Fundamentals of MEMS Course Syllabus EECE 5108/6008

Fall Semester 2024

This syllabus is subject to modification.

INSTRUCTOR: Professor Chong H. Ahn
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Office hours: Wednesday 1:00-2:00 PM in 900 Rhodes

LECTURES: **BALDWIN 741**, 3:30 PM to 4:50 PM Tuesdays & Thursdays

TEXTBOOKS: Class notes and handouts.

REFERENCES:

- V. Choudhary and K. Iniewski, "MEMS, fundamental technology and applications", CRC press, 2013
- Chang Liu, Foundations of MEMS (2nd Edition), Prentice Hall, 2012
- M. Madou, Fundamentals of Microfabrication and Nanotechnology, CRC Press, 2012

COURSE GOAL: The goal for Fundamentals of MEMS is to introduce the fundamental principles and technologies of Micro-Electro-Mechanical Systems (MEMS), which include design, analysis and microfabrication of basic mechanical microstructures and microsensors for smart machines or microsystem on semiconductor. The applications of MEMS for pressure sensors, optical sensors, accelerometers, and IoT will be covered, and CMOS and electronic circuits integrated with the microsystem for signal conditioning will also be covered.

QUIZZES AND EXAMS:

Quizzes: Five 20-minute quizzes will be given every other Thursday before the class as scheduled. The problems of quiz are composed of brief questions of concepts/principles or simple problem solving. There will be no make-up quiz or exam and a grade of zero will be given for any missed quizzes and exams for which there have been no arrangements made ahead, unless you have a written medical excuse.

Exams: This course will have two 110 minutes long exams: One mid-term exam is scheduled during the semester (see Course Schedule below) and the final exam is given as UC final exam schedule. These exams will consist of problems (60%) and brief questions (40 %) from **homework problems** and quizzes, and all materials covered in class.

The format of all quizzes and exams is OPEN books and class notes/materials. All face-to-face quizzes and exams will be given in our regular classroom, BALDWIN 761; Mid-term exam will be given during regularly scheduled class times. No mobile phones or other communication devices are allowed during examination, only allowing to access all the class materials. There is no restriction on calculators, except smart phone calculators. There will be no make-up examination and a grade of zero will be given for any missed exams for which there have been no arrangements made ahead, unless you have a written medical excuse.

Quiz and Exam Schedule

09/12 Thursday Quiz # 1 (3:30-3:50 p.m.)
09/26 Thursday Quiz # 2 (3:30-3:50 p.m.)
10/10 Thursday Quiz # 3 (3:30-3:50 p.m.)

10/24 Thursday Quiz # 4 (3:30-3:50 p.m.)
10/31 Thursday Midterm Examination (3:30-4:50 p.m.)
11/14 Thursday Quiz # 5 (3:30-3:50 p.m.)
12/10 Tuesday Final Examination (4:00–6:00 p.m.)

HOMEWORK ASSIGNMRNT:
Self-Study Homework Assignments
Four homework assignments (self-study types) will be given, but their submission is not required. One week later, homework keys will be provided. No grading but the extension or application of the homework problems could be repeated in the mid-term and final examinations.

ATTENDANCE: You are required to attend all classes except for emergencies.

RELIGIOUS ACCOMODATIONS:
Ohio law and the University's Student Religious Accommodations for Courses Policy 1.3.7 permits a student, upon request, to be absent for reasons of faith or religious or spiritual belief system or participate in organized activities conducted under the auspices of a religious denomination, church, or other religious or spiritual organization and/or to receive alternative accommodations with regard to examinations and other course requirements due to an absence permitted for the above-described reasons. Not later than fourteen days after the first day of instruction in the course, a student should provide the instructor with written notice of the specific dates for which the student requests alternative accommodations. For additional information about this policy, please contact the Executive Director of the Office of Equal Opportunity and Access at (513) 556-5503 or oeohelp@UCMAIL.UC.EDU.

CONDUCT: The University Rules, including the Student Code of Conduct (SCC), and other documented policies of the department, college, and university related to academic integrity will be enforced. Any violation of these regulations, including acts of plagiarism or cheating, will be dealt with on an individual basis according to the severity of the misconduct. Unless explicitly stated, the SCC applies to any assignment that counts towards a student's course grade.

WITHDRAWAL: Check Catalyst for the last day to withdraw from this course and receive a "W" grade.

GRADING: Grade for the course will be determined by your performance on the (i) Mid-term exam (120 points) and (ii) Final exam (130 points) and (iii) Quizzes (10 points x 5 = 50 points). An aggregate percent score will be obtained out of the max points of 300 (100%). The Final grade for the course will be obtained by curving your aggregate score.

Please note that Point Totals (or Average) shown on the CANVAS Grade book ARE NOT CALCULATED using the Grading Scheme listed above, and therefore do not correspond to student's actual Course Score. However, points for individual assignments (*homework assignments and exams*) displayed in the CANVAS Grade Book correspond to student's correct score on these assignments. Letter grades for the course will be assigned using the following approximate guidelines:

$x \geq 93$	A
$90 \leq x < 93$	A-
$87 \leq x < 90$	B+
$83 \leq x < 87$	B
$80 \leq x < 83$	B-
$77 \leq x < 80$	C+

$73 \leq x < 77$	C
$70 \leq x < 73$	C-
$67 \leq x < 70$	D+
$63 \leq x < 67$	D
$60 \leq x < 63$	D-
$x < 60$	F

Lecture Schedule

1	Introduction and overview of MEMS	1 wk
2	Design approaches of MEMS	2 wk
3	Microfabrication techniques	3-4 wk
4	Driving principles for MEMS	5 wk
5	MEMS materials	6 wk
6	Fundamental microstructures for MEMS	7 wk
7	Microtransducers and microactuators	8-9 wk
8	Microactuation-based microsensors	10 wk
9	Microsystems and control	11 wk
10	Circuit integration and signal conditioning	12 wk
11	Packaging, assembly, and testing of MEMS devices	13 wk
12	MEMS/BioMEMS applications	14 wk