Email Address	Name of the faculty member	PhD Topic	In the TA category?	If in the project category, PI can enter the project code	A brief description about the topic, and your specific requirements, if any
bbanerjee@iitb.ac.in	Biplab Banerjee	Composable Geospatial Foundation Models for Multimodal and Temporal Remote Sensing Understanding	No	RD/0125-GOOGL2A-002	**How can we build a composable multimodal geospatial foundation model that can ingest heterogeneous remote-sensing sources across time and support retrieval, recognition, change understanding, and decision-oriented reasoning under limited supervision?**
bbanerjee@iitb.ac.in	Biplab Banerjee	Improved multi-task learning models for remote sensing applications	No	Spons/CR/10001772-11/2025	
deepak.singh@iitb.ac.in	Deepak Singh	Investigating Cloud Dynamics and Super-Rotation on Venus through Multi-Mission Data Analysis	Yes		**The work aims to understand Venus' cloud structure, atmospheric circulation, and radiative processes is central to understanding the evolution of terrestrial planets. The investigation focuses on upper-cloud dynamics, thermal-radiative coupling, and the microphysical behaviour of SO_2-H_2SO_4 cloud particles, which strongly modulate the planet's climate. Fundamental knowledge of Machine Learning and atmospheric dynamics is desired. Experience in remote sensing or handling large planetary data is a plus.**
soumyakar@iitb.ac.in	Soumyashree Kar	Knowledge-Guided Explainable AI for High Throughput Plant Phenotyping and Trait Discovery	Yes		**In the plant science domain, data is largely multimodal and unstructured lacking standardized methods to perform integrated analysis on the siloed datasets. This work, therefore, aims to abridge the raw, messy plant biology data with structured logic required to accelerate the way we understand plant traits and build truly intelligent machines.** **Candidates with AI/ML background (especially computer vision and semantic knowledge representation), strong programming skills, and with an interest in vegetation studies will be preferred.**
soumyakar@iitb.ac.in	Soumyashree Kar	Crop Canopy Characterization and 3D Plant Phenomics using Deep Learning	NO	RD/0525-IRCCSH0-007	**Crop canopy characterization is critical to understanding the effects of canopy light interaction on the development of plant traits and its responses to the environmental effects. In the current research landscape, 3D phenomics is the**

					gold standard because it allows for the measurement of such complex traits by integrating both physical crop models and deep learning in a high throughput manner. **Candidates with AI/ML background (especially computer vision and time series analysis), strong programming skills, and crop modeling will be preferred.**
soumyakar@iitb.ac.in	Soumyashree Kar	GeoAI for Ontology-Aware Precision Agricultural Applications	Yes		**This research sits at the intersection of three rapidly evolving fields: Geospatial AI (GeoAI), Semantic Web/Ontologies, and Smart Agriculture. Most agricultural AI fails because it lacks "domain awareness" - it can identify a green pixel, but it doesn't "know" that the pixel is a nitrogen-deficient maize leaf during a specific growth stage. This project addresses this semantic gap by using ontologies to intelligently automate the understanding of farm and crop conditions.** **Candidates with AI/ML background (especially computer vision and ontology engineering), strong programming skills, and Geoinformatics will be preferred.**
karthikl@iitb.ac.in	Karthikeyan Lanka	Downscaling of Satellite Soil Moisture Using Multi Sensor Fusion and AI (with Prof. Avik Bhattacharya and Biplab Banerjee)	Yes		**Soil moisture is a critical variable for agriculture, drought monitoring, hydrology, and climate studies. Satellite based soil moisture products currently suffer from a fundamental trade-off between spatial and temporal resolutions. Missions such as Soil Moisture Active Passive (SMAP) provide frequent observations but at coarse spatial scales (tens of kilometers), while higher-resolution radar missions like NASA-ISRO Synthetic Aperture Radar (NISAR) offer finer spatial detail but with large revisit gaps (e.g., ~10 days). As a result, we lack soil moisture datasets that are both high-resolution and temporally continuous, limiting their use in agriculture, hydrology, and climate applications. The core problem is to develop a physics-informed deep learning framework that can fuse multi-sensor satellite and meteorological data to generate soil moisture estimates that are available at high-resolution in space and continuous in time while remaining physically consistent with soil water**

