ME 3057 Experimental Methods Laboratory (Required)

Catalog Description: ME 3057 Experimental Methods Laboratory (2-3-3)

Prerequisites: COE 3001 Mechanics of Deformable Bodies and ME 3340 Fluid Mechanics

Corequisites: ME 3017 System Dynamics, ME 3345 Heat Transfer, and MATH 3670 Probability and Statistics with Applications

Introduction to basic instrumentation and experimental methodology used in mechanical engineering, including calibration, use, precision, and accuracy. Consideration of errors, precision, and accuracy in experimental measurements. Preparation of technical reports.

Textbook: *Laboratory Manual for ME 3057 Experimental Methodology*, The George W. Woodruff School of Mechanical Engineering.

Sheldon Jeter and Jeffrey Donnell, *Writing Style and Standards in Undergraduate Reports*, 2nd Edition, College Publishing, 2011.

Topics Covered:

1. Teaming, planning, and collaboration.
2. Technical report writing.
3. Accuracy, precision, and error propagation; statistical uncertainty analysis of measured physical quantities; estimation of a pendulum natural frequency.
4. Characterization of second-order mechanical systems.
5. Machine diagnostics (time domain and frequency domain representation of data, FFT analysis and aliasing).
6. Acoustics (consideration of sound pressure levels and use of the anechoic chamber).
7. Introduction to microcontrollers (consideration of microcontroller architecture, applications, and programming).
8. Open and closed-loop control using a microcontroller (consideration of calibration, resolution, and sensitivity; magnetic encoder and PWM; consideration of feedback control).
9. Thermal measurements (practice in the use of thermocouples, RTDs, and heat flux sensors) for transient and steady-state heat transfer problems.
10. Stress, strain, and force measurements (consideration of resonance and damping; practice with load cells, strain gauges and rosettes, and LVDTs).
11. Viscosity measurements (use of various viscometers).
12. Optics (laser interferometric and diffractive sensors).

Course Outcomes:

Outcome 1: To apply in practice the logical steps in experimentation: conceptualization, planning, execution, data acquisition, analysis, interpretation, conclusion, and reporting.

1.1 Students will demonstrate proficiency in planning and performing experiments, data acquisition, and in writing laboratory reports. Knowledge and understanding of data acquisition from sensors used in the many fields of mechanical engineering is tested. Proficiency with varieties of signal conditioning and filtering and spreadsheet-based data analysis will be demonstrated.

Outcome 2: To develop the ability to work in teams.

2.1 Students will successfully perform experiments and prepare reports individually and in teams. A standard format is used for reports, graphs, charts, and sample calculations.

Outcome 3: To practice the principles of operation, calibration, and use of basic instrumentation.

3.1 Students will demonstrate an understanding of the operating principles, calibration, and use of basic instrumentation.

Outcome 4: To apply concepts of sensitivity, resolution, random and systemic errors, precision, accuracy, and uncertainty in experimental measurements.

4.1 Students will demonstrate an understanding of sensitivity and resolution, random and bias error, and precision and accuracy in evaluating data. Estimation of uncertainty error will be performed using statistical analysis.

Correlation between Course Outcomes and Student Outcomes:

ME 3057											
	Mechanical Engineering Student Outcomes										
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Outcome 1.1	X	X		X			X				X
Course Outcome 2.1	X			X	X		X				X
Course Outcome 3.1	X	X			X						X
Course Outcome 4.1	X				X						X

GWW School of Mechanical Engineering Student Outcomes:

(a) an ability to apply knowledge of mathematics, science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

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