Design Lab Projects: Spring 2026

Albany Medical Center

Spring '26: 3-4 spots available

- **Project Title**: EASyExam: Artificial Intelligence for Ultrasonic Heart Images
- **Likely Skills / Technology Involved:** Programming / artificial intelligence / pattern recognition tools
- **Description:** Each year, almost 300,000 in-hospital cardiac arrests occur in the United States, with survival rates standing at a mere 15-20%. Sepsis contributes to 40% of these cardiac arrests, with over 1 million new cases diagnosed annually in America. Ideally, a comprehensive echocardiographic assessment would guide the best treatment plan for a patient. However, most situations render this impractical, as only 2% of hospital personnel are trained in formal echocardiography, and a full assessment takes at least an hour to complete. Consequently, the current treatment protocol for sepsis requires clinicians to make critical care decisions based on limited clinical information. Regardless of the diverse underlying conditions potentially causing sepsis, each patient receives similar treatment, which can be ineffective or even exacerbate conditions in certain cases. There's a need for an AI-based software tool compatible with a handheld ultrasound machine for critical care scenarios. This tool should recognize a patient's anatomical structures and suggest management plans. Nibras Bughrara, MD, has developed a user-friendly and readily accessible exam, Echocardiographic Assessment using Subxiphoid-Only View (EASy Exam). This allows any clinician to obtain a suggested patient management plan by quickly analyzing a single view from a handheld ultrasound. The capstone project focuses on training a AI system to read and classify subxiphoid ultrasound image on a local device that can be used in a medical setting.

New York State Department of Transportation

Spring '26: 3 spots available

- **Project Title:** NYSDOT 2070 Traffic Controller Testing System
- **Likely Skills / Technology Involved:** Embedded systems, instrumentation, test engineering, applied software development
- **Description:** This capstone project, sponsored by the New York State Department of Transportation (NYSDOT), focuses on the development of a modernized software-based testing system for 2070 traffic signal controllers, which are routinely repaired and validated by NYSDOT. An existing testing setup became obsolete following the end-of-life of Windows 7, creating an operational need for a new, maintainable testing application and workflow. Student teams will pick up development of a partially completed tester application, extending and refining it to support single- and multi-controller testing scenarios, improve usability, and ensure long-term compatibility with current operating systems. The project emphasizes real-world software engineering, hardware–software integration, and test automation, with opportunities for continuity across multiple semesters and coordination with a NYSDOT summer intern.

Green Mountain Semiconductor

Spring ’26: Project full. No spots currently available.

- **Project Title**: Portable Data Logger for In Situ Radiation Testing of a Novel AI Chip
- **Likely Skills / Technology Involved:** Embedded systems programming, microcontroller development, hardware design and adaptation, and software development for data logging.
- **Description**: This project focuses on developing a microcontroller-based data logger and control board designed for portability and in situ operation during radiation testing. The system will be capable of operating on battery power, allowing it to be transported to radiation testing equipment and used during testing. The chip under test is an AI image processor test vehicle utilizing resistive memory (RRAM) circuits, developed by Green Mountain Semiconductor in collaboration with the University at Albany and NY Creates, as part of a NASA Phase II SBIR contract. Testing will take place in situ, allowing for real-time observation of temporary and permanent changes caused by radiation exposure. The project encompasses both hardware and software tasks, with the potential to adapt an existing microcontroller board for this purpose. Software will be developed to control the test chip and log relevant data, storing it in the microcontroller’s Flash memory. The project may conclude with actual testing and the presentation of results. Green Mountain Semiconductor, based in Vermont, is an innovative chip design company specializing in memory products and in-memory computation for AI applications.

Atmospheric Sciences Research Center

Professor Scott Miller, Dept. of Atmospheric Sciences

Spring ‘26: 3 spots available

- **Project Title:** Low-Cost Environmental Sound Monitoring for the NYS Mesonet
- **Likely Skills / Technology Involved:** Embedded systems, signal processing, instrumentation, environmental sensing, and data acquisition systems
- **Description:** This capstone project focuses on the design and refinement of a low-cost environmental sound monitoring system for integration into the New York State Mesonet, a statewide network of meteorological monitoring stations. Building on prior prototype work, student teams will develop a Raspberry Pi–based system that captures environmental sound and extracts frequency-resolved sound level metrics suitable for long-term monitoring and analysis, without recording or storing raw audio. The project emphasizes hardware–software co-design, signal processing, system calibration, remote operation, and reliability for outdoor deployment, while addressing privacy and regulatory constraints.

CREATE Competition – Paper Handling System

New York State Industries for the Disabled (NYSID) & Center for Disability Services Mail Center

There are two projects participating in the NYSID CREATE Competition this year.

Spring '26: Project full. No spots currently available.

