General Engineering Fall 2024

Creative Inquiry Project List

Creative Inquiry (CI) is the imaginative combination of engaged learning, cross-disciplinary interactions and undergraduate research that is unique to Clemson University. Team-based investigations are led by faculty mentors and typically span a year or more. Students take on problems that spring from their own curiosity, from a professor's challenge or from the pressing needs of the world around them. These invaluable experiences produce exceptional graduates.

The following list of CI projects in the College of Engineering, Computing, and Applied Sciences (CECAS) has been compiled for Fall 2024 General Engineering (GE) students. All projects on this list are appropriate for freshmen and new transfers. This list is comprised of several projects that are two or more semesters, meaning it can be continued once you have transitioned to your engineering major. Other projects may only last one or two semesters. Many of these CI projects are interdisciplinary and provide exposure to multiple fields of engineering (e.g., civil engineering, environmental engineering, electrical engineering, etc.).

All projects listed are open to any GE student. Projects with a "TBA" time, mean the faculty will work with students to decide on a meeting time. Information for each of the CI projects is presented as follows:

Project # | Title **Project Course Information**

Primary Faculty (*Faculty Dept./Program*)		Project Meeting Day and Time
Description of CI Project		

During orientation registration for Fall 2024 classes, interested students should register for the CI holding section (ENGR 1900-999, 1 credit hour). Engineering students are asked to submit their top three CI project choices via a Google Form that will be sent to their Clemson email address after their orientation session.

Please note: Students who register for the CI holding section MUST submit their project choices by 4 PM the day after their orientation session to remain enrolled in the ENGR 1900-999 holding section. Students who register for the holding section and do not submit their CI project choices via the Google Form will be dropped from the holding section. Students will be notified of their project placement via email. Please allow up to 7 business days for your class to update on your schedule.

Questions, please contact Monica Sint, GE Registration Coordinator, at **msint@clemson.edu**.

CI Projects for General Engineering Students

Project 1 | Advanced Manufacturing by Ultrafast Lasers **ME 2900/3900/4900-037**

Dr. Xin Zhao (*Mechanical Engineering*)	1 Credit Hour	TBA
This project includes hands-on participation to learn the state-of-the-art ultrafast laser and use it for micro-manufacturing, material strengthening, and multi-functional surface processing.		

Project 2 | Green Energy and Biodiesel Project **BE 4990-005**

Dr. Tom Dodd (*Biosystems Engineering*)	1 Credit Hour	TBA
From Fields to Fuel, team members will be researching all aspects of sustainable biofuels production and engineering while facilitating biodiesel and ethanol production to be utilized by University Facilities. Projects will focus on facility optimization through relief of production bottlenecks, and research increasing biodiesel feedstock acquisition through cultivation of energy crops and harvest of waste lipid streams. Led by Biosystems Engineering faculty.		

Project 3 | Water Quality and Controlled Environment Agriculture **EES 4900-011**

Dr. David A. Ladner (*Environmental Engineering*), Dr. Abayomi Alayande (*Environmental Engineering*)	1 Credit Hour	TBA
Students will assist with an ongoing National Science Foundation project, which uses an anaerobic membrane bioreactor (AnMBR) to treat wastewater. The treatment allows removal of pathogens and undesired organic carbon, but retains nutrients like nitrogen and phosphorus. The water is then fed to a hydroponic system for growing crops like lettuce. The student will assist with operation of the AnMBR as well as measurement of water quality parameters like nitrate, ammonia, phosphate, chloride, sulfate, carbonaceous oxygen demand (COD), methane, etc.		

