

APPLICATION FOR NEW COURSE

1. Submitted by College of Engineering Date 11/22/05

Department/Division offering course Electrical and Computer Engineering

2. Proposed designation and Bulletin description of this course

a. Prefix and Number EE 555 b. Title* Introduction to Micro-/Nano-Electromechanical Systems

*NOTE: If the title is longer than 24 characters (including spaces), write

A sensible title (not exceeding 24 characters) for use on transcripts Intro MEMS/NEMS

c. Lecture/Discussion hours per week 3 d. Laboratory hours per week _____

e. Studio hours per week _____ f. Credits 3

g. Course description

This course provides an overview of micromachined structures with an emphasis on operational theory and fabrication technology.

h. Prerequisites (if any)

Engineering Standing or consent of instructor.

i. May be repeated to a maximum of _____ (if applicable)

4. To be cross-listed as ME/MSE 555

Prefix and Number

[Signature] [Signature] 8/31/09

Signature, Chairman, cross-listing department

5. Effective Date Spring ~~2006~~ 2010

Approved by ME Faculty 1/22/10
(semester and year)

6. Course to be offered Fall Spring Summer

7. Will the course be offered each year? Yes No
(Explain if not annually)

8. Why is this course needed?

This course is needed because there are currently no existing courses that include these types of devices.

9. a. By whom will the course be taught? Dr. Ingrid St. Omer

b. Are facilities for teaching the course now available? Yes No
If not, what plans have been made for providing them?

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10. What enrollment may be reasonably anticipated? 10 - 15

11. Will this course serve students in the Department primarily? Yes No

Will it be of service to a significant number of students outside the Department? Yes No
If so, explain.

Design and manufacture of MEMS/NEMS structures requires an interdisciplinary approach.

Will the course serve as a University Studies Program course? Yes No

If yes, under what Area? _____

12. Check the category most applicable to this course

traditional; offered in corresponding departments elsewhere;

relatively new, now being widely established

not yet to be found in many (or any) other universities

13. Is this course applicable to the requirements for at least one degree or certificate at the University of Kentucky? Yes No

14. Is this course part of a proposed new program: Yes No
If yes, which?

15. Will adding this course change the degree requirements in one or more programs? Yes No
If yes, explain the change(s) below

16. Attach a list of the major teaching objectives of the proposed course and outline and/or reference list to be used.

17. If the course is a 100-200 level course, please submit evidence (e.g., correspondence) that the Community College System has been consulted.

18. If the course is 400G or 500 level, include syllabi or course statement showing differentiation for undergraduate and graduate students in assignments, grading criteria, and grading scales.


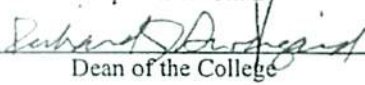

19. Within the Department, who should be contacted for further information about the proposed course?

Name Dr. Ingrid St. Omer Phone Extension 257-6143

*NOTE: Approval of this course will constitute approval of the program change unless other program modifications are proposed.

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Signatures of Approval:

	11/22/05
Department Chair	Date
21-0 in favor	
	12-01-09
Dean of the College	Date
	11-20-09
*Undergraduate Council	Date of Notice to the Faculty
	4-28-2010
	Date
*University Studies	Date
*Graduate Council	Date
*Academic Council for the Medical Center	Date
*Senate Council (Chair)	Date of Notice to University Senate

*If applicable, as provided by the Rules of the University Senate

ACTION OTHER THAN APPROVAL

EE/MSE/ME 555 Micro-/Nano- Electromechanical Devices
 University of Kentucky
 Department of Electrical & Computer Engineering
 Fall 20XX
 Tuesday, Thursday 9:30 – 10:45 am
 FPAT 263
 3 credit hours

Instructor: Dr. Ingrid St. Omer
 Office: 471 FPAT
 Office hours: Mon. 1:30-3:30 pm,
 Tues. 4:00-5:30 pm, or by appointment.
 Phone: 257-6143
 Email: istomer@enr.uky.edu

