## MECH3830 Laboratory

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<th>Course Code: MECH3830</th>
<th>Course Title: Laboratory</th>
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<tr>
<td>Required Course Or Elective Course: required</td>
<td>Terms Offered (Credits): Spring (3 credits)</td>
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<td>Faculty In Charge: Qing CHEN</td>
<td>Co-Requisites: LANG4034</td>
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**Course Structure:** Lecture: 1 days per week, 1.8 hours; Tutorial: 1 day per week, 1.3 hour; Lab: 1 day per week, 3 hours

**Textbook/Required Material:**
1. Lab Manual
2. Class notes

**Bulletin Course Description:**
This is a required course for the BEng in Mechanical Engineering. It is an introductory laboratory course to provide training in experimental techniques and laboratory procedures, data acquisition, analysis, creative and innovative design of experiments, and technical communication.

**Course Topics:**
1. Introduction to writing engineering laboratory reports and presentations.
2. Basic concepts and terms: dimensions, units and standards; significant figures, precision, accuracy, and bias; resolution, sensitivity, and linearity.
3. Design of Experiments: design of experiments; test matrix and test sequence; calibration.
4. A/D conversion; data acquisition and sampling theory; quantization and discretization; aliasing and leakage.
5. Analysis of experimental data: method of least squares; Fourier analysis; error analysis.
6. Measurement principles and basic instruments: flow sensors, strain gauges, displacement sensors, temperature sensors, vibration and motion sensors.
7. Case studies of measurements: flow, displacement, temperature, vibration, motion, refrigeration and air-conditioning, viscoelastic properties and fracture toughness measurements.

**Lab Content:**
1. Data acquisition and data analysis
2. Temperature measurements – thermocouple
3. Free and forced vibration measurements
4. Strain measurement and stress concentration
5. Flow through a Venturi meter
6. Pin-jointed frame with buckling member
7. Convective heat transfer
8. Refrigeration and air conditioning
9. Boundary layer
10. Measurement of fracture toughness

**Course Objectives:**
1. To introduce the basic understanding of physical measurements, the working principles of various transducers, and the knowledge of signal processing and data analysis. (P-O1, P-O3)
2. To develop skills to design and analyze measurement systems. (P-O3)
3. To develop creative thinking and diagnostic skills. (P-O5)
4. To develop proficiency in data analysis, presentation and technical communication. (P-O1)
5. To provide a platform for practice in different engineering measurements. (P-O1, P-O3)

| Course Outcomes: (correlated course objectives and program outcomes) | On successful completion of this course, students are expected to be able to:
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<tr>
<td></td>
<td>A. Explain key concepts of physical measurements, and the working principles of various transducers, signal processing and data analysis. (1) (POC1, POC2)</td>
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<td>B. Design and analyze measurement systems. (1, 2) (POC1, POC2, POC3)</td>
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<td>C. Apply a range of diagnostic methods and approaches to analyze and determine creative solutions to a variety of engineering measurement problems. (3) (POC2, POC3, POC4, POC7)</td>
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<td>D. Conduct effective data analysis, and present findings using appropriate technical terminology. (4) (POC3, POC6, POC7)</td>
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<td>E. Practice different engineering measurements in a wide variety of scenarios. (3, 5) (POC1, POC2, POC3, POC4, POC6, POC9)</td>
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<th>Assessment Tools: (correlated course outcomes)</th>
<th>Homework assignments – 15% (A-E)</th>
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<td>Lab performance, assignments, and reports - 60% (A-E)</td>
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<td>Mid-term exam – 25% (A-E)</td>
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**BEng in Mechanical Engineering (4-year program)**

**Program Objectives:**

P-O1. Be able to communicate and perform as an effective engineering professional in both individual and team-based project environments,

P-O2. Have an international outlook with clear perspectives on the Pearl River Delta and Greater China,

P-O3. Be able to research, design, develop, test, evaluate and implement engineering solutions to problems that are of complexity encountered in professional practice and leadership,

P-O4. Clearly Consider the ethical implications and societal impacts of engineering solutions,

P-O5. Continuously improve through lifelong learning.

**Program Outcomes:**

POC1. ability to identify and formulate problems in multidisciplinary environment with an understanding of engineering issues and constraints;

POC2. ability to design and conduct experiments as well as analyze and interpret data;

POC3. ability to apply knowledge of mathematics, science, and engineering for problem solving in mechanical engineering and related sectors or for further education in a research career;

POC4. ability to develop specification and to design system, component, or process to meet needs;

POC5. ability to understand the manufacturability, maintainability, and recyclability of engineering system and components;

POC6. ability to use modern engineering tools, techniques, and skills in engineering practice;

POC7. ability to communicate effectively;

POC8. ability to function in multi-disciplinary teams and provide leadership;

POC9. broadly educated with an understanding of the impact of engineering solutions on issues such as economics, business, politics, environment, health and safety, sustainability, and societal context;

POC10. clear understanding of professional and ethical responsibilities;
POC11. recognition of the need for life-long learning and continuing education;
POC12. international outlook with knowledge of contemporary issues.