Project 4 | NASA Micro-G NExT Competition Team **CE 2990/ 3990/4990-013**

Dr. Laura Redmond (*Civil Engineering*)	3 Credit Hours	TBA
The NASA Micro-g Neutral Buoyancy Experiment Design Teams (Micro-g NExT) challenges undergraduate students to design, build, and test a tool or device that addresses an authentic, current, space exploration challenge outlined by NASA. The team will work through the research, design and prototyping process to put forth a proposal to NASA, which, if accepted, will give them the opportunity to travel to NASA JSC to test the device/tool. The team will also participate in public outreach in local K-12 schools to promote STEM education. More information on the challenge can be found at NASA's official website https://beta.nasa.gov/learning-resources/micro-g-neutral-buoyancy-experiment-designteams/		

CI Projects for General Engineering Students

Project 5 | Timber Strong Design Build **CE 4990-026**

Dr. Michael Stoner (*Civil Engineering*)	1 Credit Hour	TBA
The competition seeks student teams to design and build an artistically creative 2-story wood light-framed building that is sustainable, aesthetically pleasing and structurally durable.		

Project 6 | Robotic Systems Research **ECE 1990/2990/3990/4990-001**

Dr. Hassan Raza (*Electrical and Computer Engineering*)	1 Credit Hour	TBA
The team is to design and construct a robot which will compete in IEEE's Southeastcon conference hardware competition.		

Project 7 | Nanotechnology **ECE 1990/2990/3990/4990-002**

Dr. Hassan Raza (*Electrical and Computer Engineering*)	1 Credit Hour	TBA
In this CI course, students will be introduced to the fundamentals and applications of Nanotechnology from Electrical and Computer Engineering (ECE) perspective. Nanotechnology is the art, science, and engineering of designing materials, devices, and systems at the nanoscale from bottom-up and/or top-down approaches. The role of this technology in ECE has been the driving force behind the information technology revolution over the past few decades and is further expected to be the enabling technology behind the next technological revolution in robotics, automation, and artificial intelligence. The course is structured around some introductory lectures, followed by student-driven research on a topic of student's choice. This CI experience may lead to publication of a review article, if a student takes the sequence over a few semesters.		

CI Projects for General Engineering Students

Project 8 | Circuit Cellar **ECE 1990/2990/3990/4990-006**

Dr. Hassan Raza (*Electrical and Computer Engineering*)	1 Credit Hour	TBA
In this CI, students will have the opportunity to learn hands-on activities related to circuits and electronics based on integrated circuits (ICs) and discrete components. We will discuss various practical techniques complemented by simulations. Students may take this course sequence over multiple semesters to work on various aspects of hands-on skillset. Within the scope of this project-based learning, a student may work on a semester long project or on a project that spans over multiple semesters. Skillsets learned here include but are not limited to circuit analysis, electronics design techniques, PCB design and manufacturing, EDA tools, etc. We will conclude the semester by designing and implementing an electronic project based on the student's personal interest.		

Project 9 | Microfluidics and Lab-on-a-chip for Point of Care Technology **ENGR 1900-031**

Dr. Xiangchun Xuan (*Mechanical Engineering*)	1 Credit Hour	TBA
We explore the use of electric, magnetic or flow field for the transport and control of biological and synthetic particles in engineered microchannels with lab-on-a-chip applications to chemistry and biomedicine for point of care technology.		

Project 10 | Makerspace Operations **ENGR 1900-219**

Dr. Todd Schweisinger (*Mechanical Engineering*	1 Credit Hour	TBA
The Clemson Makerspace provides students the ability to collaborate and innovate using current technologies such as 3D-Printing, laser cutting, textiles processing equipment, and electronics. The Makerspace educates and trains students of all majors on machines and processes. Students in this CI will learn to operate key equipment in the Makerspace such as 3D scanners, 3D printers, water jets, laser cutters, electronics, embroidery and sewing machines, direct to Garment Printers, etc. The objective is to develop a safe set of Standard Operating Procedures (SOPs) for training students on makerspace equipment within the culture and requirements of the university. Students will research, implement and evaluate the effectiveness of training methods that will likely include manuals, videos, and presentations. This CI has a strong hands-on component, and a team leadership aspect.		

