Southern Illinois University Carbondale

ECE 459/ECE 593m Syllabus
Fall 2014

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Office Hours: MWF 11:00-01:00 or by appointment.
Lecture: MWF, 08:00-08:50 am., ENGR A-0207
Labs: TBA

Grading/Evaluation:

- Homework (30%)
- Labs/Class Presentations (20%)
- Mid Test (20%)
- Final Exam (comprehensive) (30%)

Grading Scale: A: 100-90; B: 89-80; C: 79-70; D: 69-55; F: 54-0.

Classroom Policies:

A. Attendance Policy: Attendance will be taken at random throughout the semester, and may be counted as bonus points toward the final grade. Students are responsible for all announcements made in class.

B. Late Homework/Missed Exams: Late homework is not accepted without an excuse. If an exam is missed for a legitimate reason, a grade will be assigned based on the remaining homework/exams.

C. Academic Honesty: Plagiarized work will be punishable up-to a failing grade in the course and referral to the university. Copying on homework, projects or exams or cheating will also be punishable with a failing grade in the course and referral to the university.

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1 Pages 2 and 3 are for ABET
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1. **Course number and name**: ECE 459 MEMS and Micro-Engineering

2. **Credits and contact hours**: 4 credits, three hours a week.

3. **Course Committee**: TBA

4. **Text book(s)**: MEMS and Microsystems: Design and Manufacture by Tai-Ran Hsu
   **Suggested References or other supplemental materials**:
   - Foundations of MEMS by Chang Liu, Publisher - Prentice Hall
   - Micromachined Transducers by Gregory T. A. Kovaes, Publisher - McGraw-Hill
   - Fundamentals of Microfabrication by Marc J. Madou, Publisher - CRC Press.

5. **Specific course information**
   a. **(Catalogue Description)**: Electromechanical Systems, MEMS and microstructures
      and MEM Devices, microfabrication and microengineering, micromachining,
      MEMS Design, Materials, Principles of electrostatic, thermal, piezoelectric and
      optical sensing and actuation MEMS devices and systems. Prerequisite: ECE 315
      and ECE 356.
   b. indicate whether a required, elective, or selected elective (as per Table 5-1) course
      in the program: None
   c. Professional Component {Credit Hours}
      Mathematics 0  Sciences 0  General Ed. 1  Eng. Science 3  Eng. Design 1

6. **Instructional Objectives (with SO’s)**, ex. The student will be able to explain the
   significance of current research about a particular topic.
   Upon completion of the course, the student should be able to:
   - Understand working principles of electromechanical systems, sensing and actuation in
     thermal, piezoelectric, electrostatic and optical domains. (a,d)
   - Learn and would be able to scale the electromechanical systems to micro
     electromechanical systems (MEMS), understand scaling laws. (k)
   - Understand fabrication techniques, photolithography, etching, diffusion, oxidation,
     deposition techniques and materials required for MEMS, understand
     micromanufacturing, bulk micromachining, surface micromachining, LIGA process
     (c,e)
   - Acquire electrical, mechanical, optical and thermal engineering background involves in
     design of MEMS, model and design MEMS for these applications. (a,i)
   - Use Layout editor such as cadence virtuoso to design masks required in achieving
     MEMS design. (k)
   - Understand more about written technical reports and presentations through study of
     existing MEMS designs and devices. (i,g)
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7. Brief list of topics (class, lab and project) to be covered (with hours)\(^2\)
   a. Lectures
      
      • Review of principles of working of electromechanical systems \(\{6 \text{ classes}\}\)
      
      • Scaling laws involved in miniaturization \(\{3 \text{ classes}\}\)
      
      • Materials for MEMS, selection criteria, silicon, compounds of silicon, wafer material, sacrificial layer material, microstructure material, silicon crystal lattice and planes. \(\{7 \text{ classes}\}\)
      
      • Microfabrication techniques, process technologies, crystal growth, oxidation, ion implantation, deposition techniques, etching – dry and wet, isotropic and anisotropic etching, photolithography etchants \(\{11 \text{ classes}\}\)
      
      • Micromanufacturing, bulk micromachining, surface micromachining, LIGA process, examples of few MEMS designs, micromotor fabrication, micro pressure sensors. \(\{10 \text{ classes}\}\)
      
      • MEMS Design, understanding state-of-the-art sensors, systems and devices, flow sensors, temperature sensors, inertial, accelerometer and packaging. \(\{7 \text{ classes}\}\)

   b. Lab
      
      1. Layout Editor Basics
      2. Design rules
      3. Design mask designs for Microcantilever beam
      4. Design mask designs for Microgripper
      5. Final Project

