PI: Dr. Jaswinder Kaur (ECED); Co-PIs - Dr. Rajesh Khanna (ECED) and Dr. Deepti Mittal (EIED)

6. Remote diagnosis and Health monitoring using smart phone based VCSEL with an Embedded 2D Material

PI: Soumendu Jana (SPMS)

7. Development of nanobiocomposites as next generation arsenals against biofilms

PI: Dr. Moushumi Ghosh (BTD); Co-PI: Dr. B N Chudasama (SPMS)

### Seed Money

8. Design and development of nano-coated antimicrobial composite system to resist air and water borne infection in under-developed areas of India

PI: Dr. Anoop Kumar (SEE)

9. Development of high-end protein-rich animal feed from Jellyfish and standardization of industrial-scale production

PI: Dr. Diptiman Choudhury (SCBC)

10. Graphene oxide coating of titanium screws used in prosthetic joints and its in-vitro assessment of antimicrobial activity and cytotoxicity: A feasibility study

PI: Prof. Dinesh Goyal (BTD); Co-PIs - Dr Deepa Mudgal (BTD) and Dr. Siddharth Sharma (BTD)

11. VOx@graphene electrochemical high sensitivity and selectivity for H2O and Dopamine

PI: Dr. Loveleen Kaur Brar (SPMS); Co-PI - Dr. O. P. Pandey (SPMS)

12. Design of magnetic nanoparticles exhibiting thermo chemotherapeutic effects specific to cancer cell

PI: Dr. Manoj Baranwal (BTD); Co-PI - Dr. B.N. Chudasama (SPMS)

13. Construction of enzyme-metal hybrid catalysts for concurrent chemo-enzymatic reactions

PI: Dr. Vikas Tyagi (SCBC); Co- PI - Dr. Banibrata Maity (SCBC)

## II. X-Graphene+

1. Synthesis of Graphene oxide and reduced Graphene oxide from coal, and scale-up of the process

PI: Dr. Rajeev Mehta (CHED); Co-PIs - Dr. Soumen Basu (SCBC) and Dr. Neetu Singh (CHED)

2. Synthesis of GQDs and CQDs from different precursors for fluorometric detection of biomolecules/ metal ions: A detail comparison study

PI: Dr. Soumen Basu (SCBC); Co- PI: Dr. Banibrata Maity (SCBC)

3. Utilization of non-biodegradable wastes for development of carbon and carbon supported nano/2D structures for sustainable energy

PI: Dr. O. P. Pandey (SPMS)

4. Synthesis of carbon dots powder and films for the evaluation of latent fingerprints. State metal ions

PI: Dr. Soumen Basu (SCBC); and Dr. Shagun Kaith, RA (SCBC)

5. Impact of surface engineering in carbon dots for detection of multiple oxidation

PI: Dr. Soumen Basu (SCBC); and Dr. Shagun Kaith, RA (SCBC)

### Seed Money

6. Nano-bubbles enhanced froth flotation process for replacement of acid treatment step in coal to graphene oxide/multilayer graphene process

PI - Dr. Neetu Singh (CHED)

**III. Graphene-x-polymer nanocomposites**

1. Graphene based epoxy coatings for corrosion inhibition in reinforcing bars in concrete

PI: Dr. Shruti Sharma (CED); Co-PIs - Dr. Sandeep Sharma (MED) and Dr. Rajeev Mehta (CHED)

2. Structural health monitoring of structures retrofitted with graphene-FRP composites

PI: Naveen Kwatra (CED); Co-PI - Dr. Himanshu Chawla (CED)

3. Synthesis of organic compounds with effective functional groups to act as migratory corrosion inhibitors for RC structure

PI: Dr. Shweta Goyal (CED); Co-PI - Dr. Vijay Luxmi (SCBC)

4. Synthesis of polyaniline-metal-oxide/chalcogenide-coal-derived- GO/C3N4 ternary nanocomposites for wastewater treatment

