



भारतीय प्रौद्योगिकी संस्थान कानपुर
Indian Institute of Technology Kanpur

CIVIL ENGINEERING

POST GRADUATE PROGRAM

CIVIL ENGINEERING

Postgraduate education in the department is aimed at attaining an understanding of the basic scientific principles underlying various disciplines in Civil Engineering. In addition, the research component of the graduate programs is meant to develop capabilities to confidently undertake an independent analysis of complex field situations. Our graduates have gone on to become leaders in their professions and have significantly contributed to research and development in Civil Engineering and related fields.

POST-GRADUATE PROGRAMMES OFFERED

- **Master of Technology (M.Tech.)**
 - Environmental Engineering (EE)
 - Geoinformatics (GI)
 - Geotechnical Engineering (GTE)
 - Hydraulics and Water Resources Engineering (HWRE)
 - Structural Engineering (STR)
 - Transportation Engineering (TE)
- **MS by Research (MSR)**
 - Environmental Engineering (EE)
 - Geoinformatics (GI)
- **Diploma of IIT (DIIT)**
 - Geoinformatics (GI)
- **Doctor of Philosophy (Ph.D.)**
 - Environmental Engineering (EE)
 - Geoinformatics (GI)
 - Geotechnical Engineering (GTE)
 - Hydraulics and Water Resources Engineering (HWRE)
 - Infrastructure Engineering and Management
 - Structural Engineering (STR)
 - Transportation Engineering (TE)

LABS/FACILITIES

- a. In each of the areas of specialization, the Department is equipped with well-developed laboratory facilities. The state-of-the-art research facilities in the Department include the following:
- Inductively Coupled Plasma Mass Spectrometer (ICP-MS) and Optical Emission Spectrometer (ICP-OES), Microwave Plasma Atomic Emission Spectrometer (MP-AES), Ion Chromatograph (IC), High Performance Liquid Chromatograph, AAS, TOC, CHNOS Analyzer, GC-ECD-FID, Weather Monitoring Station, UV Visible Spectrophotometer, HDTLC, GC-MS, Particle-Size and Zeta Potential Analyzer, Optical Particle Counter, Scanning Mobility Particle Sizer, Aerosol Mass Spectrometer, Micro-Orifice Uniform Deposition Impactors, Aerodynamic Particle Sizer, Cloud Condensation Nuclear Counter, Particle Soot Absorption Photometer, Particle Absorption Soot Photometer, Cloud Combination Probe, Condensation Particle Counter, Fog Chamber, Optical Particle Sizer, Micro Pulse Lidar, Sun photometer, Gas Analyzers (Ozone, Sulfur Dioxide, Carbon Mono Oxide, Nitrogen Oxides), Scanning Mobility Particle Sizer, High Performance Computing Clusters, Freeze-Drying Apparatus/ Lyophilizer
 - Robotic and Motorized Total Stations, Digital and Auto Levels, Digital Theodolites, Single and Dual Frequency Geodetic Quality Differential GPS Receivers, Navigational GPS Receivers, Permanent GPS Reference Station for Engineering and Scientific Applications, Gravimeters (CG-6 and gPhoneX), Low-cost GNSS stations, Terrestrial Laser Scanner, Range Camera, Integrated GPS and INS system, Digital Photogrammetric Workstation, Software for Geospatial Applications: ERDAS Imagine, ERMapper, ArcInfo and ArcView, AutoDesk and Bentley Microstation Suites, Terrascan, Terramodeller, Polyworks, Leica Photogrammetry Suite.
 - Advanced Cyclic Triaxial Testing Facility, In-situ Testing, SCPT Plate Load Test Facility, Spectrum Analyzer for Surface Waves, Seismic Down-Hole Testing Facility, Geotechnical Digital System (GDS), Geosynthetics Testing Facility for Geogrids and Geonets, Facility for testing unsaturated soils, Unsaturated triaxial system, Gas permeameter, Toxic interface system.
 - Complete Infrastructure for Physical Modelling of Rivers for studying scour patterns and river training works, Fluid friction apparatus, Momentum measurement apparatus, Apparatus to calculate sudden losses in expansion, Contraction and bends, Wind tunnels, Hydrology system, Tilting flumes, Acoustic Doppler flowmeter, Ultrasonic and Electromagnetic flowmeters, Hydro-meteorological observatories.
 - Pseudo Static Cyclic Testing Facility, Shake Table Test Facility for Small Scale Models, Accelerometer-Based Wireless Measurement System, Fibre Optic-Based Strain and Temperature Measurement System, State-of-the-Art Teaching Laboratory for Structural Dynamics, Construction Materials Testing Facilities including NDT equipment, Equipment for determining the Properties of Fresh and Hardened Concrete, Universal Testing Machines, Vibration Survey System

