EEE 6465  Design of MEMS Transducers

1. Catalog Description: (3 credits) A continuation of EEL5225 focused on developing a framework to design microelectromechanical system (MEMS) transducer systems in the context of physical, technological, and economic constraints.

2. Pre-requisites: EEL5225 or approval of instructor

3. Course Objectives: To teach how to design MEMS transducers and to explore design tradeoffs, circuit/system issues, device performance, and manufacturing of microsystems.

4. Contribution of course to meeting the ABET professional component (undergraduate courses): N/A

5. Relationship of course to ABET program outcomes (undergraduate courses): N/A

6. Instructor:  Dr. Huikai Xie
   a. Office location: BEN 221
   b. Telephone: 846-0441
   c. E-mail address: hnx@ufl.edu
   d. Web site:  http://lss.at.ufl.edu (E-Learning in Sakai)
   e. Office hours: TR 4 - 5 pm, or by appointment

7. Teaching Assistant: None

8. Meeting Times:  T/R 7-8 (1:55-3:50pm)

9. Class/lab schedule: Two lectures (50 min. and 100 min. respectively) per week.

10. Meeting Location: CHE 316

11. Material and Supply Fees: None

12. Textbooks and Software Required:
   a. Title: Microsystem Design
   b. Author: S. D. Senturia
   d. ISBN number:
   e. Software: MATLAB, MathCAD, Excel, or equivalent may be needed for homework
   f. Software: Finite-Element software (e.g. COMSOL, ANSYS, etc.)

13. Recommended Reading:
   Books:

Primary Journals:
- *J. Microelectromechanical Systems* (IEEE/ASME)
- *J. Micromechanics and Microengineering* (IoP)
- *Sensors and Actuators* (Elsevier)

Major Conferences:
- Transducers ‘XX, Int. Conf. on Solid-State Sensors and Actuators, odd-numbered years since 1983, proceedings available from IEEE (US meetings), Elsevier (European meetings), IEE Japan (Japanese meetings).
- Eurosensors ‘XX, annual since 1987, proceedings published in special issues of Sensors and Actuators.
- MEMS ‘XX, IEEE Workshop on Micro Electro Mechanical Systems, annual since 1989, proceedings available from IEEE.
- … plus many more area-specific conferences, e.g. PowerMEMS, μTAS, Optical MEMS, BioMedical, etc.

Informative Websites:
- [www.memsnet.org](http://www.memsnet.org)  General MEMS and Nanotechnology Information
- [www.mems-exchange.org](http://www.mems-exchange.org)  MEMS Exchange – MEMS Foundry Services
- [www.smalltimes.com](http://www.smalltimes.com)  News about MEMS, Nanotechnology, and Microsystems
- [www.mancef.com](http://www.mancef.com)  Micro and Nanotechnology Commercialization and Education Foundation
- [www.memsindustrygoup.org](http://www.memsindustrygoup.org)  North American MEMS Industry Group

14. Course Outline:
- Review of LEM and Transducers (1)
- Domain-Specifics (6)
  - Thermal
  - Fluidics
- Case Study: Vibratory Gyroscopes (3)
  - Coriolis acceleration
  - Gyroscope design and analysis
  - Gyroscope fabrication
  - Applications
- System Issues (6)
  - Interface Electronics
Noise
Case Study: RF MEMS (5)
Advanced Modeling (6)
  - Optimization Techniques
  - Finite-Element Modeling
MEMS Manufacturing (3)
  - Economics
  - Yield, Statistical Analysis
  - Test Structures
Device Characterization (4)
  - MEMS Metrology
  - Uncertainty Analysis
  - Design of Experiments

15. Attendance and Expectations: Students are expected to attend class lectures and arrive on time. Please turn off cell-phones, pagers, and other electronic devices.

16. Grading:
   
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<tr>
<th>Homework</th>
<th>15%</th>
<th>6-8 assignments</th>
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<tbody>
<tr>
<td>Exam 1</td>
<td>25%</td>
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<tr>
<td>Exam 2</td>
<td>25%</td>
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<tr>
<td>Design Project</td>
<td>35%</td>
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17. Grading Scale:

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<tr>
<th>Numeric Cutoff</th>
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<th>Grade Points</th>
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<tr>
<td>87</td>
<td>A-</td>
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<tr>
<td>83</td>
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<tr>
<td>80</td>
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<td>B-</td>
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<tr>
<td>73</td>
<td>C+</td>
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<td>D-</td>
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<td>E</td>
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18. Make-up Exam Policy:
   
   Homeworks: DUE AT BEGINNING OF CLASS PERIOD
              -10% if turned in after lecture begins
              -20% if turned in after lecture ends (up to 24 hours late)

   Exams: No make-up unless prior written documentation from Dean of Students, Physician, or Judge.
If you have a University-approved excuse and arrange for it in advance, or in case of documented emergency, a make-up exam will be allowed. For information on UF policies concerning attendance, please visit: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx#absences

19. **Honesty Policy** – All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others.

*UF Honor Statement: We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.*

***CHEATING, COPYING, or PLAGERISM will result in a ZERO ON THE ASSIGNMENT, and DISCIPLINARY ACTION WILL BE PURSUED (see http://www.dso.ufl.edu/studenthandbook/studentrights.php)

20. **Accommodation for Students with Disabilities** – Students Requesting classroom accommodation must first register with the Dean of Students Office. That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.

2. **UF Counseling Services** – Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:
   - UF Counseling & Wellness Center, 3190 Radio Rd, 392-1575, psychological and psychiatric services.
   - Career Resource Center, Reitz Union, 392-1601, career and job search services.

21. **Software Use** – All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.