Standardized Syllabus for the College of Engineering

EEE 6465 Design of MEMS Transducers Spring 2018 Section: 1H41

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: N/A
5. Relationship of course to ABET program outcomes: N/A
6. Instructor: David Arnold
    a. Office location: LAR 213
    b. Telephone: 392-4931
    c. E-mail address: darnold@ufl.edu
    d. Web site: http://lss.at.ufl.edu (E-Learning in Canvas)
    e. Office hours: MWF 9:30 - 10:30 am, or by appointment
7. Teaching Assistant: None
    a. Office location:
    b. Telephone:
    c. E-mail address:
    d. Office hours:
8. Meeting Times: MWF 2 (8:30 - 9:20 am)
9. Class/lab schedule: Three 50-min. lectures per week
10. Meeting Location: BLK 315
11. Material and Supply Fees: None
12. Textbooks and Software Required:
    S. D. Senturia, *Microsystem Design*, Kluwer Academic Publishers: Boston, 2001.
    MATLAB, MathCAD, Excel, or equivalent may be needed for homework.
    Finite-Element software (e.g. COMSOL, ANSYS, etc.)
13. Recommended Reading:
    Books:
    G. Kovacs, *Micromachined Transducers Sourcebook*, McGraw-Hill,1998
    M. Madou, *Fundamentals of Microfabrication*, 2nd Ed., CRC Press, 2002.
    R.C. Jaeger, *Introduction to Microelectronic Fabrication*, 2nd ed., Prentice Hall, 2002.
    J. A. Pelesko and D. H. Bernstein, *Modeling of MEMS and NEMS*, Chapman & Hall/CRC, 2003.
    T. B. Jones and N. G. Nenadic, *Electromechanics and MEMS*, Cambridge University Press, 2013.
    Primary Journals:
    J. Microelectromechanical Systems (IEEE/ASME)
    J. Micromechanics and Microengineering (IoP)
    Sensors and Actuators (Elsevier)
    Microsystems and Nanoengineering (Nature)
    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).

IEEE MEMS ‘XX, annual since 1989, proceedings available from IEEE.

IEEE Sensors ‘XX, annual since 2002, proceedings available from IEEE.

Hilton Head ‘XX, Solid-State Sensors and Actuators Workshop, Hilton Head, SC, even-numbered years since 1984, proceedings available from Transducer Research Foundation.

Eurosensors ‘XX, annual since 1987, proceedings published in special issues of Sensors and Actuators.

Napa ‘XX, Topical meetings, Napa, CA, held in odd-numbered years annual since 2011.

… plus many more area-specific conferences, e.g. PowerMEMS, μTAS, Optical MEMS, BioMedical, etc.

Informative Websites:

www.memsjournal.com Premiere online journal of MEMS-related news

www.semi.org/en/msig-information-hub MEMS & Sensors Industry Group (MSIG)

www.memsnet.org General MEMS and Nanotechnology Information

www.mems-exchange.org MEMS Exchange – MEMS Foundry Services

14. Course Outline:

Week	**Topic**
1	Intro/Review of MEMS 1
2	Mechanical Systems
3	Thermal Systems
4	Thermal / Fluidic/Acoustic Systems
5	Fluidic/Acoustic Systems
6	Optimization
7	Finite Element Modeling
8	Interface Electronics
9	Interface Electronics/Noise
10	Noise
11	MEMS Manufacturing
12	Device Characterization
13	Design Project
14	Design Project

15. Attendance and Expectations:

Students are expected to attend class lectures and arrive on time. Please turn off cell-phones and other electronic devices.

16. Grading:

Homework	15%	~8 assignments
Exam 1	25%	tentatively Friday 3/2/18 in-class
Exam 2	25%	tentatively Wed 4/25/18 in-class
Team Design Project	35%	
	100%	

17. Grading Scale:

Numeric Cutoff	Letter Grade	Grade Points
90	A	4.00

87	A-	3.67
83	B+	3.33
80	B	3.00
77	B-	2.67
73	C+	2.33
70	C	2.00
67	C-	1.67
63	D+	1.33
60	D	1.00
57	D-	0.67
<57	E	0.0

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.
19. Students Requiring Accommodations:
    Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, https://www.dso.ufl.edu/drc) by providing appropriate documentation. Once registered, students will receive an accommodation letter, which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.
20. Course Evaluation:
    Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at https://evaluations.ufl.edu/evals. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at https://evaluations.ufl.edu/results/.
21. University Honesty Policy:
    UF students are bound by The Honor Pledge which states, "*We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code*." On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.
22. Software Use:
    All faculty, staff, and students 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.

23. Student Privacy:
    There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see:
    http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html
24. Campus Resources:
    Health and Wellness
    - U Matter, We Care: If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.
    - Counseling and Wellness Center: http://www.counseling.ufl.edu/cwc, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.
    - Sexual Assault Recovery Services (SARS): Student Health Care Center, 392-1161.
    - University Police Department at 392-1111 (or 9-1-1 for emergencies), or http://www.police.ufl.edu/.

    Academic Resources
    - E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. https://lss.at.ufl.edu/help.shtml.
    - Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. https://www.crc.ufl.edu/.
    - Library Support, http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.
    - Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. https://teachingcenter.ufl.edu/.
    - Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. https://writing.ufl.edu/writing-studio/.
    - Student Complaints Campus: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.
    - On-Line Students Complaints: http://www.distance.ufl.edu/student-complaint-process.