PI: Dr. Soumen Basu (SCBC); Co- PI - Dr. Rajeev Mehta (CHED)

**Seed Money**

5. Non-stoichiometric metal oxide@porous carbon–polyvinyl difluoride based membranes for oxygen sorption from air

PI: Dr. Raj Kumar Das (SCBC ); Co-PI - Prof. Bonamali Pal (SCBC )

6. Coal derived graphene reinforced hybrid glass/carbon fiber epoxy nano composites for improved impact resistance

PI: Dr. Sandeep K. Sharma (MED) Co-PI - Dr. Rajeev Mehta (CHED)

7. Sustainable concrete using epoxy nano-composite coatings utilizing coal derived graphene and its derivatives

PI: Dr. Shruti Sharma (CED ); Co-PI - Dr. Rajeev Mehta ( CHED)

**IV. Exploratory research (U2R) including applications**

1. Chemical sequestration of carbon dioxide to yield degradable terpolymers

PI: Dr. Rajeev Mehta (CHED); Co-PI - Dr. Amjad Ali (SCBC)

2. Design and development of graphene-based microwave device for stealth applications

PI - Dr. Rana Pratap Yadav (ECED); Co-PI - Dr. Soumen Basu (SCBC)

3. Development of low-cost and highly conductive carbon-nanotube/graphene sensors based physiological recording system

PI: Dr. Mandeep Singh (EIED); Co-PIs - Dr. K.S. Sandha (ECED) and Dr. Moon Inder Singh.

4. Triglyceride/glycerol transformation into value added products employing heterogeneous catalysts

PI: Dr Amjad Ali (SCBC); Co-PI: Dr B N Chudasama (SPMS)

5. Hydrogen production from water splitting and industrial waste solvents by graphene oxide coated metal TiO2 nanocatalysts under solar radiation

PI: Dr. Bonamali Pal (SCBC)

6. Multifunctional 1, 8-naphthalimide derivatives for biological and medicinal applications

PI: Dr. Kamaldeep Paul (SCBC)

**Seed Money**

7. Flexible lead-free piezoelectric energy harvesting device for wearable applications

PI: Dr. Jayant Kolte (SPMS); Co-PI: Dr. Jayant Dr. Puneet

8. Sensor using graphene oxide and anodic aluminium oxide (Al2O3) for condition monitoring of power transformer and SF6 circuit breaker

PI: Mr. Shailesh Kumar (EIED)

9. Food quality monitoring using novel graphene based microstrip antenna sensor

PI: Dr. Jaswinder Kaur (ECED); Co- PI: Dr. Rajesh khanna (ECED)

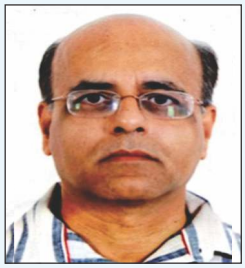
10. VOx@graphene electrochemical high sensitivity and selectivity for H2O and dopamine

PI: Dr. Loveleen Kaur Brar (SPMS ); Co- PI: Dr.O. P. Pandey(SPMS )

11. Synthesis and stabilization of biogenic selenium nanoparticles (BioSeNPs) using biocompatible matrices

PI: Dr. N.Tejo Prakash (SEE), Co- PI: Dr. Ranjana Prakash (SCBC)