					processes. **The aim of this project is to develop a physics-informed deep learning framework that produces soil moisture data that is both high-resolution in space and continuous in time by fusing multi-sensor satellite and meteorological data. Specifically, the project will aim to:** **1. Downscale or improve the resolution of coarse soil moisture products (e.g., Soil Moisture Active Passive (SMAP)) using high-resolution SAR and optical/thermal data.** **2. Fill temporal gaps in radar-based soil moisture (e.g., NASA-ISRO Synthetic Aperture Radar (NISAR)) using meteorological information.** **3. Embed physical soil water balance constraints into deep learning models to ensure physically consistent predictions.** **Requirements:** **Technical Capabilities:** **• Strong programming skills in Python (PyTorch/TensorFlow preferred).** **• Solid understanding of machine learning and deep learning, especially spatio-temporal modeling.** **• Experience with handling large geospatial datasets (satellite or gridded data).** **• Familiarity with remote sensing data formats (e.g., NetCDF, HDF) and GIS tools.** **• Knowledge of numerical modeling and basic statistics.** **Desirable (but not mandatory):** **• Background in microwave remote sensing or SAR data processing.** **• Understanding of hydrology, land surface processes, or soil moisture dynamics.** **• Experience with physics-informed neural networks or hybrid modeling frameworks.** **• Experience working in high-performance computing (HPC) environments.**
karthikl@iitb.ac.in	Karthikeyan Lanka	Deep Learning Post-Processing of AI and Dynamical	Yes		**The emergence of AI-based global forecast systems — GraphCast, GenCast, Pangu-Weather — alongside established dynamical models such**

		Forecast Systems for India-Specific Weather and Seasonal Prediction (with Prof. Biplab Banerjee)			**as GFS and seasonal forecast systems such as CFSv2 and SEAS5, has fundamentally altered the landscape of operational weather and climate prediction. These systems demonstrate impressive global skill, yet they are trained or tuned on global reanalysis products that systematically underrepresent the observational density, orographic complexity, and mesoscale dynamics of the Indian subcontinent. Furthermore, the potential of physically informed causal climate features as auxiliary inputs to improve post-processing skill at extended lead times remains underexplored for a domain as teleconnection-sensitive as India. This project aims to address the following question:** **Can timescale-appropriate deep learning architectures, trained on Indian observational and reanalysis products and conditioned on physically informed climate state features where relevant, systematically improve the reliability and resolution of forecasts from multiple AI and dynamical systems for India-specific extremes of rainfall, temperature, and soil moisture across weather-to-seasonal lead times?** **Requirements:** **Technical Capabilities:** **• Strong programming skills in Python (PyTorch/TensorFlow preferred).** **• Solid understanding of machine learning and deep learning, especially spatio-temporal modeling.** **• Experience with handling large geospatial datasets (satellite or gridded data).** **• Familiarity with remote sensing data formats (e.g., NetCDF, HDF) and GIS tools.** **• Knowledge of numerical modeling and basic statistics.** **Desirable (but not mandatory):** **• Understanding of hydrology, land surface processes, or soil moisture dynamics.** **• Experience with physics-informed neural networks or hybrid modeling frameworks.** **• Experience working in high-performance computing (HPC) environments.**