LABS/FACILITIES

(including eccentric mass shaker) for In-situ Measurement of Dynamic Properties of Existing Structures.

- Centrifuge Bitumen Extractor, Marshall Test, Fatigue Test for Bituminous Mixes, Profilograph, Rotational Viscometer, Vacuum Viscometer, British Pendulum Tester, Traffic Speed Measurement Radar, Stone Polishing Machine, Thin Film Oven Test, Asphalt Content Tester by Ignition Method, GPS Set-up, State - of - the - art Instrumented vehicle (Sensors installed: Lidar, IMU GPS Unit, Steering angle sensor, Brake pedal sensor, accelerator pedal sensor, Gear shift force sensor, OBD GPS data logger), CBR testing, Light Weight Deflectometer, Universal Testing Machine for Asphaltic and Granular Materials, Vacuum Density Measurement for Mixes, Benkelmen beam deflection apparatus, Dynamic cone penetrometer, Micro-calorimeter, Simultaneous DSC-TGA.

b. National Centre for Geodesy, IIT Kanpur

A National Centre for Geodesy (NCG) has been setup at IIT Kanpur, with the support from Department of Science and Technology (DST). The objective of this centre is to nucleate and strengthen activities in the area of Geodesy education, capacity building and academic research and development by preparing well trained PG students, conducting state of the art research and development activities. This centre acts as the National Resource Center for extensive support (laboratory, equipment, training, library, SW, etc.) to students and researchers from various universities and institutions and advise state/central government departments on all issues related to Geodesy. NCG offers M. Tech, MSR and PhD programs in the areas of Geodesy/Geoinformation. The eligibility requirements are the same as those listed under Geoinformatics in the earlier section.