# PEOPLE

| Name | Designation | Department/School | Web link | Photograph |
|---|---|---|---|---|
| Dr. Roop Lal Mahajan | Thapar Chair Professor- CEEMS Lewis A. Hester Chair Professor of Engineering Global Ambassador, Institute for Critical Technology and Applied Science (ICTAS) | Department of Mechanical Engineering Virginia Tech, Falls Church, VA 22043 | https://me.vt.edu/people/faculty/mahajan-roop.html |  |
| Dr. Rajeev Mehta | Professor & Head, Chemical Engineering Department Coordinator, CEEMS | Department of Chemical Engineering, Thapar Institute of Engineering and Technology, Patiala, Punjab, India 147004 | http://ched.thapar.edu/facultydetails/OTE1 |  |
| Dr. Ajay Batish | Professor, Dean Partnerships and Accreditation, and Deputy Director | Mechanical Engineering Department | http://med.thapar.edu/facultydetails/MTE1MA== |  |
| Dr. Amjad Ali | Professor | School of Chemistry and Biochemistry | http://scbc.thapar.edu/facultydetails/MTMyOA== |  |
| Dr. B. N. Chudasama | Associate Professor | School of Physics and Material Science | http://spms.thapar.edu/facultydetails/NzA3 |  |
| Dr. Amanpreet Kaur | Associate Professor | Department of Electronics and Communication Engineering | http://eced.thapar.edu/facultydetails/MTIyMg== |  |

# PEOPLE

| Name | Designation | Department/School | Web link | Photograph |
|---|---|---|---|---|
| Dr. Diptiman Choudhury | Associate Professor | School of Chemistry and Biochemistry | http://thapar.edu/faculties/view/Dr.-Diptiman-Choudhury/Mzk=/MTE= |  |
| Dr. M. Ghosh | Professor | Department of Biotechnology | http://btd.thapar.edu/facultydetails/ODk5 |  |
| Dr. B. Pal | Professor | School of Chemistry and Biochemistry | http://scholar.google.co.in/citations https://www.researchgate.net/profile/Bonamali_Pal2 |  |
| Dr. Himanshu Chawla | Assistant Professor | Department of Civil Engineering | http://ced.thapar.edu/facultydetails/OTQ4 |  |
| Dr. Hari Shankar | Assistant Professor | Department of Electronics and Communication Engineering | http://eced.thapar.edu/facultydetails/MTI0Ng== |  |
| Dr. Karmjit Singh Sandha | Assistant Professor | Department of Electrical and Instrumentation Engineering | http://thapar.edu/faculties/view/Dr.-Karmjit-Singh-Sandha/MjY4/MTU= |  |

# PEOPLE

| Name | Designation | Department/School | Web link | Photograph |
|---|---|---|---|---|
| Dr. Moon Inder Singh | Assistant Professor | Department of Electrical and Instrumentation Engineering | http://www.thapar.edu/faculties/view/Moon-Inder-Singh/MTA3/Nw== |  |
| Dr. Mandeep Singh | Professor | Department of Electrical and Instrumentation Engineering | http://www.thapar.edu/faculties/view/Dr.-Mandeep-Singh/MTAw/Nw== |  |
| Dr. Naveen Kwatra | Professor | Department of Civil Engineering | http://ced.thapar.edu/facultydetails/OTM5 |  |
| Dr. Neetu Singh | Associate Professor | Department of Chemical Engineering | http://ched.thapar.edu/facultydetails/OTIz |  |
| Dr. Neeraj Kumar | Associate Professor | Department of Mechanical Engineering | http://med.thapar.edu/facultydetails/MTE3OQ== |  |
| Dr. O. P. Pandey | Senior Professor | School of Physics and Materials Science | http://www.thapar.edu/faculties/view/Dr.-O.P.-Pandey/NDM=/MTQ= http://scholar.google.co.in/citations?user=aDG1jUoAAAAJ&hl=en&oi=ao |  |

# PEOPLE

| Name | Designation | Department/School | Web link | Photograph |
|---|---|---|---|---|
| Dr. Pramod Kumar Avti | Associate Professor | Department of Biophysics, PGIMER Chandigarh | https://orcid.org/0000-0001-5603-4523 |  |
| Dr. Prasenjit Basak | Associate Professor | Department of Electrical and Instrumentation Engineering | http://www.thapar.edu/faculties/view/Dr.-Prasenjit-Basak/MjU5/Nw== |  |
| Dr. Rana Pratap Yadav | Professor | Department of Electronics and Communication Engineering | http://eced.thapar.edu/facultydetails/MTIxMw== |  |
| Dr. Rajesh Khanna | Professor | Department of Electronics and Communication Engineering | http://eced.thapar.edu/facultydetails/MTIxMw== |  |
| Dr. Shailesh Kumar | Assistant Professor | Department of Electrical and Instrumentation Engineering | http://thapar.edu/faculties/view/Shailesh-Kumar/MzEy/Nw== |  |
| Dr. Soumen Basu | Professor | School of Chemistry and Biochemistry | https://thapar.edu/faculties/view/Dr.-Soumen-Basu/Mzg=/MTE= |  |