CI Projects for General Engineering Students

Project 11 | Building at the Nanoscale: Biomaterials **MSE 3910-007**

Dr. Kimberly Weirich (*Materials Science & Engineering)*	1 Credit Hour	TBA
The remarkable ability of cells to build nanoscale materials that self-organize, control shape, regulate motion through adaptive mechanics, and replicate are some of the key features that set living systems apart from most synthetic systems. In this creative inquiry project, we will investigate nanoscale materials designed from biological and bioinspired building blocks, such as purified proteins or synthetic DNA "origami". Research will investigate regulating the intriguing properties and mechanics of these nanoscale materials through nanoscale architecture. We welcome a variety of backgrounds and majors to join our project. Students will gain experience in quantitative analysis, experimental techniques, and learn to be collaborative researchers as part of an interdisciplinary team. Curiosity required!		

Project 12 | Engineering Biology of Arthropods **MSE 3900-002**

Dr. Konstantin Kornev (*Mechanical Engineering*)	1 Credit Hour	TBA
We explore structural and organismal features of insects from the physics and materials point of view looking at the physical determinants of the materials performance. The current project is focused on analysis of insect antennae as multifunctional fibers. The muscle-free antennae of insects demonstrate the behavior that surprise and challenge our assumptions about why and how muscle-free organs move and maneuver fast with a high precision and withstand extremely strong forces while keeping their functionality. There is an indication that insects control antennal movements by pumping blood through its lumen, as one would control a robotic arm by a hydraulic joystick. Considering that antenna is typically thinner than the human hair, the mechanisms that explain its millisecond reaction on perturbations are not clear. A team of students will study mechanisms of antenna bending and twisting, materials and transport properties of antennae and design and manufacture micro-joysticks for neurosurgical applications.		

Project 13 | Robot Networks **ECE 1990-014**

Dr. Yongqiang Wang (*Electrical and Computer Engineering*)	3 Credit Hours	TBA
The technological development of the last decade in robots, computing and communications has led to envisage the design of robotic and automation systems consisting of networked vehicles, sensors, actuators and communication devices. These developments enable researchers and engineers to design new robotic systems that can interact with human beings and other robots in a cooperative way. Applications span surveillance/monitoring, manufacturing, intelligent vehicles, exploration, and many others. In this project, we will explore some basics of robot networks and build robotic cooperation using several intelligent ground robots available in the lab. No knowledge of distributed dynamical systems or robotics is needed.		

CI Projects for General Engineering Students

Project 14 | Future Engineers **ECE 1990-004**

Dr. Melissa Smith (*Electrical & Computer Engineering)*	1 Credit Hour	T/Th 3:30-5:00 pm Seneca, Easley, Pickens, Liberty (must have transportation)
The Future Engineers program will work with the non-profit BRIEF (https://briefnonprofit.org/) to develop and deliver hands-on STEM content with the goal of inspiring them to pursue careers in STEM fields. The program runs during the fall and spring semesters with opportunities also available during the summer. Because most of these activities are developed and conducted by Clemson students, they prove to be beneficial for all involved. The students learn about many of the STEM activities at the university and offer a unique perspective and some interesting ideas for the proposed engineering problems. The university students gain valuable experience in presenting their ideas and research to a diverse audience. The activities range from exploring optimization problems in industrial engineering, dissecting a computer, exploring manufacturing and aerodynamics with paper airplanes, and programming robots, to learning about friction, gravity, and energy with roller coasters and rockets. The service locations for BRIEF are in Greenville, Tamassee, Seneca, Easley, and Liberty where they provide access, training, and experience to kids from low income families.		

Project 15 | Machine Learning and Big Data Research (ML/BD) **ECE 1990-018**

Dr. Melissa Smith (*Electrical & Computer Engineering)*	1 Credit Hour	TBA
The ML/BD team will familiarize themselves with the various skills and best practices pertaining to ML and BD research, including (1) dataset manipulation and visualization, (2) high-level software implementation of ML systems, and (3) proper utilization of a high-performance computing (HPC) system. Additionally, each student will develop his/her own project pertaining to a real-world problem for which ML/BD is applicable, typically by finding a dataset for a topic of interest to the student and doing an ML task with the data. This work culminates in a final report for each student at the end of the semester, in which the student details their entire research process -- problem definition, implementation, experiments, results, challenges, and future work.		