FACULTY LIST

- **Abhas Singh, Ph.D. (Washington University, St. Louis):** Environmental geochemistry of heavy metals and inorganic contaminants, Inorganic contaminant fate and transport in groundwater, Contaminant remediation in natural as well as engineered environments, Recycling and stabilization of municipal and hazardous solid waste
- **Abhishek Chaudhary, Ph.D. (ETH Zurich):** Sustainable Development, Environmental Modeling, Life Cycle Assessment, Biodiversity conservation, Sustainable agriculture and diets, Sustainable infrastructure
- **Aditya Medury, Ph.D. (University of California, Berkeley):** Road safety (crash-based prediction models, surrogate safety estimation, exposure modeling, road user behaviour), transportation infrastructure management (optimization problems for resource allocation, performance modeling)
- **Amar Nath Roy Chowdhury, Ph.D. (National University of Singapore):** Stability of plate and shell structures. Mechanics and design of thin-walled structures. Molecular dynamics simulation of materials.
- **Animesh Das, Ph.D. (IIT Kharagpur):** Pavement design, Pavement materials, Pavement evaluation and maintenance.
- **Anubha Goel, Ph.D. (University of Maryland):** Characterization of emissions from combustion sources for source identification a selection of mitigation strategies, technical interventions, indoor environmental quality, emission factors for pollutants from vehicular exhaust, impact of inhaled particles on human health, agricultural activity and climate change, management of solid waste for sustainable development.
- **Arghya Das, Ph.D. (University of Sydney):** Constitutive modeling of Geomaterials. Micromechanics of granular materials. Bifurcation & instability analysis in Geomaterials. Numerical & physical modeling in Geotechnical Engineering.
- **Bipin Kumar Gupta, PhD (University of Waterloo):** Foundations for Offshore Wind Turbines, Soil-structure interaction analysis and design, Numerical and Analytical Methods in Geomechanics
- **B. Nagarajan, Ph.D. (The Ohio State University):** Geodesy, Satellite altimetric and gravimetric studies, Earth rotation and polar motion, photogrammetry and remote sensing, Topographical surveying and mapping, Regional Geoidal models
- **Balaji Devaraju, Ph.D. (University of Stuttgart):** Signal processing on the sphere, Satellite gravimetry, Future satellite missions, Geodetic sensors for environmental monitoring, Data assimilation and Adjustment theory.
- **Bharat Lohani, Ph.D. (University of Reading):** Terrestrial, Mobile and airborne laser scanning, Remote sensing, GIS, GPS, Electronic surveying, Algorithm development, Terrain modeling, Geodata visualization, and Applications.
- **ChinmoyKolay, Ph.D. (Lehigh University):** Behaviour of structures under extreme load events (e.g., earthquake, windstorm, and blast), Real-time hybrid (pseudo-dynamic) simulation, Structural dynamics and control, Nonlinear structural analysis, Numerical techniques and Soil-structure interaction.
- **Chunendra K Sahu, Ph.D. (University of Alberta, Canada):** Flow and mixing in porous media, Buoyancy and density-driven flows, Carbon sequestration, Theoretical and experimental methods.
- **Durgesh C Rai, Ph.D. (University of Michigan, Ann Arbor):** Experimental seismic behavior of structures, Seismic evaluation and strengthening, Energy dissipation devices, Masonry and Steel-RC composite members.
- **GourabanandaPahar, Ph.D. (IIT Kharagpur):** Computational and experimental

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- hydraulics, Lagrangian particle methods.
- **Gaurav Tiwari, Ph.D. (IISc Bangalore):** Geotechnical engineering, rock mechanics and rock engineering, experimental rock mechanics, probabilistic rock engineering.
 - **Harish K Venkatanarayanan, Ph.D. (Clemson University):** Microstructure of cement-based material, Material characterization techniques, Advanced cementitious materials, Sustainable construction materials, Repair and rehabilitation of concrete structures.
 - **Hemant Gehlot, Ph.D. (Purdue University):** Transportation network modelling, Combinatorial optimization, Disaster management, Intelligent transportation systems.
 - **Jagdish Prasad Sahoo, Ph.D. (IISc Bangalore):** Foundation Engineering, Reinforced earth structures, stability of tunnels, underground openings and slopes, Pavement geotechnics, Strength behavior of rocks
 - **Mukesh Sharma, Ph.D. (University of Waterloo):** Air quality modeling and management, Fate processes of organic pollutants and parameter estimation, GHG emissions and mitigation.
 - **Nihar R Patra, Ph.D. (IIT Kharagpur):** Pile foundations, Soil-structure interactions, Ground engineering, Soil arching, Liquefaction potential evaluation.
 - **Onkar Dikshit, Ph.D. (Cambridge University):** DIP, GPS, GIS, Remote Sensing and Pattern recognition applications.
 - **ParthaChakroborty, Ph.D. (University of Delaware):** Traffic flow theory and traffic engineering, Optimal transit system design, Transport system evaluation and management.
 - **Partha Narayan Mishra, PhD (University of Queensland):** Engineering behaviour of unsaturated soils, Electromagnetic measurement and monitoring of soil properties, Biomediated and bioinspired geotechnics, Geotechnics of tailings and industrial wastes
 - **Prabin Kumar Ashish, Ph.D. (IIT Bombay):** Performance based mechanistic characterization of asphalt binder and mixes, Semi Flexible Pavement (SFP) based composite materials, Non-destructive methods for understanding pavement materials behavior, Bonding/debonding between aggregate and asphalt binder, Development of sustainable pavement materials.
 - **Pranamesh Chakraborty, PhD (Iowa State University):** Intelligent Transportation Systems, Machine Learning, Big Data Analytics, Naturalistic Driving Studies
 - **PrishatiRaychowdhury, Ph.D. (University of California, San Diego):** Soil dynamics, Geotechnical Earthquake Engineering, Seismic soil-structure interaction.
 - **Priyanka Ghosh, Ph.D. (IISc Bangalore):** Bearing capacity of foundations and Stability of slopes under both static and seismic cases, Method of characteristics, Upper bound limit analysis and Finite element analysis, Liquefaction analysis.
 - **Purnendu Bose, Ph.D. (University of Massachusetts, Amherst):** Physico-chemical processes for water and wastewater treatment, Advanced oxidation processes for water and wastewater treatment, Abiotic remediation of groundwater resources.
 - **Rajesh Sathiyamoorthy, Ph.D. (IIT Bombay):** Numerical and Physical modeling, Geo-Environmental Engineering, Geosynthetics, Unsaturated soil mechanics, Railway Geotechnology.
 - **Rajesh Srivastava, Ph.D. (University of Arizona, Tucson):** Flow and transport through variably saturated porous media.

