ME 3263 – Introduction to Sensors and Data Analysis

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

Instructors: Kevin Murphy

Textbook: *Theory and Design for Mechanical Measurements*, Fourth Edition, R.J. Figliola, D.E. Beasley, Wiley, 2005

Specific Course Information:

a. Catalog Description: Introduction to the design and behavior of common sensors, highlighting their proper use and physical limitations. In the lab, each type of sensor is used in a practical engineering problem, with data being taken via data acquisition software. Data analysis techniques, including Gaussian statistics, uncertainty analysis, frequency domain studies, are also covered and used on the acquired data.

b. Prerequisites: ME 2233, PHYS 1502Q, CE 2110

c. Required, Elective or Selected Elective: Required

Specific Goals:

a. Course Outcomes:

After completing ME 3263 students should be able to:

1. Conduct a simple statistical analysis on a data set
2. Conduct an uncertainty analysis of a data set
3. Understand the physical principles behind certain common sensors (e.g., strain gages) and be able to use the sensor with the associated instrumentation to measure a physical quantity.
4. Understand the limitations of a discretely sampled signal, particularly as they effect frequency domain results

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 ability to apply knowledge in mathematics, physics, chemistry and thermodynamics to the experimental phenomena associated with the indicated topics. The students are expected to utilize conservation laws for mass, momentum and energy as applied to thermal and fluidic systems.

b) an ability to design and conduct experiments, as well as analyze and interpret data:
Students are heavily engaged in conducting a series of experiments and the associated analysis of the experimental data. Additionally, they are required to construct simple analytical models of some experiments and compare the numerical results with the measured data.

c) an ability to design a system, component, or process to meet desired needs:
An open-ended design project is included toward the end of the semester.

d) an ability to function on multi-disciplinary teams:

Students are required to work in groups of two to four person teams and must learn to work cohesively in all aspects of the experimental process. Though the teams are not truly multi-disciplinary, the students are exposed to principles of group dynamics as they work though the various lab experiments.

e) an ability to identify, formulate, and solve engineering problems:
Students are given latitude in the set-up and conduct of the experiments and the range of parameters they select in exploring the experimental phenomena.

f) an understanding of professional and ethical responsibility:
Professional responsibility is modeled in each student's efforts within the group.

g) an ability to communicate effectively:
Students are engaged in written communication through laboratory and design project 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 enhancing of the laboratory to include state of the art 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 digital data acquisition techniques necessary in experimental research.

Topics Covered:

- Analog/Digital data acquisition
- Signal sampling
- Uncertainty analysis
- Temperature measurement
- Radiation
- Pressure measurement and calibration
- Flow rate measurement
- Species concentration and gas discharge
- Viscosity
- Unsteady flows
- Transient systems and measurements