deepak.singh@iitb.ac.in	Deepak Singh	Evolution of Lunar Polar Craters and Volatiles from Dual-Frequency Polarimetric SAR Observations	Yes		**The work will investigate how crater degradation in lunar polar regions governs radar backscatter behavior and whether it can serve as a reliable proxy for surface evolution, particularly within permanently shadowed regions. By using DFSAR data from Chandrayaan-2, it will also address the long-standing ambiguity in interpreting high circular polarization ratios—discriminating between contributions from subsurface water ice and blocky ejecta. The study aims to establish a coupled physical framework linking crater degradation state, regolith properties, and volatile accumulation, thereby advancing our understanding of the processes controlling the stability and spatial distribution of lunar polar ice. Prior knowledge of working with SAR data is preferred.**
sdurbha@iitb.ac.in	Surya Durbha	Quantum-Enhanced Spatiotemporal Modeling: Leveraging Hybrid Quantum Machine Learning for Scalable Earth Observation	Yes		**Investigate how quantum entanglement can be utilized to capture complex, long-range spatial correlations and handle high dimensional data with applications to disaster events.**
sdurbha@iitb.ac.in	Surya Durbha	Neuro-Symbolic GeoAI: Grounding Small Language Models (SLMs) with Geospatial Knowledge Representation for Edge-Based Spatial Reasoning	Yes		**Integration of Small Language Models (SLMs) with Geospatial Knowledge Representation to facilitate high-fidelity spatial reasoning in resource-constrained environments.**
gulab.singh@csre.iitb.ac.in	Gulab Singh	Digital Twins in Satellite Technology	Yes		**In satellite technology, digital twins are used to create dynamic, high-fidelity models of satellites, their subsystems, and even entire space missions. This research area focuses on developing digital twins for satellites to enable real-time monitoring, anomaly detection, predictive maintenance, and mission optimization. By combining telemetry data, physics-based models, and AI/ML techniques, a satellite's digital twin can simulate behavior under different space conditions, helping engineers anticipate failures**

					and improve performance without physical intervention. **Desirable Academic Background:** **A strong interdisciplinary foundation is typically expected: M.Tech in Geoinformatics with B.E/B.Tech Degrees in Aerospace Engineering/Electrical/Electronic Engineering/Computer Science and Engineering/Systems Engineering** **Desirable Knowledge Areas:** **• Satellite systems and orbital mechanics** **• Control systems and embedded systems** **• Data science, machine learning, and AI** **• Simulation and modeling tools (e.g., MATLAB, Simulink, STK)** **• Internet of Things (IoT)** **• Signal processing and communication systems** **Additional Valuable Skills:** **• Programming (Python, C++, or similar)** **• Experience with real-time systems or hardware-in-the-loop simulation** **• Knowledge of space environment effects and reliability engineering** **• Familiarity with cloud computing and big data platforms**
pritam.das@iitb.ac.in	Pritam Das	Incorporating Human Agency into Data-Driven Streamflow Estimation for Regulated Rivers	Yes		**Deep Learning methods have shown tremendous potential to improve streamflow prediction in the past. These models still perform poorly in basins with a high degree of river regulation. The scholar will develop new, or improve existing ML-driven approaches to streamflow estimation, focusing primarily on regulated rivers.** **Required: Demonstrable background in satellite remote sensing/geoinformatics/hydrology/earth sciences/geomatics or allied areas.** **Desired skills:** **- Programming** **- Statistics/data science/machine learning**

pritam.das@iitb.ac.in	Pritam Das	Streamflow Estimation in Regulated Rivers within a Data Assimilation Framework	No	RD/0525-IRCCSH0-034	**The scholar in this project will develop the existing Reservoir Operations-driven River Regulation (ResORR) model further, to improve the accuracy of regulated streamflow, quantify the uncertainty in estimates, and provide decision-ready estimates. The project will involve developing public-facing dashboards in later stages of the project.** **Required: Demonstrable background in satellite remote sensing/geoinformatics/hydrology/earth sciences/geomatics or allied areas.** **Desired skills:** **- Programming** **- Statistics/data science/machine learning**
pritam.das@iitb.ac.in	Pritam Das	Multi-Satellite Surface Water Probe	Yes		**In this project, the scholar will develop a multi-sensor method for estimating water surface dynamics using the arsenal of existing remote sensing satellites. The focus would be especially on the water surface elevation, surface area, and volume. The project will involve developing public-facing dashboards in later stages of the project.** **Required: Demonstrable background in satellite remote sensing/geoinformatics/hydrology/earth sciences/geomatics or allied areas** **Desired skills:** **- Programming** **- Statistics/data science/machine learning**