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- **Richa Ojha, Ph.D. (Purdue University):** Flow and transport through unsaturated porous media, scaling of hydrological processes.
- **Sachchida Nand Tripathi, Ph.D. (University of Reading):** Laboratory measurements of aerosol absorption and hygroscopic properties, Fog processing of aerosols, Aerosol climate impacts, Electrical properties of aerosols, Development of new techniques to measure carbonaceous aerosols.
- **Salil Goel, Ph.D. (University of Melbourne and IIT Kanpur):** Indoor/Outdoor Navigation, Cooperative Localization, LiDAR, Photogrammetry, Sensor fusion, Filtering and estimation theory, Integrated navigation/mapping systems, UAV applications
- **Samit Ray Chaudhuri, Ph.D. (University of California, Irvine):** Structural dynamics, Earthquake Engg., Performance-based design, structural rehabilitation, seismic soil-structural interaction, structural health monitoring & structural testing.
- **Saumyen Guha, Ph.D. (Princeton University):** Subsurface Flow and Transport; Bioremediation of Toxic Organics in Natural Systems; Fate and Transport of Pesticides and Heavy Metals in the Natural Systems; Metal Uptake in Plants; Natural Isotopes.
- **Shivam Tripathi, Ph.D. (Purdue University):** Statistical hydrology, Sediment transport, Eco-hydrology.
- **Sudhir Misra, Ph.D. (University of Tokyo):** Durability of concrete and nondestructive testing; Infrastructure management; Sustainability in construction; Concrete engineering.
- **Sudib K Mishra, Ph.D. (University of Arizona, Tucson):** Multi-scale, Multi-physics in materials and Mechanics, Stochastic optimization, Reliability analysis of structures, structural damage assessment.
- **Suparno Mukhopadhyay, Ph.D (Columbia University):** Structural Identification and Health Monitoring, Structural Dynamics, Earthquake Engineering
- **Syam Nair, Ph.D. (Texas A&M):** Stabilization of pavement subgrade soils and base materials, Post-stabilization swelling in expansive soils, Characterization and performance prediction of cementitious materials, Use of recycled materials and by-products in pavement construction, Surface properties of aggregates and interaction with binding materials.
- **Tarun Gupta, Sc.D. (Harvard University):** Development of instruments for aerosol measurement, Engineering control of particles in ambient and indoor settings, Physico-chemical characterization of atmospheric pollutants, Personal exposure assessment and health effects of inhaled particles.
- **Tushar Apurv, PhD (University of Illinois Urbana-Champaign):** Drought risk management, hydro-climatology, water resources systems analysis, hydrologic modelling, coupled human-natural systems
- **Venkatesan Kanagaraj, Ph.D. (IIT Madras):** Traffic Flow Theory, Crowd Dynamics, Connected and Autonomous Vehicles.
- **Vinay K Gupta, Ph.D. (University of Southern California):** Random vibrations, Earthquake engineering.
- **Vinod Tare, Ph.D. (IIT Kanpur):** Water and wastewater treatment, modelling and simulation of environmental systems.