8. CAD and Computer Tools Used: MATLAB and Cadence Virtuoso Layout editor or any other available

9. Assessment of the Contribution to Student Outcomes

<table>
<thead>
<tr>
<th>Outcome</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
<th>g</th>
<th>h</th>
<th>i</th>
<th>j</th>
<th>k</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessed</td>
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<td>X</td>
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</tbody>
</table>

Student Outcomes (ABET criteria a-k) are quoted here:

(a) an ability to apply knowledge of mathematics, science, and engineering  
(b) an ability to design and conduct experiments, as well as to analyze and interpret data  
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

\(^2\) subject to change at the instructor’s discretion. Students are responsible for announcements made in class and on D2L.
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
University Policies

A. Incomplete Grades: An INC is assigned when, for reasons beyond their control, students engaged in passing work are unable to complete all class assignments. An INC must be changed to a completed grade within a time period designated by the instructor but not to exceed one year from the close of the term in which the course was taken, or graduation, whichever occurs first. Should the student fail to complete the course within the time period designated, not to exceed one year, or graduation, whichever comes first, the incomplete will be converted to a grade of F and the grade will be computed in the student’s grade point average. Students should not reregister for courses in which an INC has been assigned with the intent of changing the INC grade. Re-registration will not prevent the INC from being changed to an F.

B. Academic Integrity: You are expected to submit your original work and adhere to the academic policies as stated in the SIU Student Conduct Code: http://srr.siu.edu (listed under Additional Links). Any act of academic dishonesty, cheating, or plagiarism in any form, including anonymous internet sources used in student papers, will be reported. These acts are taken seriously and the consequences may range from failing as assignment to expulsion from the university.

C. SIU Email: Your SIU email account is an official form of University communication. Your instructor will use SIU email as a primary means of electronic communication with students. Please make sure that you maintain a valid password and acquire the habit of regularly checking your SIU email account for important instructor and University announcements. You may view the official SIU Student Email Policy at: http://policies.siu.edu/policies/email.html.

D. Emergency Procedures: SIU is committed to providing a safe and healthy environment for study and work. Because some health and safety circumstances are beyond our control, we ask that you become familiar with SIU Emergency response Plan and building Emergency Response Team (BERT) program. Emergency response information is available on posters in buildings on campus, available on BERT’s website at http://www.bert.siu.edu/, the SIU Department of Public Safety’s website www.dps.siu.edu (disaster dropdown and video, “Shots Fired”), and in the Emergency Response Guideline pamphlet. Know how to respond to each type of emergency. Instructors will provide guidance and direction to students in the classroom in the event of an emergency affecting your location. It is important that you follow these instructions and stay with your instructor during an evacuation or sheltering emergency. The Building Emergency Response Team will provide assistance to your instructor in evacuating the building or sheltering within the facility.
E. **Supplementary Assistance:** SIU is committed to assisting students with disabilities. With the cooperation of SIU’s Disability Support Services (DSS), each student who qualifies for reasonable supplementary assistance has the right to receive it. Students requesting supplementary assistance must first register with DSS in Woody Hall, B-150, 618-453-5738 or 618-453-2293 (TTY), by email DSS@siu.edu, or http://disabilityservices.siu.edu/. Notice: If you have any type of special need(s) or disability for which you require accommodations to promote your learning in class, please contact me as soon as possible. The Office of Disability Support Services (DSS) offers various support services and can help you with special accommodations. You may wish to contact DSS to verify your eligibility and options for accommodations related to your special need(s) or disability.

**Student Services**

A. **Learning Support Services:** The Center for Learning Support Services (CLSS) assists students of all cultures, abilities, backgrounds and identities with enhancing their self-management and interdependent learning skills. Programs offered by CLSS include: group study sessions; math tutoring; academic coaching; early intervention program; and study skills seminars. For additional information please contact CLSS in Woody Hall, Room A-313, 618-453-2925, or www.tutoring.siu.edu.

B. **Writing Center:** The Writing Center offers free tutoring services and assistance with improving writing skills to all SIU undergraduate students and faculty. For center locations and hours, to schedule an appointment online, and to view information regarding the Online Writing Lab (OWL) contact the Writing Center at 618-453-1231 (Morris Library location); 618-453-2927 (Trueblood location), or www.write.siu.edu.

C. **Saluki Cares:** The purpose of Saluki Cares is to develop, facilitate and coordinate a university-wide program of care and support for students in any type of distress-physical, emotional, financial or personal. By working closely with faculty, staff, students and their families, SIU will continue to display a culture of care and demonstrate to our students and their families that they are an important part of the community. To make a referral to Saluki Cares click, call or send: http://salukicares.siu.edu/index.html; 618-453-5714, or siucares@siu.edu.