Course Grading Criteria

Homework	20 %
Midterm	25 %
Final Exam	30 %
Project	25 %

Total	100 %

Our accreditation association and policy of the Graduate School require that there be different assignments and grading criteria for undergraduate students and graduate students in 400G and 500-level courses. For this reason, you will find differences in course requirements and/or grading criteria in this class, posted on the syllabus. *In this course, the differentiation will be noted in the scope of the class project.*

Project

Undergraduate students will give a presentation to the class that summarizes a technical paper on a topic related to sensor design, fabrication, materials or device operation. **Graduate students** will give a presentation that analyzes a technical paper and related experimental precedent. **Graduate students** will also be expected to propose an appropriate method for future experimental work. The instructor will provide a list of suggested topics to the students. Students may also propose alternative topics to the instructor. Two pre-presentation meetings with the instructor are required. **The first meeting will take place between weeks 6 and 8 of the term. The second meeting must be held at least one week before the scheduled presentation. At the second meeting an outline of the talk is due. Presentations will be scheduled during weeks 14 and 15 of the term. A written summary of the seminar project will be due within 7 days of the oral presentation for all students.**

Final Grade:

Undergraduate	Graduate ♀
85 – 100 % (A)	85 – 100 % (A)
75 – 84 % (B)	75 – 84 % (B)
50 – 74 % (C)	50 – 74 % (C)
40 – 49 % (D)	Below 49% (E)
Below 40 % (E)	

Note: Graduate students must earn a C or better in the course to receive credit. A cumulative GPA of less than 3.0 can result in scholastic probation or dismissal depending on student status. Consult the Graduate School Bulletin for specific regulations.

Textbook

Marc J. Madou, *Fundamentals of Microfabrication: The Science of Miniaturization*, 2nd Ed., CRC Press, 2002.

References:

Gregory T.A. Kovacs, *Micromachined Transducers Sourcebook*, WCB/McGraw-Hill, 1998.
Stephen Campbell, *The Science and Engineering of Microelectronic Fabrication*, Oxford University Press, 1996.
S. M. Sze, *Semiconductor Sensors*, John Wiley & Sons, Inc., 1994.
Ljubisa Ristic, *Sensor Technology and Devices*, Artech House, 1994.

Prerequisites:

Engineering standing or consent of instructor.

Course Web Site:

A course homepage is available at <<http://courses.engr.uky.edu/ECE/ee555>>. The course site contains the above information, a tentative schedule, and it will be updated periodically to reflect homework assignments and solutions. The instructor reserves the right to change the schedule as needed. The web site also includes some links to various external sites that you may or may not find useful. An additional resource is the textbook website whose address is <http://mmadou.eng.uci.edu/Edu_Services/MEMSEdu.htm>.

Course Content

This course provides an overview of micromachined structures with an emphasis on operational theory and fabrication technology.

Topics

Sensor Classification and Terminology
 Classification of Semiconductor Sensors
 Sensor Parameters
Semiconductor Sensor Technologies
 Basic Semiconductor Fabrication Processes
 Materials Properties
 Dimensional Effects
 Bulk Micromachining
 Surface Micromachining
 LIGA and Micromolding
Modeling and Simulation
Packaging
Scaling and Nanotechnology
Sensor Examples
 Mechanical
 Optical
 Thermal
 Chemical/Biological

Microfluidic

Student Learning Outcomes

Upon completion of the course, the student should be able to:

- Define important terminology used in the discussion and design of MEMS/NEMS structures
- Discuss the classification scheme and give examples of each type of signal
- Discuss the design and fabrication cycle in terms of the modeling, simulation, fabrication, packaging, and manufacturing
- Explain the importance of materials, their physical properties, and influence, in the fabrication and operation of MEMS/NEMS structures
- Explain the fundamental processes for micromachining
- Determine the substrate and machining approach for a new micromachining application

Homework

Homework is due at the beginning of the indicated class period. **Late homework will not be accepted.**

Class Participation

During portions of the lecture students will work in small groups to practice problem-solving skills. Students are expected to work productively with their classmates on these tasks. In addition, students are expected to contribute to class discussions during the lectures.