BROAD RESEARCH AREAS

The broad research areas in each area of specialization are listed below:

- **Environmental Engineering:** Environmental geochemistry of heavy metals and inorganic contaminants; Investigate physical and chemical processes such as adsorption, precipitation, and reduction-oxidation occurring at mineral-water-microbial interfaces, and relate them to larger scales; Predict inorganic contaminant fate and transport through surface complexation and flow-through reactor modeling; Develop tools to target contaminant remediation in natural as well as engineered environments; Evaluating the impact of human consumption activities on different environmental domains (climate change, water use, land use, eutrophication, acidification; Generating quantitative information to guide transition towards sustainable technology, systems and human behaviors; Developing methods for biodiversity and ecosystem service impact assessment; Environmental life cycle assessment (LCA); Product environmental footprint (PEF) assessment; Characterising the sustainability status of global diets and food systems through nutrition, human health and environmental indicators; Characterization of emissions from vehicular exhaust; Indoor and ambient air quality assessment; Size segregated distribution of particulates and organic pollutants on aerosols; Health risk assessment; Environmental modeling, Fate and transport of pollutants; Solid Waste Management; Agricultural impact on climate change; Air quality modelling and management; Fate processes of organic pollutants and parameter estimation; Physico-chemical processes for water and wastewater treatment; Abiotic remediation of groundwater resources; Advanced oxidation processes for water and wastewater treatment; Aerosol Science and Technology; Low-Cost Sensors for Air Quality Monitoring; Air pollution source identification in near real-time; Aerosol-Land Use-Rainfall-Climate coupling; Large-Scale Chamber Aerosol Experiments for Reactor Safety; Development of instruments for aerosol measurement; Engineering control of particles in ambient and indoor settings; Physico-chemical characterization of atmospheric pollutants; formation of secondary organic aerosol; Personal exposure assessment and health effects of inhaled particles; Source apportionment of air pollution; formation and control of engine exhaust emissions, and risk assessment; Processes for natural resource conservation and regeneration; Physicochemical, Biological and Ecological processes, Water and wastewater treatment; Modelling and simulation of environmental systems; EIA& EA.
- **Geoinformatics:** Satellite Altimetry and Gravimetric Studies; Earth Rotation and Polar Motion; Photogrammetric and Remote sensing; Topographical Surveying and Mapping; Regional Geoidal Models; Physical Geodesy; Future Satellite Gravity Missions; Geodetic tools for monitoring the environment; 3D laser imaging and LCS measurement; Technology for motion correction and error analysis in laser scanning; Propagation modelling using high resolution LiDAR data (flood, sound, GPS signal); As built mapping using terrestrial laser scanning of complex structure including heritage structures; Development of LiDAR simulator-airborne and spaceborne; GIS for optimized land consolidation; Remote Sensing Applications, Photogrammetry; GIS; GPS and DIP for engineering and Natural Resource Management Problems; Unmanned Aerial

