ME296N Section 01: Sensor Technology and Principles
San Jose State University, Fall 2006

Instructor: Winncy Du, Ph.D., P.E. | 408-924-3866 | wdu@email.sjsu.edu | E310F

Office Hours: TR 14:20-15:20; W 10:30-11:30; W 20:00-21:00; F 15:00-16:00 or by appointment

Class Meeting: W: 17:30-20:00, E192

Credit Units: 3 units, section 02, lecture format (including case studies and projects)

Course Description: Introduction to sensors and principles, including mechanical and magnetic sensors, optical sensors, fluid sensors, chemical and bio sensors; Sensor circuitry, signal characterization & processing; Sensor design, fabrication, and applications.

Prerequisites: BSME or consent of instructor


References:

Grading Scheme:
- HW 15 % | A+ 97~100,  A 93~96.99,  A- 89~92.99
- 2 Midterm 35 % | B+ 86~88.99,  B 82~85.99,  B- 78~81.99
- Final Exam 30 % | C+ 75~77.99,  C 71~74.99,  C- 67~70.99
- Course Project 20 % | D+ 64~66.99,  D 60~63.99,  D- 56~59.99 | F Below 56

Final Exam: 17:15-19:30, Wednesday, December 13, 2006

Course Project: Students will be divided into groups (2-4 people in each group). Several case studies related to the course contents will be assigned to each group. Course project reports, in-class discussions, and presentations are required for each group.

Academic Integrity:
- Students should maintain high ethical standards/conduct in all matters pertaining to the course (e.g. exams, homework, projects; behavior in the class, treatment of classmates and instructor).
- Students are also expected to familiarize themselves with how to avoid plagiarism defined as “the use of another person’s original (not common-knowledge) work without acknowledging its source” (from “Defining and Avoiding Plagiarism: The WPA Statement on Best Practices).

Student Obligations:
- (1) Attendance at every scheduled lecture and exam is expected.
- (2) Hand in all HW at the beginning of Thursday’s class – one week after assigned. Late HW will be returned with a zero grade. Your two lowest HW grades will be dropped when calculate your final grade.
- (3) Follow the given format to prepare the course project report and presentation.
- (4) Understand the policies and procedures about add/drops, academic renewal, withdrawal, etc.
### Disability Accommodation

Campus policy in compliance with the Americans with Disabilities Act: *If you need course adaptations or accommodations because of a disability, or if you need special arrangements in case the building must be evacuated, please communicate this to the instructor as soon as possible. Presidential Directive 97-03 requires that students with disabilities register with the Disability Resource Center (DRC) to establish a record of their disability.*

### Course Goals

1. To ensure students understand the principles of various sensors in measuring physical quantities such as temperature, displacement, velocity, acceleration, force, pressure, sound, light, ionic potential, optical radiation.
2. To have students understand the basic sensing elements, transducers, and sensor signal conditioning, and operating requirements of representative sensors from each category.
3. To familiarize students with sensor design and fabrication.
4. To inform students of the latest applications and developments impacting smart sensors.

### Learning Objectives

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

1. explain the principles and applications of typical sensors (e.g. mechanical, electrical, magnetic, chemical, optical, fluid sensors);
2. state the basic structure, performance, and operation requirements of typical sensors from each category;
3. describe elementary electronic circuits which are typically used with sensors;
4. process a sensor signal and interpret it;
5. integrate a sensor with other devices like controllers, actuators, and other sensors;
6. know how to design and build a sensor;
7. understand the micro sensor fabrication techniques and processes.
## Tentative Course Topics

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<tr>
<th>Week #1  (08/24)</th>
<th>Course Information (Greensheet), Requirements, Enrollment Overview of Sensor Technology</th>
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<tr>
<td>Week #2  (08/29, 08/31)</td>
<td><strong>Ch. 1</strong> Introduction: Sensor Classification and Terminology – Transfer Function, Span, Hysteresis, Nonlinearity, Resolution, Calibration, Reliability, Uncertainty</td>
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<td>Week #3  (09/05, 09/07)</td>
<td><strong>Ch. 2 (1)</strong> Mechanical &amp; Electrical Sensors: Piezoelectric sensors (pressure gauge, accelerometers, load cells), inductive sensors, temperature sensors (thermal infrared radiation sensors, thermistors)</td>
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<td>Week #4  (09/12, 09/14)</td>
<td><strong>Ch. 2 (2)</strong> Electromagnetic Sensors (magnetoresistance, manetodiode, magnetotransistor, inductosyn, reed switches, magnetoresistors, Hall sensors)</td>
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<td>Week #5  (09/19, 09/21)</td>
<td><strong>Ch. 3 (1)</strong> Flow Sensor &amp; Measurement (Pitot tube, orifice plate, flow nozzle, viscosity, thickness, Breeze, Coriolis mass flow, drag force flow)</td>
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<td>Week #6  (09/26, 09/28)</td>
<td><strong>Ch. 3 (2)</strong> Microflow Sensors</td>
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<td>Week #7  (10/03, 10/05)</td>
<td><strong>Ch. 4</strong> Optical Sensors (CCD camera, optic fiber and waveguide, photo diode, laser diode, photoresistor, phototransistor, micro-channel photo multiplier, incremental encoder)</td>
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<td>Week #8  (10/10, 10/12)</td>
<td><strong>Ch. 5 (1)</strong> Chemical Sensors (Ions, pH, Oxygen, Nucleic Acid, Metal-Oxide, Chemiresistors, evanescent wave sensors, Optrodes)</td>
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<td>Week #9  (10/17, 10/19)</td>
<td><strong>Ch. 5 (2)</strong> Biosensors (affinity biosensors, catalytic biosensors, enzyme, glucose, urea, membrane)</td>
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<td>Week #10  (10/24, 10/26)</td>
<td><strong>Ch. 6</strong> Other Sensors (ultrasonic, radar, microwave, gyroscope)</td>
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<td>Week #11  (10/31, 11/02)</td>
<td><strong>Ch. 7 (1)</strong> Smart sensors (data acquisition, D/A and A/D converter, interface to and communication with a microcontroller).</td>
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<td>Week #12  (11/07, 11/09)</td>
<td><strong>Ch. 7 (2)</strong> Sensor integration and control</td>
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<td>Week #13  (11/14, 11/16)</td>
<td><strong>Ch. 8 (1)</strong> Sensor Materials (passive/active materials, silicon, plastics, metals, ceramics, glass)</td>
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<td>Week #14  (11/21, 11/23)</td>
<td><strong>Ch. 8 (2)</strong> Sensor Manufacturing (silicon planar IC technologies, deposition technologies, etching processes, Lithography, wet technologies)</td>
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<td>Week #15  (11/28, 11/30)</td>
<td><strong>Ch. 8 (3)</strong> Latest sensor technologies (MEMS, Nano, sensor network, data fusion)</td>
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<td>Week #16  (12/05, 12/07)</td>
<td>Course review</td>
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<td>Week #17  (12/12)</td>
<td><strong>Final exam:</strong> 17:15-19:30, Wednesday, December 13, Room: E192</td>
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