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, Chairman, cross-listing department ____________________________
   Effective Date Spring 2006
   (semester and year)

5. Course to be offered ☐ Fall ☐ Spring ☐ Summer

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

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

8. By whom will the course be taught? Dr. Ingrid St. Omer
   Are facilities for teaching the course now available? ☐ Yes ☐ No
   If not, what plans have been made for providing them?

9. a. ☐ Yes ☐ No
   b. ☐ Yes ☐ No
APPLICATION FOR NEW COURSE

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.

12. Will the course serve as a University Studies Program course? [Yes] [No]
    If yes, under what Area?

13. Check the category most applicable to this course
    [ ] traditional; offered in corresponding departments elsewhere;
    [X] relatively new, now being widely established
    [ ] not yet to be found in many (or any) other universities

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

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

16. 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.
APPLICATION FOR NEW COURSE

Signatures of Approval:

Department Chair

Dean of the College

*Undergraduate Council

*University Studies

*Graduate Council

*Academic Council for the Medical Center

*Senate Council (Chair)

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

11/22/05

Date

12-01-09

Date

11-20-09

Date of Notice to the Faculty

4-28-2010

Date

Date

Date

Date

Date of Notice to University Senate

ACTION OTHER THAN APPROVAL

Rev 3/04
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@engr.uky.edu

Course Grading Criteria

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>20%</td>
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<tr>
<td>Midterm</td>
<td>25%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>30%</td>
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<tr>
<td>Project</td>
<td>25%</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
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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:**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>A</td>
<td>85 – 100%</td>
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<tr>
<td>B</td>
<td>75 – 84%</td>
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<td>C</td>
<td>50 – 74%</td>
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<tr>
<td>D</td>
<td>40 – 49%</td>
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<td>E</td>
<td>Below 40%</td>
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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

References:

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