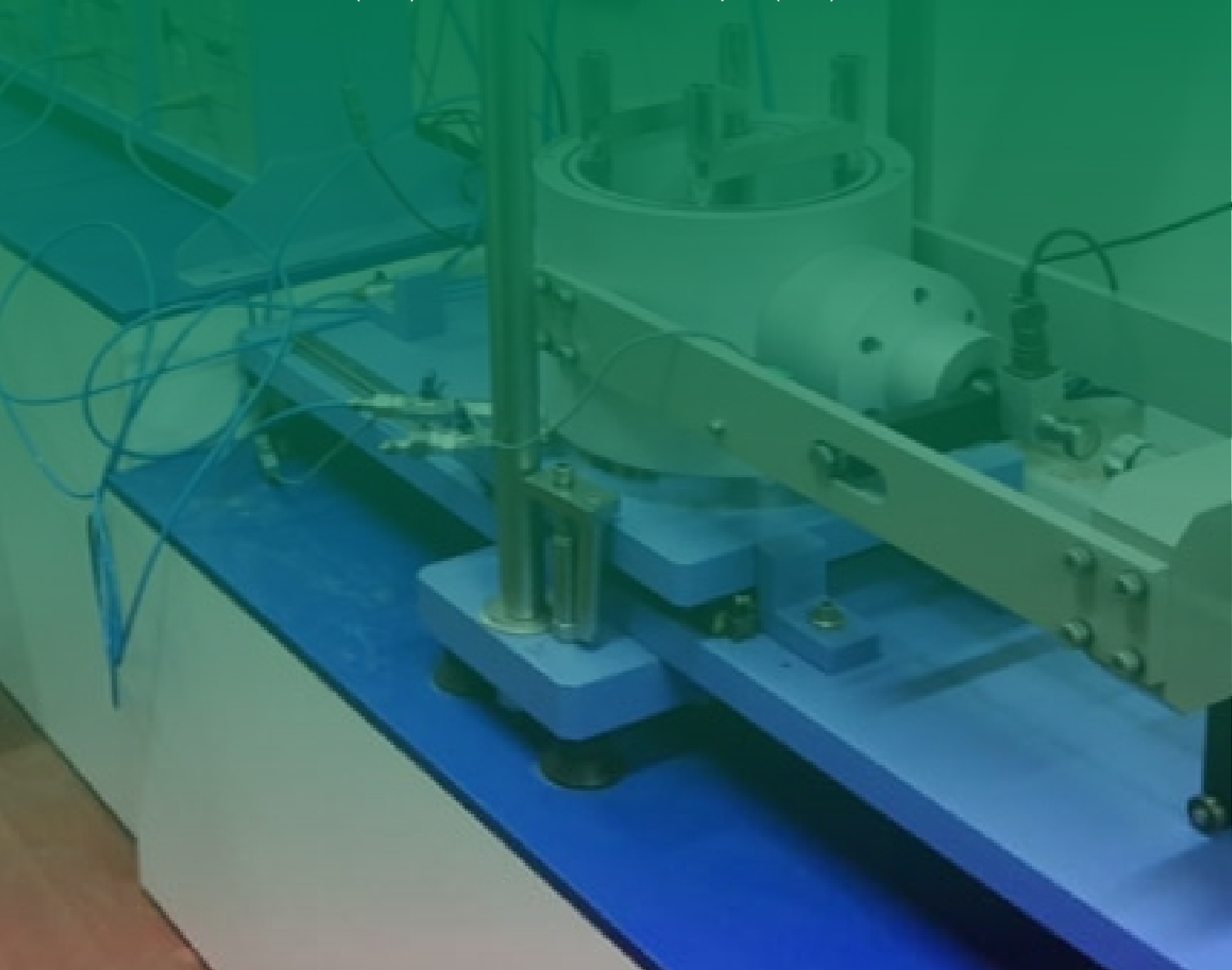
BROAD RESEARCH AREAS

- Vehicles (UAVs), LiDAR, Photogrammetry, GNSS/INS Integration, Filtering and estimation, Sensor fusion.
- **Geotechnical Engineering:** Constitutive modeling of geomaterials; Micromechanics of granular materials; Bifurcation & instability analysis in geomaterials; Numerical and physical modeling in geotechnical engineering; Foundations for Offshore Wind Turbines; Soil-structure interaction analysis and design; Numerical and Analytical Methods in Geomechanics; Rock Mechanics, Probabilistic methods in Rock Engineering; Foundation Engineering; Reinforced earth structures; stability of tunnels; underground openings and slopes; Pavement geotechnics; Strength behavior of rocks; Pile Foundations; Soil Arching; Liquefaction Potential Evaluation; Soil dynamics; Geotechnical earthquake engineering; Seismic soil-structure interaction; Bearing capacity of foundations; Retaining walls and earth pressure theory; Pullout resistance of anchors; Stability of slopes; Geo-Environmental Engineering; Ground Improvement Techniques; Thermo-hydro-mechanical behaviour of unsaturated soils; Stability of engineered landfills and ash dyke; Electromagnetic methods for measurement and monitoring of soil properties; Geotechnics of tailings and industrial wastes; Biomediated and bioinspired geotechnics
 - **Hydraulics & Water Resources Engineering:** Flow and mixing in porous media; Buoyancy and density driven flows; Dye-attenuation technique; Carbon sequestration, groundwater contamination, geothermal energy recovery; Computational and experimental hydraulics; Lagrangian particle methods; Subsurface Flow and Transport; Bioremediation of Toxic Organics in Natural Systems; Fate and Transport of Pesticides and Heavy Metals in the Natural Systems; Metal uptake in plants; Natural Isotopes; Flow and transport through variably saturated porous media; Flow and transport in porous media; Scaling of hydrological processes; Hydrologic extremes; Statistical hydrology; Sediment transport; Eco-hydrology; Drought risk management; Hydro-climatology; Water resources systems analysis; Hydrologic modelling.
