ME 3260/3260W – Measurement Techniques

**Credits and Contact Hours:** 3 Credits. Two 50 minute lectures and one 2 hour lab per week.

**Instructors:** Robert Gao, Chih-Jen Sung


**Specific Course Information:**

a. **Catalog Description:** Theory and practice of measurement including analysis and application of electromechanical transducers. Methods of measuring length, area, time, pressure, temperature, force and strain. The determination of the phase relation between a driving potential and the response of a system. The application of statistical methods to analysis of experimental data.

b. **Prerequisites:** ECE 3002, (for W version also ENGL 1010 or ENGL 1011 or ENGL 3800)

c. **Required, Elective or Selected Elective:** Required (replaced by ME 3264)

**Specific Goals:**

a. **Course Outcomes:**
   After completing ME 3260 students should be able to:
   1. Wheatstone bridges; multiple arm bridge sensitivity; strain gages and strain measurement.
   2. First-order dynamic system; determination of time constant, etc. of the first-order system.
   3. Response of second-order dynamic system; determination of coefficients for viscous damping and Coulomb damping; oscillation period as a function of swing angle and moment of inertia.
   4. Interpretation of the response characteristics of the first and second order dynamic systems;
   5. Piezoelectric effect and principle of a piezoelectric drive; hysteresis effect; positioning errors.
   6. Principles of various sensors, such as strain gages, LVDT and piezoelectric force transducer.
   7. Least squares regression.
   8. Gaussian distribution; Student T-distribution; confidence level and interval, etc.

b. **Relationship of Course Outcomes to Criterion 3 Student Outcomes:**
   a) an ability to apply knowledge of mathematics, science, and engineering:
   This course emphasizes the student's ability to apply their knowledge in mathematics, strength of materials and dynamics to the experimental phenomena associated with the indicated topics. The students are expected to utilize energy
principles, Newton's 2nd Law, statistics and differential equations as applied to mechanical systems.

b) an ability to design and conduct experiments, as well as analyze and interpret data:
   Students are heavily engaged in conducting experiments and performing the associated analysis of the experimental data. In addition, they are required to construct simple analytical models of all experiments and develop physical insight to the response of the systems.

c) an ability to design a system, component, or process to meet desired needs:
   Students’ final experiment involves designing an experiment and conducting tests.

d) an ability to function on multi-disciplinary teams: not applicable

e) an ability to identify, formulate, and solve engineering problems:
   In this course students perform the experiments, analyze the associated data, identify the fundamental system model, analyze the model and compare the response of the model to the response of the experiment.

f) an understanding of professional and ethical responsibility: not applicable

g) an ability to communicate effectively:
   Students are engaged in written communication through laboratory reports. This aspect is taken into account in grading all reports and exams.

h) the broad education necessary to understand the impact of engineering solutions in a global and societal context: not applicable

i) a recognition of the need for, and an ability to engage in life-long learning:
   The need for life-long learning is emphasized with respect to new instrumentation, modern digital data acquisition systems and the continual enhancement of the laboratory to include up to date equipment.

j) a knowledge of contemporary issues: not applicable

k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice:
   Students learn to use modern data acquisition techniques necessary in experimental research.

**Topics Covered:**

- Visual interface construction using LabVIEW software
- Principles of strain gages and strain measurement
- Time response of first order systems, theory and experiments
- Time response of second order systems, theory and experiments
- Piezoelectric positioning drive
- Design of experiments
- Statistics (including gaussian distribution, confidence intervals, linear regression and T-Distributions)