# PEOPLE

| Name | Designation | Department/School | Web link | Photograph |
|---|---|---|---|---|
| Dr. Soumendu Jana | Associate Professor | School Of Physics and Materials Science | https://spms.thapar.edu/facultydetails/NzA5 |  |
| Dr Jaswinder Kaur | Assistant Professor-III | Electronics & Communication Engineering Department | https://eced.thapar.edu/facultydetails/MTIzNg== |  |
| Dr. Deepti Mittal | Associate Professor | EIED | https://eied.thapar.edu/facultydetails/MTEwMw== |  |
| Dr. Hem Dutt Joshi | Associate Professor | ECED | https://eced.thapar.edu/facultydetails/MTIzMw== |  |
| Dr. Kamaldeep Paul | Professor | School of Chemistry and Biochemistry | https://scbc.thapar.edu/facultydetails/MTMzMA== https://sites.google.com/a/thapar.edu/kamal/home |  |
| Dr. Manoj Baranwal | Associate Professor | Department of Biotechnology | https://manojbar https://manojbaranwal.wixsite.com/my-page |  |

# PEOPLE

| Name | Designation | Department/School | Web link | Photograph |
|---|---|---|---|---|
| Dr. Anoop Verma | Associate Professor | School of Energy and Environment (SEE), TIET, Patiala | http://see.thapar.edu/facultydetails/NzMx |  |
| Dr Dinesh Goyal | Professor | Biotechnology | https://sites.google.com/thapar.edu/dineshgoyal https://scholar.google.co.in/citations?user=eFjZZagAAAAJ&hl=en&authuser=1 https://www.linkedin. com/in/goyal-dinesh-143751217/ https://www.scopus.com/redirect.uri?url= https://orcid.org/0000-0002-5277-2788 |  |
| N Tejo Prakash | Professor | School of Energy and Environment | School of Energy and Environment - Thapar Institute of Engineering and Technology |  |
| Dr. Vikas Tyagi | Assistant Professor | School of Chemistry and Biochemistry | https://sites.google.com/a/thapar.edu/vikas-tyagi-research-lab/home |  |
| Dr. Loveleen Kaur Brar | Assistant Professor | SPMS | https://spms.thapar.edu/facultydetails/NzA2 |  |

# PEOPLE

| Name | Designation | Department/School | Web link | Photograph |
|---|---|---|---|---|
| Dr. Raj Kumar Das | Assistant Professor | School of Chemistry and Biochemistry | https://scbc.thapar.edu/facultydetails/MTM0MQ== |  |
| Dr. Mayank Agarwal | Assistant Professor | ECED | https://www.thapar.edu/faculties/view/Dr.-Mayank-Agarwal/NDc5/MTU= |  |
| Dr. Trishna Choudhury | Assistant Professor | CED | https://www.thapar.edu/faculties/view/Dr.-Trishna-Choudhury/NDkx/Mw== |  |
| Dr. Rafat Siddique | Sr Professor & Dean of Research and Development Cell | CED | https://www.thapar.edu/faculties/view/Dr.-Rafat-Siddique/MTcz/Mw== |  |
| Dr. Danie Roy A. B | Assistant Professor | CED | https://www.thapar.edu/faculties/view/Dr.-Danie-Roy-A.-B/MTkw/Mw== |  |
| Dr. Arpit Goyal | Assistant Professor | CED | https://www.linkedin.com/in/arpit-g?lipi=urn%3Ali%3Apage%3Ad_flagship 3_profile_view_base_contact_details%3B%2By7s0q7ATXOt1h3o7PR11w%3D%3D |  |

