ME 3264 – Applied Measurements Laboratory

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

Instructors: Wilson Chiu and Bryan Weber

Textbook: *Writing in Engineering: A Brief Guide*, Robert Irish, Oxford, 2016

Specific Course Information:

a. Catalog Description: Application of fundamental measurement techniques developed in ME 3263 to various mechanical systems and processes. Hands-on laboratory experiences include measurements in energy conversion, solid mechanics, dynamics, and fluid and thermal sciences, as well as statistical methods to analysis of experimental data.

b. Prerequisites: ME 2234 and ME 3263

c. Required, Elective or Selected Elective: Required

Specific Goals:

a. Course Outcomes:

After completing ME 3264 students should be able to:

1. Understand the working principle of various sensors and use them for measurements of physical parameters.
2. Model dynamic systems using first-order and second-order models, interpret their responses, and understand the basic principle of feedback controllers for system control.
3. Understand basic concepts in statistical data analysis, confidence interval, curve fitting, regression, and error propagation, and apply them to experimental data analysis.
4. Understand basic principle of energy conversion and power generation from conventional and alternative sources.

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 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.
2. An ability to apply both analysis and synthesis in the engineering design process, resulting in designs that meet desired needs.
   A set of connected laboratories are conducted that require students to combine data from multiple experiments and simulations to evaluate appropriate fluid system design.
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 and design project reports. Students engage with writing activities in the classroom to develop further communication skills for audiences from professional engineers to the public.
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 enhancing of the laboratory to include state of the art equipment. Students learn to use modern digital 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 to four 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)