- **Project Title:** Assistive Paper Handling System for Workplace Accessibility
- **Likely Skills / Technology Involved:** assistive technology, control systems, human–machine interfaces, embedded systems
- **Description:** This capstone project involves the design and refinement of a human-centered assistive mechanical system to support employees with disabilities at the Center for Disability Services in handling heavy printed paper stacks. The project focuses on reducing physical strain and injury risk during repetitive lifting and flipping tasks while preserving worker engagement and control, emphasizing assistance rather than automation. Student teams will develop and test a lever-assisted paper handling mechanism that uses mechanical advantage and controlled motion to improve safety, accessibility, and usability within an existing workplace environment. The project highlights ergonomic design, electronics and embedded software used to sense, assist, and control mechanical motion, safety-driven constraints, stakeholder-informed iteration, and practical fabrication.

CREATE Competition – Mail Tray System

New York State Industries for the Disabled (NYSID) & Center for Disability Services Mail Center

There are two projects participating in the NYSID CREATE Competition this year.

Spring '26: Project full. No spots currently available.

- **Project Title:** Assistive Sleeve Tray System for Accessible Mail Handling
- **Likely Skills / Technology Involved:** assistive technology, electromechanical systems, controls, human–machine interfaces, embedded systems
- **Description:** This capstone project, sponsored by NYSID through the CREATE program, focuses on the design and refinement of an assistive system to help workers with disabilities safely and independently insert heavy mail trays into USPS cardboard sleeves at a Disability Services Mailing Center. The project addresses a physically demanding and ergonomically challenging task by developing a low-cost, accessibility-focused solution that integrates electronics and software to coordinate and assist mechanical motion, improving consistency, safety, and ease of use. Student teams will work on an electro-mechanical system that supports controlled sleeve opening and tray insertion through intuitive user controls, emphasizing human-centered design, reliability, and seamless integration into an existing workflow.

Naval Nuclear Laboratory

Spring '26: 3-4 spots available

- **Project Title:** Energy Harvesting for Embedded Systems
- **Likely Skills / Technology Involved:** ultra-low-power system design, circuits and instrumentation, power electronics, embedded systems
- **Description:** This project involves designing, implementing, and testing innovative methods for powering embedded systems without relying on traditional power sources. Students will explore alternative energy harvesting techniques, such as solar, vibration (haptic) energy, and heat (Peltier effect), to power an ultra-low power embedded microcontroller. The system will be required to handle a range of various scenarios and be designed with careful consideration of stakeholder design constraints. The project's success will depend on the

ability to integrate these energy sources effectively, ensuring reliable operation even under variable environmental conditions. Students will also need to evaluate the long-term sustainability and efficiency of their solutions, aiming to meet or exceed the standards expected in real-world applications.

Northeast Regional Defense Technology Hub (NORDTECH)

This is a collaborative project involving the ECE department (Professor Muckell & Moulic), Department of Nanoscale Engineering (Professor Cady), NY CREATES, and resources available from the Northeast Regional Defense Technology Hub (NORDTECH)

Spring '26: 3-4 spots available

- **Project Title:** Shared Silicon Framework for IC Projects
- **Likely Skills / Technology Involved:** Vivado, Cadence Tools, Hardware Description Languages (HDL) specifically Verilog, VLSI and ASIC Design
- **Description:** The primary goal of this project is to create a reusable hardware framework that will serve as a cost-effective fabrication option for future capstone teams. Specifically, this framework will support up to four separate independent capstone projects that can fabricate and single shared chip (IC). This modular framework must support at least four independently developed Verilog modules. At runtime, a control signal will select which module is active, allowing the modules to share I/O ports without interference. The final design must satisfy all standard fabrication and verification requirements, including DRC (Design Rule Check): ensuring compliance with process-specific layout constraints, LVS (Layout vs. Schematic): verifying that the physical layout matches the intended logic, and additional verification steps required by the foundry. By consolidating multiple projects into a single shared tape-out, this approach will reduce fabrication costs while also preparing students with workforce-ready skills in modern semiconductor design and verification. The framework will be well-documented, modular, and designed for scalability to support future teams with minimal interdependencies.

GlobalFoundries – Bath Level Monitoring

We will be fielding <u>two</u> GlobalFoundries projects this year.

Spring '26: Project full. No spots currently available.

- **Project Title:** ASML Scanner UPW Bath Level Monitoring
- **Likely Skills / Technology Involved:** Embedded systems programming, microcontroller interface design, sensor selection and integration, optical sensing for non-contact measurement, 3D modeling and printing for mechanical mounts, and data acquisition systems.
- **Description:** ASML photolithography scanners at GlobalFoundries utilize two coolant water reservoirs that supply internal cooling loops with ultra-pure water (UPW). Over time, water can evaporate or leak, requiring refills or repairs. At present, reservoir levels are manually monitored via a sight glass, meaning fills are reactive—triggered only after levels are already low—leading to tool downtime and potential collateral damage. In addition, the current process cannot track rate-of-change data, making it impossible to detect leaks before they trigger hard errors. This project will design and implement a monitoring solution that digitizes the sight glass reading and interfaces with a microcontroller. The system must operate externally to the reservoir, with no contact with the UPW, and should be capable of streaming real-time data to the factory monitoring network (IT interface to be developed by GlobalFoundries). The design will include selecting or developing a non-contact sensor system capable of accurately reading fluid levels through the existing sight glass, creating a mechanical mounting solution (via 3D printing or other methods), and integrating the sensor with a microcontroller for continuous monitoring. The final deliverable will be a functional prototype with documented calibration procedures, leak detection capabilities based on rate-of-change analysis, and a clear path for integration into factory systems.