# PEOPLE

| Name | Designation | Department/School | Web link | Photograph |
|---|---|---|---|---|
| Dr. Satish Kumar Sharma | Associate Professor & Head | SOM | https://www.thapar.edu/faculties/view/Dr.-Satish-Kumar-Sharma/MTkx/MTM= |  |
| Dr. Tanuj Chopra | Assistant Professor | CED | https://www.thapar.edu/faculties/view/Dr.-Tanuj-Chopra/MTg1/Mw== |  |
| Dr. Ranjana Prakash | Professor | SCBC | https://www.thapar.edu/faculties/view/Dr.-Ranjana-Prakash/MjI=/MTE= |  |
| Dr. Davinder Kumar | Assistant Professor | SCBC | https://www.thapar.edu/faculties/view/Dr.-Davinder-Kumar/MTcw/MTE= |  |
| Dr. Jayant Kolte | Assistant Professor | SPMS | https://www.thapar.edu/faculties/view/Dr.-Jayant-Kolte/Mzgy/MTQ= |  |
| Dr. Banibrata Maity | Assistant Professor | SCBC | https://www.thapar.edu/faculties/view/Dr.-Banibrata-Maity/MTcx/MTE= |  |

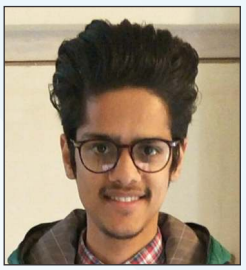
# PEOPLE

| Name | Designation | Department/School | Web link | Photograph |
|---|---|---|---|---|
| Dr. Priyankar Dey | Assistant Professor | BTD | https://www.thapar.edu/faculties/view/Dr.-Priyankar-Dey/NTMy/NQ== |  |
| Dr. Vijay Luxmi | Associate Professor | SCBC | https://www.thapar.edu/faculties/view/Dr.-Vijay-Luxami/Mzc=/MTE= |  |
| Dr. Puneet Sharma | Associate Professor | SPMS | https://www.thapar.edu/faculties/view/Dr.-Puneet-Sharma/NDc=/MTQ= |  |
| Dr. Mohit Agarwal | Assistant Professor | ECED | https://www.thapar.edu/faculties/view/Dr.-Mohit-Agarwal/Mjc4/MTU= |  |
| Dr. Siddharth Sharma | Associate Professor | BTD | https://www.thapar.edu/faculties/view/Dr.-Siddharth-Sharma/MTIx/NQ== |  |

# RESEARCH FELLOWS

| Name | Designation | Department | Ph.D. Supervisors | Photograph |
|---|---|---|---|---|
| Dr. Shagun Kainth | PDF | Center of Excellence in Emerging Materials | Dr. Soumen Basu |  |
| Dr. Piyush Sharma | PDF | Center of Excellence in Emerging Materials | Dr. Rajeev Mehta<br>Dr. Roop L. Mahajan |  |
| Ms. Aayushi | JRF | School of Chemistry and Biochemistry | Dr. S. Basu<br>Dr. Banibrata Maity |  |
| Ms. Anushka Garg | JRF | School of Chemistry and Biochemistry | Dr. Rajeev Mehta (CHED)<br>Dr. Soumen Basu (SCBC) |  |
| Mr. Jaydeep Panchal | JRF | Department of Electrical and Instrumentation Engineering | Dr. Mandeep Singh (EIED)<br>Dr. K.S. Sandha (EIED)<br>Dr. Moon Inder Singh(EIED) |  |
| Ms. Komal Attri | JRF | School of Chemistry and Biochemistry | Dr. Diptiman Choudhury (SCBC)<br>Dr. Amrik Sen (SOM) |  |

