**IIT Kharagpur – University of Delaware**

**Summer Scholar Exchange**

**Civil and Environmental Engineering**

**Summer 2020**

**Advisor: Jack Puleo**

**Project Title:** Effect of Ship Wake on Living Shorelines

**Project Description:** Navigation channels are often contained by low-lying areas and vegetated wetlands. Vessel traffic may generate ship wake that for a short duration exceeds background wave conditions. Susceptible wetlands may be protected from erosion by hardened structures or nature-based solutions such as living shorelines. However, scant data exist on the effect of ship wake on living shorelines. The student will work with the advisor and a large research team installing sensors, collecting and analyzing data on waves, currents, morphology and vegetation. The student will assist in surveying nature-based solutions to erosions problems and work with the advisor and graduate students to design a nature-based living shoreline for a section of Pea Patch Island. The student should have some experience in coastal oceanography/engineering, civil engineering, and/or hydraulics, and an interest in performing field work.

**Student Background:** Students should have already taken foundational courses in civil or environmental engineering (e.g. statics, fluid mechanics, soil mechanics).

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**Advisor: Paramita Mondal**

**Project Title:**Durability and Sustainability of Construction Materials

**Project Description:**Concrete is the single most widely used material and plays an important role in the future success of sustainable infrastructure development. The concrete industry is facing a critical challenge to reduce its negative environmental impact while still meeting the escalating need. The overarching theme of the project is to find material solutions for addressing this critical challenge. The student will work with the advisor and the research team to provide innovative material solutions that allow a reduction in cement use in concrete, development of concrete using alternative “green” cement, and, most importantly, assurance of longer life of concrete structures reducing the need for frequent repair and rebuilding. The student will assist the advisor and graduate students to prepare and test new concrete mixes. The student should have some knowledge of cement and concrete, and an interest in performing laboratory work.

**Student Background:**Students with knowledge, interest and working experience in concrete is preferred.

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**Advisor: Paul Imhoff**

**Project Title:** Biochar-Amended Media for Treating Nutrient-Laden Stormwater

**Project Description:** In urban and suburban areas, stormwater can be a significant contributor to pollution of waterways. Biochar has been proposed as an amendment to roadway soils and stormwater treatment media, e.g., bioretention systems, to increase water storage, maintain stormwater infiltration capacity, and enhance pollutant retention and microbial transformations. The student will work with the advisor and graduate students on a research team to perform field and laboratory experiments that quantify biochar’s impact on soil hydrology and nutrient retention and transformation.

**Student Background:** Students should be pursuing an undergraduate degree in chemical engineering, civil engineering, or environmental engineering and have completed courses in chemistry and fluid mechanics. Previous coursework in soil mechanics is beneficial.

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**Advisor: Jovan Tatar**

**Project Title:** Durability Assessment of Externally Bonded Fiber Reinforced Polymer Composites in Civil Infrastructure

**Project Description**

Externally bonded fiber reinforced polymer (EBFRP) composites appeared in the early 1990s as a viable solution for rehabilitation and repair of concrete structures. EBFRP consist of fibers embedded in a polymer matrix. Fibers provide strength and stiffness to the composite, while matrix ensures proper fiber alignment, distributes stress across the fibers, and protects fibers from environmental deterioration. Effectiveness of the EBFRP repair/strengthening depends on the durability of constituent materials, the substrate, and the corresponding material interfaces – each is affected by environmental exposure, most notably the epoxy adhesive used as the composite matrix, and the EBFRP-concrete bond line. The student will work with the advisor and graduate students in conducting mechanical, chemical and thermal characterization of EBFRP composites to assess their durability properties. The student will perform a variety of laboratory procedures and tasks on a regular basis, operate testing equipment, maintain accurate records of all experiments performed, and conduct data analysis. The student should have a background in civil engineering and/or materials science and interest in performing experimental research.

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**Advisor: Tian-Jian Hsu**

**Project Title:** Numerical modeling of waves, currents and turbulence around the beach face.

**Project Description:** Beach berms and dunes play an important role in protecting the coastal community from flooding during extreme wave events, such as the passage of tropical cyclones. Our capability to predict dune erosion due to energetic flows during a storm is the key for coastal management. However, the energetic flow field associated with wave-breaking, wave-driven currents and turbulence at the beach face is poorly understood. The project will utilize an effective numerical model created in the OpenFOAM to simulate wave-resolving hydrodynamics processes around the beach face and compare with measured data obtained recently in a large wave flume experiment. The work will also involve inter-model comparison with a more computationally intensive large-eddy simulation data for the same wave condition (performed by graduate student) in order to improve turbulence-averaged numerical modeling in the beach face region. The student should have some experience in coastal oceanography/engineering, fluid mechanics and an interest in performing numerical modeling.

**Student Background:** Students should have already taken foundational courses in civil or environmental engineering (e.g. statics, fluid mechanics, soil mechanics).