GlobalFoundries – Helium Detection

We will be fielding two GlobalFoundries projects/teams this year.

Spring ’26: Project full. No spots currently available.

- **Project Title:** Portable Helium Capture and Analysis System
- **Likely Skills / Technology Involved:** Embedded systems programming, microcontroller-based sensor integration, data acquisition and logging, signal processing, electronics for precision gas sensing, and mechanical integration with sensor hardware.
- **Description:** GlobalFoundries’ Fab 8 relies on extremely high-purity helium in numerous semiconductor manufacturing processes. Due to its small atomic size and low density, helium can escape through the smallest leak points and disperse quickly, making detection challenging. Helium is both expensive and finite, and current leak detection methods are slow, labor-intensive, and depend on costly specialized equipment. This project will design and prototype a portable, microcontroller-driven helium capture and analysis system. The team will integrate a sealed gas sampling chamber with electronic sensing components capable of detecting and quantifying helium concentration. Tasks will likely include selecting and interfacing appropriate gas sensors, designing signal conditioning electronics for accurate measurements, implementing microcontroller firmware for sensor control and data logging, and developing algorithms to process sensor data for leak detection. Additional work will involve designing a user interface or data output method for real-time readings, and documenting a repeatable testing and calibration procedure.

TT Electronics & UAlbany Signals & Networks (SINE) Lab

Spring ’26: Project full. No spots currently available.

- **Project Title:** LiFi Modules for Internet Access
- **Likely Skills / Technology Involved:** Hardware description languages (VHDL), familiarly or interest in learning about FPGAs, interest in learning PCB layout. Circuits and digital logic.
- **Description:** This project focuses on developing an innovative wireless communication system using visible light communication (VLC), commonly known as LiFi. This technology serves as an alternative to traditional radio frequency (RF) communications, offering advantages such as unlicensed spectrum, enhanced security, and resistance to jamming. The project aims to create LiFi modules capable of delivering Internet access at speeds exceeding 1 Mbit/s, using commercial off-the-shelf (COTS) components. The design will leverage iCE40 FPGA technology to enable real-time processing and high-speed data acquisition, addressing the limitations of existing LiFi solutions that often lack networking capabilities. The project will include hardware design, software development, and extensive testing to ensure the modules are cost-effective, compatible with existing networks, and perform reliably under various conditions. The expected outcome is the successful demonstration of these modules, contributing to the advancement of LiFi technology for indoor wireless connectivity. This is a collaborative project involving a business leader at TT Electronics (Sergey Komarov) that is also a UAlbany physics alumni, and electrical and computer engineering professor Hany Elgala. This work expands upon a working prototype developed last academic year by a previous capstone team, but which needs additional improvements to meet or exceed the 1 Mbit/s bandwidth goal.

UAlbany Signals & Networks (SINE) Lab

Spring ’26: Project full. No spots currently available.

- **Project Title:** Spatio-temporal Assessment for Population RF exposure
- **Likely Skills / Technology Involved:** RF Engineering, Data Analysis, AI and Machine Learning.
- **Description:** Over the years, various worldwide governing bodies have imposed emission limits on EMF radiation from wireless networks, yet concerns remain about whether these limits account for the increasing use of wireless devices, densification of deployments, in-building systems, and emerging technologies such as smart meters. While studies have shown potential harm from long-term EMF exposure, most have assessed individual exposure in controlled environments rather than the total exposure experienced by the general public in real-world indoor settings. Building on work developed by a prior capstone team, this project will expand the system to focus on large-scale data collection using low-cost EMF sensing units, the creation and curation of robust datasets, and the integration of AI/ML methods to analyze patterns, predict exposure trends, and identify potential high-risk scenarios. Students will also develop a mobile or web application to visualize results, support public participation in data gathering, and democratize access to EMF exposure information for sub-6 GHz frequencies used in 5G and WiFi.

ECE Department

Spring ‘26: 3-4 spots available

- **Project Title:** BeagleBone I/O Expansion Board for Engineering Education
- **Likely Skills / Technology Involved:** Embedded C programming, digital I/O and peripheral interfacing, PCB design, hardware–software integration, low-level testing and validation
- **Description:** This capstone project involves the design and development of a custom daughter board (shield) that interfaces with the BeagleBone single-board computer to provide a reliable, well-defined set of input/output peripherals accessible through C programming. The goal is to create a robust instructional platform that enables students in ECE 240 (Data Structures and C Programming) and ECE 332 (Computer Organization and Programming) to interact with hardware peripherals (such as buttons, LEDs, and a display) without requiring ad hoc breadboarding or custom wiring. Student teams will design and fabricate a PCB, develop and validate low-level C drivers for the board’s I/O, and implement a comprehensive testing strategy to ensure reliability and repeatability in a classroom environment. The project emphasizes hardware–software co-design, documentation, and long-term maintainability, with the outcome intended for sustained use across multiple courses and semesters.