



ME 495: Mechanical and Thermal Systems Lab – Spring 2014

Department of Mechanical Engineering,
San Diego State University

Professor: Sam Kassegne, PhD, PE



Course Description

Data acquisition theory, instrumentation, sensors, data reduction, statistical and uncertainty analysis, and design of experiments. Experience in designing, performing, and reporting experiments on mechanical and thermal systems, mechanisms, vibrations, structures, thermodynamics, heat transfer.

Prerequisites

Courses: ME 314, 330, 351, 452

Topics: Engineering Thermodynamics, Fluid Mechanics, Engineering Materials, Heat Transfer.

Textbook

Mechanical Measurements, Bechwith, Marangoni and Lienard, 5th or 6th edition.

Prerequisites by Topic

- 1 Engineering thermodynamics
- 2 Fluid mechanics
- 3 Engineering materials

Course Objectives:

To provide students with experience in designing, performing, and reporting experiments on mechanical and thermal systems, mechanisms, vibrations, structures, thermodynamics, and heat transfer. More specifically, the objectives are:

1. Ability to apply knowledge of mathematics, science, and engineering.
2. Ability to design and conduct experiments, as well as analyze and interpret data.
3. Ability to function on multi-disciplinary teams.
4. Ability to identify, formulate, and solve engineering problems.
5. Understanding of professional and ethical responsibility.
6. Ability to communicate effectively.
7. Recognition of the need for an ability to engage in life-long learning.
8. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
9. Ability to apply advanced mathematics through multivariate calculus and differential equations.
10. A familiarity with statistics and linear algebra.

11. Ability to work professionally in both thermal and mechanical systems areas including the design and realization of such systems.
12. Knowledge of chemistry and calculus based physics with depth in at least one of these

Topics Covered:

1. Process of Measurement Overview
2. Standards and Dimensional Units of Measure
3. Assessing and Presenting Experimental Data
4. The Analog Measurand: Time-Dependent Characteristics
5. The Response of Measuring Systems
6. Theory and Review of Sensors.

Grading

Homework	10%	
Lab Reports	30%	
Mid-term Exam		35%
Final Design Presentation	25%	

Homework

Homework will be assigned periodically and will be due as described in the assignment. Late homework will not be accepted. Solutions to the homework will be posted, if applicable, after the assignment is turned in.

Lab Reports

A lab report is required for each lab exercise. Some lab reports will be done individually; some will be done in groups. Each student in the group must contribute a portion of work to group lab reports. The reports will be typed, double-spaced, minimum font size of 11. Lab reports **shall follow the enclosed format**. Lab reports are due at the start of the following class. Each report is worth 100 points. Late reports will be given reduced grades. Reports handed in up to one week late receive a maximum score of 70. Reports handed in between the one week late to two weeks late receive a maximum score of 50. Lab reports will not be accepted after two weeks from the date that they are due.

Lab Procedures

The experimental procedures for each lab are posted online at the class website and it is expected that they will be reviewed before the day of the lab.

Mid-Term Exam

The exam will cover material from lectures, homework assignments and experiments.

Office Hours

Monday & Wednesday: 1:00 PM – 4:00 PM.

Room: PS – 127.

ME495 Lab Report Format

The ability to communicate both orally and in writing is of great importance to professional engineers. You will spend a good part of your time explaining your ideas to your superiors and technicians under your supervision. The preparation of laboratory reports provides you an opportunity to improve your communicative and writing skills.

A technical report has a certain standard format that must be adhered to. Additionally, the style of writing in a technical report is different than that of a magazine or newspaper article. Colloquial language is not used; instead, explain your ideas in simple and grammatically correct English using clear **short** sentences. Get to the point directly. Do not elaborate or embellish with wordy descriptions. It is a well-established tradition in scientific writing to report in the past tense and in the third person. Avoid using “I” and “we”.

Title Page – (5 points total)

The title page should indicate:

- The name of the university, course and the department in which the course is offered. (1)
- The title of the experiment performed. (1)
- Your name and the names of the people in your group and your group number. (1)
- The name of the instructor to whom the report is submitted. (1)
- The date of submission. (1)

Table of Contents – (5 points total)

The TOC should indicate:

- The various topics described below and the page numbers in which they are contained. (2)
- After each topic, state the person responsible for generating that portion of the work. (3)

Objective of the experiment – (10 points total)

- State the purpose or the goals of the experiment and what you expect to accomplish by performing the experiment. (4)
- Describe in detail the theory and principle behind the experiment. Include the equations you will be using. (4)
- Properly define all symbols and acronyms. (2)

Equipment – (10 points total)

- List the equipment used in the experiment. (5)
- Describe the specific characteristics of each piece (e.g., capacity and accuracy of the reading). (5)

Experimental Procedure – (15 points total)

- Write, **in your own words**, in paragraph format, the actual experimental procedure followed. Do not copy from the experimental guide. The procedure should reflect the facilities available at the laboratory where the experiment was conducted and any deviations that you did (10).
- Reference the experimental guide that you used to perform the experimental process (5).

Experimental Results – (15 points total)

- In this part of your paper, raw data taken during the course of the experiment should be presented in appropriate form such as tables, graphs or figures. **See the attached.** These must be numbered and supplemented by captions that briefly describe what the figures are about. Miniature or over-enlarged graphs should be avoided. Remember to plot the independent variables along the abscissa, and the dependent variables along the ordinate.

Discussion of Results – (15 points total)

- Discuss the experimental data obtained (5).
- Discuss the possible sources of the experimental error and how it affected the results (10).
- Provide a correlation or comparison of your experimental results with those that you predicted or expected from theories or theoretical analysis (provided in the “**Objective of the Experiment**” Explain any discrepancy (5).

Lab Guide Questions – (10 points total)

- Answer any questions posed in the lab guide in paragraph format; write the question asked and then the answer in the same order they were asked in the guide

Conclusion – (10 points total)

Present what you can conclude from the results of the experiment and the analysis applied in the previous discussion. You may add your personal opinion whether the experiment served the goal of reinforcing your knowledge and skills as an engineer.

References – (5 points total)

Cite any texts or other sources you consulted while performing the exercise or report. (at the very least the experimental guide will be here).

Table 1 Calculations for Burst Pressure (BP)

BP (psi)	PDF _{BP} (psi)	DEV _{BP} (psi)	Mean _{BP} (psi)	STDDEV _{BP} (psi)
48	0.009888	16.4	64.4	9.72
55	0.025714	9.4		
58	0.033045	6.4		
59	0.035174	5.4		
64	0.041008	0.4		
66	0.040490	1.6		
67	0.039600	2.6		
72	0.030234	7.6		
75	0.022647	10.6		
80	0.011323	15.6		

Figure 1 Probability Distribution Function (PDF) for Burst Pressure (BP)