ME 4056 Mechanical Engineering Systems Laboratory (Required)

Catalog Description: ME 4056 Mechanical Engineering Systems Laboratory (2-3-3)

Prerequisites: ME 3017 System Dynamics, ME 3057 Experimental Methodology Laboratory, ME 3345 Heat Transfer, and MATH 3670 Probability and Statistics with Applications

Measurement and analysis of mechanical, acoustic, manufacturing, thermodynamic, fluid, and heat transfer phenomena. Emphasis on data acquisition, reduction, analysis, and report preparation.

Textbook: Lab Manual and Lecture Notes for *ME 4053a Thermal Energy and Fluids Laboratory*, The George W. Woodruff School of Mechanical Engineering.
Lab Manual for *ME 4053b Mechanical Systems Lab*, The George W. Woodruff School of Mechanical Engineering.

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

Topics Covered:

1. Principles and standard practice of written and graphical reporting.
2. Oral and visual presentation techniques.
3. Experimental statistics including regression and significance tests.
4. Teaming, planning, and collaboration.
5. Investigation of mechanical behavior, such as structural vibration.
6. Investigation of acoustic phenomena, such as propagation and attenuation.
7. Investigation of simple open- and closed-loop control systems.
8. Investigation of thermodynamic properties, such as vapor pressure, and thermal systems, such as refrigerators and heat pumps.
9. Investigation of internal and/or external fluid flow with pressure, thermal, and laser-Doppler sensors.
10. Investigation of heat transfer, such as forced convection, heat exchangers, and radiation.
11. Investigation of fluid machines, such as the centrifugal pump, jet impingement, and/or major losses.
12. Estimation of bias uncertainty by error propagation analysis.

Course Outcomes:

Outcome 1: Students will learn the theory and techniques used in the experimental investigation of a variety of mechanical engineering systems.

1.1 Students will learn theoretical background in several subject areas with an emphasis on how the theory can be tested experimentally.

1.2 Students will apply the theory and compare predicted behavior with experimental findings.

Outcome 2: Students will learn and gain practice in fundamental concepts of experimental engineering including the use of transducers, data acquisition, signal processing, experimental statistics, and basic experimental planning.

2.1 Students will use state-of-the-art equipment to actuate and sense physical systems, gather analog and/or digital signals, and to transfer this data to a PC using A/D and DAQ devices.

2.2 Students will process their acquired data using signal processing, regression analysis, averaging, and other statistical methods to derive experimental results with appropriate confidence intervals.

Outcome 3: Students will further develop their ability to work professionally and ethically, both as individuals and as members of a team.

3.1 Students will successfully perform experiments and plan and accomplish report preparation in teams.

3.2 Students will conduct themselves professionally and exercise the highest ethical standards in taking, recording, and processing their measurement data.

Outcome 4: Students will further develop their ability to communicate technical results in oral and written form.

4.1 Students will prepare written reports of research data and findings with substantial graphical content.

4.2 Students will conduct oral presentations of research data and findings using visual aids, including text and graphics.

4.3 Students will implement standard laboratory notebook practices in maintaining and documenting all aspects of their experiments.

Correlation between Course Outcomes and Student Outcomes:

ME 4056											
	Mechanical Engineering Student Outcomes										
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Outcome 1.1	X										
Course Outcome 1.2	X										
Course Outcome 2.1		X									X
Course Outcome 2.2	X	X									X
Course Outcome 3.1				X							
Course Outcome 3.2						X					
Course Outcome 4.1							X				
Course Outcome 4.2							X				
Course Outcome 4.3							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

Prepared by: Al Ferri and Zhuomin Zhang