**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***: Ryan Cooper and Chengyu Cao

***Textbook***: *None Required*

***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 1230 or 1402Q or 1502Q or 1530; 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:

1. An ability to identify, formulate, and solve engineering problems by applying principles of engineering, science, and mathematics.
   *This course emphasizes the student's ability to apply their knowledge in physics, strength of materials, thermodynamics, 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. 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.*
2. An ability to apply both analysis and synthesis in the engineering design process, resulting in designs that meet desired needs.
   *An open-ended design project is included toward the end of the semester. 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.*

3. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
   *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.*
4. An ability to communicate effectively with a range of audiences.
   *Students are engaged in written communication through laboratory reports. This aspect is taken into account in grading all reports and exams.*
5. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
   *Professional responsibility is modeled in each student's efforts within the group.*
6. An ability to recognize the ongoing need for additional knowledge and locate, evaluate, integrate, and apply this knowledge appropriately.
   *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. Students learn to use modern data acquisition techniques necessary in experimental research.*
7. An ability to function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty.
   *Students are required to work in groups of two person teams and must learn to work cohesively in all aspects of the experimental process. The students are exposed to principles of group dynamics as they work though the various lab experiments.*

***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)