# RESEARCH FELLOWS

| Name | Designation | Department | Ph.D. Supervisors | Photograph |
|---|---|---|---|---|
| Ms. Mandeep Kaur | JRF | Department of Civil Engineering | Dr. Naveen Kwatra (CED)<br>Dr. Himanshu Chawla (CED) |  |
| Ms. Nitika Sharma | JRF | Department of Electronics and Communication Engineering | Dr. Rajesh Khanna (ECED)<br>Dr. Amanpreet Kaur (ECED)<br>Dr. H. S. Singh (ECED) |  |
| Mr. Nikhil Sharma | JRF | Department of Civil Engineering | Dr. Shruti Sharma (CED)<br>Dr. Sandeep K. Sharma (MED)<br>Dr. R. Mehta (CHED) |  |
| Mr. Anmol Jain | JRF | School of Chemistry and Biochemistry | Dr. Kamaldeep Paul |  |
| Ms. Sonia Rani | JRF | School of Chemistry and Biochemistry | Dr. Shweta Goyal<br>Dr. Vijay Luxami |  |
| Ms. Akanksha Ranade | JRF | School of Chemistry and Biochemistry | Dr. Rajeev Mehta<br>Dr. Amjad Ali |  |

# RESEARCH FELLOWS

| Name | Designation | Department | Ph.D. Supervisors | Photograph |
|---|---|---|---|---|
| Ms. Anshu Tyagi | JRF | School of Chemistry and Biochemistry | Dr. Amjad Ali<br>Dr. B.N. Chudasama |  |
| Mr. Vikash Ranjan | JRF | Electrical and Instrumentation Engineering Department | Dr. Shailesh Kumar<br>Dr. Prasenjit Basak |  |
| Mr. Sandeep Nain | JRF | Department of Mechanical Engineering | Dr. Neeraj Kumar<br>Dr. Pramod Kumar Avti |  |
| Ms. Shelly Tiwari | JRF | School of Energy and Environment | PI: Dr. Anoop Verma<br>Co. PI: Dr. Diptiman Choudhury |  |
| Ms. Davinder Attan | JRF | School of Chemistry and Biochemistry | Dr. Bonamali Pal |  |
| Mr. Pritam Hait | JRF | School of Chemistry and Biochemistry | Dr. Soumen Basu<br>Dr. Rajeev Mehta |  |

# RESEARCH FELLOWS

| Name | Designation | Department | Ph.D. Supervisors | Photograph |
|---|---|---|---|---|
| Mrs. Heena Chawla | JRF | School of Physics and Material Science | Dr. Soumendu Jana |  |
| Sukhpreet Kaur | JRF | Electronics and Communication | Dr. Jaswinder Kaur Dr. Rajesh Khanna |  |
| Megha Dixit | JRF | Electronics and Communication | PI- Dr. Hem Dutt Joshi Co-PI-Dr. Anil Arora Co-PI-Dr. Soumen Basu Co-PI -Dr. Rana Pratap Yadav |  |
| Ankit Rathore | JRF | Biotechnology | PI: Dr. Moushumi Ghosh |  |
| Gurwinder Kaur | JRF | SPMS | Dr. O. P. Pandey |  |

THAPAR INSTITUTE
OF ENGINEERING & TECHNOLOGY
(Deemed to be University)

## Contact Info


**Dr. ROOP L. MAHAJAN**
Thapar Chair Professor-CEEMS
Lewis A. Hester Chair Professor of Engineering
Global Ambassador, Institute for Critical
Technology and Applied Science (ICTAS)
Department of Mechanical Engineering
Virginia Tech, Falls Church, VA 22043

Email: mahajanr@vt.edu

**Dr. RAJEEV MEHTA**
Coordinator CEEMS
Professor and Head
Department of Chemical Engineering
Thapar Institute of Engineering and Technology
Patiala-147004, Punjab, India

Email: rmehta@thapar.edu
Mob: 9815623714