ESE 323 - Modern circuit board design and prototyping

Syllabus for Fall 2025

Bulletin Description: Design, fabricate, and test a prototype device using a custom-made circuit board, surface mount components, and a 3D printed enclosure. Topics include printed circuit design, active and passive component selection, signal integrity, design for testability, solid modeling, and 3D printing.

Overview: ESE323 is a design and prototyping course intended to introduce students to modern circuit prototyping techniques and surface mount device (SMD) packaging. Students will perform experiments on an instructor designed circuit board including:

- 2 terminal SMD soldering
- Drag soldering
- Capacitor resonance using vector network analyzer
- Hot air soldering
- Thermal resistance
- Trace layouts around inductors
- Trace properties

Concurrently with these experiments students will design their own project. They will progressively create a bill of materials, library, schematic diagram, board layout, and enclosure. The board design will be sent out for fabrication and the student's will assemble and test their circuit board. Finally, an enclosure will be 3D printed to complete the prototype design. Students will document their work in a final report and presentation.

ESE280 is a pre-requisite for this course. The MPLAB X integrated development environment is installed on the lab computers and Microchip/Atmel programmers will be available in the lab.

We will use Autodesk Fusion 360 for schematic entry, circuit board design, and 3D mechanical design. This software may be downloaded at no cost for students who would like to work on their own computers. This software is also available in the CAD lab, the senior design lab (light 283B), and the prototyping lab (light 283A). Students may use any software they might prefer and have access to.

Required materials: You will be responsible for purchasing all of the parts for your project – circuit board, integrated circuits, displays, connectors, switches, battery holders, passive components, and whatever else you put in your design. As designer, you will have some control over the cost of your project, but you should plan on spending around $150 on parts. The circuit board itself will cost a minimum of $30 including shipping. The University will provide materials for the 3D printer.

Recommended text:

Peter Wilson, "The Circuit Designer's Companion", 4rd edition, Newnes, 2017. (recommended)

Topics:

Week 1	Class procedures, design introduction, board anatomy
Week 2	SMD packages, project costs, BOMs, and vendors
Week 3	Drag soldering, passive component non-idealities
Week 4	Network analyzers, hot air soldering
Week 5	Creating Fusion parts, reading mechanical drawings
Week 6	High speed layouts, transmission lines thermal resistance
Week 7	Fusion routing, copper pours
Week 8	Sheet resistance, design rule checks
Week 9	Computer aided manufacturing (CAM) processing
Week 10	3D modeling in Fusion 360, 3D printing
Week 11	Connectors, slicing
Week 12	Automated testing, design for test
Week 13	Guarding, creep and clearance
Week 14	Final pressentions

Course Learning Outcomes: After completing this course, students will be able to:

- Independently design an electronic circuit
- Identify common surface mount electronic component packages
- Choose parts for the design and prepare a bill of materials
- Use software to design a printed circuit board to implement the circuit
- Work with vendors to have the board made and purchase parts
- Assemble the circuit using techniques appropriate for surface mounted electronics
- Understand the role of printed circuit boards in circuit thermal management
- Use 3d CAD software to design a project enclosure
- Use a 3d printer to prototype the enclosure
- Prepare engineering documentation for the project

Laboratory work: Each student will be making their own designs and performing their own labs. In addition, there are labs to develop familiarity with the concepts and tools you will be using later for your own design. You will not be working in groups.

We will be using leaded solder in the lab. No food will be permitted in the lab. You are required to observe all safety rules as the materials and equipment in the lab is hazardous.

Exams: There will be one midterm exam and a final exam. The midterm exam will be delivered via Brightspace − you will be given a week to compete the exam. The final exam will take the form of a presentation. The final exam presentations will be on Tuesday December 15th from 5:30 pm to 8:00 pm. Alternately, students may elect to present during the final week of class as time permits.

Grading: The final grade will be weighted as follows:

Preliminary design review paper:	20%
Lab assignments	25%
Midterm exam:	15%
Critical design review paper:	30%
Critical design review presentation:	10%

Schedule: The prototyping lab will be open for your use per a schedule posted online. The schedule may change from week to week, so please check before attending. There are no assigned laboratory times – you can come in whenever the lab is open. The lab can only accommodate a handful of students at a time − plan ahead to avoid a crush.

Laboratories will be conducted in Light Engineering room 283A. Labs will begin meeting on the third week of the semester.

My office hours are on Wednesday from 6:30 PM until 8:00 PM and on Thursday from 6:30 PM until 8:00 PM in Light Engineering 143. I will be happy to meet at other times by appointment.

Contact Information: David Westerfeld: david.westerfeld@stonybrook.edu. Contact information for the Teaching Assistants will be provided on Brightspace.

The University Senate has authorized that the following required statements appear in all teaching syllabi on the Stony Brook Campus:

Disability Support Services (DSS) Statement:

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Disability Support Services, ECC (Educational Communications Center) Building, room 128, (631) 632-6748. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential.

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Disability Support Services. For procedures and information go to the following website: http://www.stonybrook.edu/ehs/fire/disabilities]

Academic Integrity Statement:

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty are required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website at http://www.stonybrook.edu/commcms/academic_integrity/index.html

Critical Incident Management Statement:

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Judicial Affairs any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures.

Document prepared by David Westerfeld on 25 August 2025.