January, 2018

School of Engineering and Computer Science, Oakland University

To: SECS Faculty and ECE 5140 Students

From: B. Dean, Oakland University,
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School of Engineering and Computer Science,
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Re: ECE 5140, Instrumentation and Measurements

Course Description:

Designing electrical instruments for measurement of mechanical quantities. Measurement of motion, pressure, flow, and temperature; and design issues such as: uncertainty, error, calibration, and dynamic performance will be discussed. Instrument design discussion will include: transducers, circuitry, filtering, data acquisition, and processing. With project. Previously EE 525. Credit cannot be received for both ECE 525 and EE 525. **(4)** *Prerequisites:* B.S. in Engineering or Science

Time/Location:

Tuesday, Thursday 5:30 to 7:17 p.m.
163 South Foundation

Office Hours:

Tuesday, Thursday 7:30 to 8:30 pm (**if needed**)

Text: Richard S. Figliola and Donald E. Beasley, Theory and Design for Mechanical Measurements, 6th edition, 2014. ISBN 978-1118881279

References:

- Ernest O. Doebelin, Measurement Systems - Application and Design, McGraw-Hill, 5th, 2004
- Chester L. Nachtigal, Editor, Instrumentation & Control - Fundamentals and Applications, Wiley Interscience, 2000;
- Thomas G. Beckwith, Roy D. Marangoni, John H. Lienhard V, Mechanical Measurements, Fifth Edition, Addison-Wesley 1993
- Professional Course, Measurements & Data Corporation;
- Agilent Technologies and Hewlett Packard Application Notes

Homework:

4 to 6 sets of problems

Project: Individual or team projects are assigned or selected by students

Examinations:

Two exams and a final are assigned during the semester

Course Objectives:

1. Identify the measurement system parameters and form measurement system equations to describe the system performance.
2. Understand the measurement process and characteristics of sensors measuring non-electrical quantities such as displacement, temperature, and pressure.
3. Understand the processes of interfacing of sensors measuring non-electrical quantities.
4. Understand the operation and limitations of digital instruments measuring such electric quantities as voltage, current, and frequency.
5. Verify the analytical problem solutions using PSPICE and/or MATLAB.
6. Understand ground and shielding in instrumentation.

Grading policy:

Homework:	15%	20%
Exam 1	~~20%~~	25%
~~Exam 2~~	~~20%~~	
Experiments and/or projects:	~~20%~~	30%
Final Examination:	25%	
	100%	

ABET outcomes: Engineering programs must demonstrate that their graduates have:

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs
(d) an ability to function on multi-disciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context
(i) a recognition of the need for, and an ability to engage in, life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Syllabus Changes:

The ECE department endeavors to continuously improve the graduate programs. With ECE 525 playing a pivotal role both in the M.S. in ECE and M.S. in Mechatronics degrees, the department has requested that changes be made to the course. During the Winter 2018 semester the second round of changes will be implemented. As such, changes to the syllabus maybe necessary throughout the semester. Students will be informed of any change via email and during in-class

discussions.

Sample Topics of Previous Projects:

Analysis of Errors in GPS
Automotive Sensors
Remote Sensing
Strain Gages, Technology and Applications
Optical Fiber Sensors in Automotive Applications
Machine Vision System
Turbine Engine Sensors
Hot Wire Mass Air Flow Sensor
Infrared Radiation Detectors
Automotive Piezoelectric Knock Sensors
Effect Sensors
Accelerometers and Gyroscopes
CAN Communication System in Measurements
Automotive Sensors for Safe Deployment of the Airbags
One Wire Thermometer Sensors in Automotive Lighting and Air Conditioning Systems
Battery Current Measurement with Hall Sensors
Controller Area Network in Automotive Measurements
Measurement of Radiated Susceptibility Using a Reverberation Chamber
Viscosity Measurements
LVDT in Automotive Measurements
Pyrometric Measurements
Collision Avoidance Radar
Power-train Test Cell
Accelerometers
Calibration Errors in GPS
Resistive Temperature Detectors
Linearization of an IC Hall Probe
Vehicle Speed Signal Analyzers
Hall
Tire Pressure Monitor

Related WEB sites:
www.omega.com/literature/domestic.html
www.microlink.co.uk/transducer.html
validyne.com
http://hibp.ecse.rpi.edu/~connor/education/EILinks.html
http://www.sensorsmag.com/
http://www.nist.gov/index.html

Some Sensor Related Links

- Analog Devices
- Columbia Research Labs
- Capacitec
- Endevco
- Humphrey
- Kistler Instruments
- Amphenol
- MTI Instruments Inc.
- PCB Piezotronic
- Raytek
- Silicon Designs
- Strain Measurement Devices
- Thermometrics
- Vishay Intertechnology
- Yellow Springs Instruments