

ESE 323 - Modern circuit board design and prototyping

Syllabus for Fall 2017

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, design for testability, solid modeling, and 3D printing

Overview: ESE323 is a prototyping course intended to introduce students to modern circuit prototyping techniques and packaging. Students will demonstrate these techniques by building and testing a microcontroller-based project utilizing surface mounted components on a student-designed circuit board. The device will be enclosed in a student-designed 3D printed enclosure.

ESE380 is a pre-requisite for this course and students will be responsible for the design of the digital section of the project. The Atmel Studio integrated development environment and Atmel programmers will be available in the lab.

We will use CadSoft EAGLE for schematic entry and circuit board design and we will use Autodesk Fusion to design the enclosure. These software packages are available in the CAD lab or they may be downloaded at no cost for students who would like to work on their own computers.

Lab sessions are scheduled after class on Tuesday. Many of the lab sections will begin with a demonstration after which students will be free to work on their own. We will be meeting in either the CAD lab (light 281) or the prototyping lab (light 283A). Both of these labs have open hours and you may prefer to do your work at other times than the scheduled lab time. Some labs (e.g. 3D printing) will require long run times on limited equipment and students are encouraged to find alternate times to perform these labs. You are required to attend the lab demonstrations, but you may leave after the demonstration is complete if you prefer to work at another time.

Topics:

- Project introduction and design goals
- How to evaluate and purchase parts
- How to draw schematics in EAGLE
- Printed circuit board construction and anatomy
- Common surface mount packages
- How to generate a custom library in EAGLE
- Trace routing in EAGLE
- How currents flow in a printed circuit board (ground planes)
- How interference can be minimized (trace layout)
- Design rule checking
- Computer automated manufacturing (CAM) tools

- Basics of Autodesk Fusion
- Limitations of 3D printing
- Slicing for 3D printing
- Hot air reflow soldering
- Common circuit failure modes

Required materials: You will be responsible for purchasing all of the parts for your project – circuit board, integrated circuits, display, 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 \$100 on parts. The University will provide materials for the 3D printer.

Texts:

Simon Monk, “Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards”, McGraw Hill, 2014. (required)

Peter Wilson, “The Circuit Designer’s Companion”, 3rd edition, Newnes, 2012. (recommended)

Course Learning Objectives:

- Students will learn how to design circuit boards using CAD tools
- Students will learn how to design prototype enclosures using CAD tools
- Students will appreciate the advantages and limitations of additive 3D printing
- Students will understand how signal integrity is affected by circuit board design
- Students will develop skills required to successfully implement advanced senior design projects
- Students will learn how to document an engineering project

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

- Design a 2 layer circuit board using EAGLE
- Design a 3D printed enclosure using Autodesk Fusion
- Demonstrate a successful 3D printed enclosure
- Identify circuit board design features intended to improve signal integrity
- Produce a engineering design report

Laboratory work: Each student will be making their own designs and performing their own labs. You will not be working in groups. This is a project oriented class: we are doing the labs to develop our project. Instead of lab reports you will need to submit a very short status report (around ½ page) each week along with any drawings you have made.

Exams: There will be one midterm exam and a final exam. See the schedule at the end of this syllabus for the exam dates.

Grading: The final grade will be weighted as follows:

Weekly status reports: 20%

Midterm exam	15%
Final exam:	25%
Design paper:	40%

Schedule: The lecture meets from 5:30 to 6:50 in Melville N4000.

Laboratories will be conducted in either Light Engineering room 283A or the CAD lab (Light Engineering 281) from 7:00 pm to 10:00 pm. The laboratory section will begin meeting at the beginning of the semester.

My office hours will be on Tuesdays from 8:00 p.m. to 9:00 p.m. and Wednesdays from 3:00 p.m. to 5:00 p.m. in Light Engineering 215. I will be happy to meet with students at other times by appointment.

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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 5 April 2016, revised August 29 2017