 - **Structural Engineering:** Structural dynamics; Structural control; Earthquake engineering; Random Vibration; Structural Identification and Health Monitoring; Performance evaluation of structural and nonstructural components and systems; Performance-based design and structural rehabilitation; Behaviour of structures under extreme load events (e.g., earthquake, windstorm, and blast); Real-time hybrid (pseudo-dynamic) simulation; Seismic soil-structure interaction; Probabilistic Safety Assessment; Structural testing; Non-destructive testing; Experimental seismic behavior of structures; Energy dissipation devices; Masonry and Steel-RC composite members; Nonlinear Finite Element Analysis; Nonlinear structural analysis; Numerical techniques; Multi-scale Modeling; Thin-Walled Structures; Stability of Structures; Structural Form Finding and Optimization; Plate and Shell Theories; Sandwich Structures; Concrete materials; Microstructure of cement based material; Material characterization techniques; Advanced cementitious materials; Sustainable construction materials; Repair and rehabilitation of concrete structures; Durability and deterioration of concrete structures.
 - **Transportation Engineering:** Traffic flow theory and Traffic Engineering; Driver

BROAD RESEARCH AREAS

behaviour modeling; Crowd Dynamics; Traffic facilities design; Transit Systems and Vehicle Routing; Pavement materials; Pavement design; Pavement evaluation, maintenance and rehabilitation; Recycling of infrastructure materials; Chemical stabilization of soils/aggregate; Utilization of industrial by-products; Transportation infrastructure management; Disaster management; Transport System Evaluation and Management; Transportation network modeling; Combinatorial optimization; Travel Demand; Road safety management; Naturalistic Driving Studies; Intelligent transportation systems; Connected and Autonomous Vehicles Machine Learning; Big Data Analytics.

- **Infrastructure Engineering and Management:** Sustainable Construction Materials; Durability of Concrete Structures; Microstructure of cement-based materials; Construction Project Management and Financing; Life Cycle Assessment in Construction; Quality and Safety; Infrastructure Asset Management; Evaluating the impact of human consumption activities on different environmental domains (climate change, water use, land use, eutrophication, acidification); Generating quantitative information to guide transition towards sustainable technology, systems and human behaviors; Environmental life cycle assessment (LCA); Product environmental footprint (PEF) assessment.





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CIVIL ENGINEERING DEPARTMENT

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