Classroom Behavior, Decorum and Civility

Students and faculty are expected to treat everyone present in the classroom with respect and civility. Disparate treatment will not be tolerated. Disparate treatment occurs when one or more persons treat an individual less favorably on the basis of their actual or perceived race, sex, age, color, national origin, religion, disability, veteran status, and/or sexual orientation. All interactions should be characterized by respect for, and consideration of, others present in the classroom.

Cellular phones, pagers, and other electronic devices should be turned off prior to entering the classroom. Any cellular phone or pager that disrupts the classroom environment will be confiscated.

Attendance

Students are expected to be *on time* and to attend every class. **It should be noted that some of the material presented in class is not found in the textbook.** Therefore, consistent attendance is strongly recommended. If a student must miss class, the student is responsible for making up any work that was missed. As previously stated, assignments are due at the beginning of the class period and late homework will not be accepted.

The following are defined as acceptable reasons for excused absences:

1. serious illness;
2. illness or death of family member;
3. University-related trips;
4. major religious holidays.

If a student must be absent for one of these reasons, the student should notify the instructor as soon as possible but no later than the second absence. Appropriate documentation regarding the nature of the absence will be required. Students anticipating an absence for a major religious holiday are responsible for notifying the instructor in writing of anticipated absences.

Cheating and Plagiarism

Cheating - claiming another individual's work as your own or permitting another person to claim your work.

Plagiarism - claiming another person's work, writing or ideas as your own. *This includes material from the Internet or other digital media.*

You are encouraged to discuss the material in this course, including homework problems (and solutions and answers) with other students but you *cannot simply copy another student's homework paper and hand it in*. Working together is OK and encouraged. **Copying**, however, is cheating and both the student who copies and the student who provides the solution will be punished. On exams, the work must be totally your own unless explicitly stated otherwise.

Cheating and plagiarism will not be tolerated at this university. The minimum penalty is a failing grade in the course; the maximum penalty is expulsion from the university. If you have any questions, ask.

Classroom and Learning Accommodations

If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide me with a **Letter of Accommodation** from the Disability Resource Center (Room 2, Alumni Gym, 257-2754, jkarnes@uky.edu) for coordination of campus disability services available to students with disabilities.

TENTATIVE SCHEDULE

WEEK	DATE	TOPIC	READINGS
1	8/25	Introduction and Terminology Classification & Parameters	Madou, Roadmap pp. 615-630
2	8/30	Lithography	Madou, pp. 1-31
	9/2		Madou pp. 31-70
3	9/5	Labor Day Holiday	
	9/6	Dry Etching	Madou pp. 77-116
	9/8		
4	9/13	Additive Techniques	Madou pp. 123-154
	9/15		Madou pp. 154-174
5	9/20	Bulk Micromachining	Madou pp. 183-228
	9/22		Madou pp. 228-249
6	9/27	Surface Micromachining	Madou pp. 259-292
	9/29		
7	10/4	Materials issues	Madou pp. 293-313
	10/6		handouts
	10/8	Fall Break	
8	10/11	LIGA	Madou pp. 325-368
	10/13		Madou pp. 369-371
9	10/18	Review	
	10/20	MIDTERM	
10	10/25	Miniaturization & Manufacturing	Madou pp. 379-423
	10/27		Madou pp. 423-458
11	11/1	Modeling & Simulation	Madou pp. 467- 523, Ristic Ch. 2
	11/3	Scaling Issues	Madou pp. 535-546
12	11/8	Actuators	Madou pp. 547- 579, handouts
	11/10	Fluidics	Madou pp. 579-587
13	11/15	Thermal, Chemical, etc.	Madou pp. 587-600
	11/17	Power	Madou pp. 600-605
14	11/22	Nanostructures	Handouts
	11/24	Thanksgiving Break	
15	11/29	Project Presentations	
	12/1	Project Presentations	
16	12/6	Project Presentations	
	12/8	Project Presentations	
17	12/16	FINAL EXAM: Friday, December 16, 8:00-10:00 am	