University Of California, Berkeley
Department of Mechanical Engineering

Syllabus for

ME 103 – Experimentation and Measurements (4 units)

Lectures (1 section, 3h/wk): M&W&F 10:10-11a, 105 North Gate
Labs (6 sections, each 3h/wk): T&Th 8-11a, W&F 11a-2p & 2-5p

INSTRUCTORS

Asst. Prof. S.A. Mäkiharju
6119 Etcheverry Hall, Office hours: M&W 1-2p or by appointment
Email: makiharju@berkeley.edu (For course related questions, first post them on Piazza in bCourses.)

Lecturer Marcel Kristel, marcelk@berkeley.edu
6173 Etcheverry, Office hours: W 2-4p and F by appointment

GSIs

Daniel Grieb, djgrieb@berkeley.edu, office hours: Tuesdays 4-5 pm, Hesse GSI Room
Alexander Baker, alexbaker@berkeley.edu, office hours: ~~Wednesdays~~ Mondays 1-2pm, Hesse 122
Minhao Zhou, minhao.zhou@berkeley.edu, office hours: Tuesdays 12:30-1:30 pm, Hesse lounge
Jason Parker, jtparker@berkeley.edu, office hours: Mondays 4:30-5:30pm, Hesse 122

GRADING

- Lab participation: should attend all. (Regardless of reason, to pass 9 of 12 required.)
- Homework (20%)
- Technical Communications – lab reports and one oral presentation (55%)
- Peer-evaluation (5%)
- In-Lab Practical Exam (5%)
- Final Written Exam (15%) OPEN BOOK => CAN BRING THE PRINTED TEXTBOOK (NO TABLETS etc.)

CATALOG DESCRIPTION

This course introduces students to modern experimental techniques for mechanical engineering, and improves students' teamwork and communication skills. Students will work in a laboratory setting on systems ranging in complexity from desktop experiments with only a few instruments up to systems such as an internal combustion engine with a wide variety of sensors. State-of-the-art software for data acquisition and analysis will be introduced and used throughout the course. The role of error and uncertainty, and uncertainty propagation, in measurements and analysis will be examined. Design of experiments will be addressed tough examples and homework. The role and limitations of spectral analysis of digital data will be discussed. Working as part of an effective team will be emphasized in all aspects of the laboratory exercises, including set-up, data collection, analysis and report writing.

COURSE PREREQUISITES

MEC85, ME40, EE 100/EE 49/EE16A.

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL

Beckwith T.G. and Marangoni, R.D., 2007, "Mechanical Measurements, 6th edition", Pearson Prentice 5th edition also acceptable.

Additional: lecture slides and handouts will be provided for free.

COURSE OBJECTIVES

Introduce students to modern experimental techniques for mechanical engineering; provide exposure to and experience with a variety of sensors, including those to measure temperature, displacement, velocity, acceleration and strain; examine the role of error and uncertainty in measurements and analysis; exposure to and experience in using commercial software for data acquisition and analysis; discuss the role and limitations of spectral analysis of digital data; provide experience in working in a team in all aspects of the laboratory exercises, including set-up, data collection, analysis, technical report writing and oral presentation.

DESIRED COURSE OUTCOMES

By the end of this course students will have experienced the many stages in designing, planning and conducting experiments, and eventually reporting the results both orally and in writing in a team environment. They will have also have seen the importance of fundamental science and complex engineering skills that are needed in engineering. Equally important, they will work in a team environment where the success of the team depends on the success of every team member. Specifically, by the end of the course students should: Know how to use, what can be measured with, and what the limitations are of the basic instruments found in the laboratory; know how to write a laboratory report and communicate their results in the form of an oral presentation; understand the relevance of uncertainty in measurements, and the propagation of uncertainty in calculations involving measurements; know how to program effectively using LabVIEW for data acquisition and analysis.
In brief: Prepare students for experimental work, or its management, in academic or industrial labs.

TOPICS COVERED

- Data acquisition and control software: LabVIEW
- Sensors: I/O requirements, calibration, limitations
- Dynamic analysis of signals: spectral analysis, bandwidth, frequency response
- Elementary statistics: normal and t-distributions, confidence intervals
- Uncertainty analysis: techniques for propagation of uncertainty
- Teams: forming, expectations, potential problems
- Technical communication: written, oral
- Design of experiments
- Measurements for complex systems

CONTRIBUTION OF THE COURSE TO MEETING THE PROFESSIONAL COMPONENT

Provides a platform where students work on increasingly complex measurement systems as teams, make formal oral presentations and submit complete technical reports. Provides the flexibility and structure to implement experiments designed by the students testing varying configurations and setups.

RELATIONSHIP OF THE COURSE TO ABET PROGRAM 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 function on multi-disciplinary teams
(d) an ability to identify, formulate, and solve engineering problems
(e) an understanding of professional and ethical responsibility
(f) an ability to communicate effectively
(g) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(h) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(i) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.