ME 360: MEASURMENT AND INSTRUMENTATION

(Revised 8/16/10)

CATALOG DATA:

ME 360 – MEASUREMENT AND INSTRUMENTATION: F 4 credits (3 lecture, 1 lab)
Theory and application of engineering measurement concepts including: temperature, pressure, displacement and flow sensing; calibration; statistical and uncertainty analysis; sampling; signal conditioning; 1st and 2nd order dynamic response; emphasis of computerized data acquisition and feedback-based actuation and control.

TEXTBOOK:

Wheeler, Anthony J., Ganji, Ahmad R., "Introduction to Engineering Experimentation" **3rd** Edition, Pearson / Prentice Hall

INSTRUCTOR:

Dr. Stephen W. Sofie, Roberts 201E, 994-6299, 994-6292 (fax), ssofie@me.montana.edu
Office Hours: As posted outside of my office.
The use of e-mail is encouraged for communication any time.

E-MAIL POLICY:

According to MSU policies and procedures, your MSU student e-mail is the official university means of communication with students. Students are expected to check their email no less frequently than twice a week in order to stay current with University-related communications. Students have the responsibility to recognize that certain communications may be time-critical. Failure to check for messages and failure to receive messages due to full mailboxes or auto-forwarded email are not acceptable excuses for missing official University communications. Students may auto-forward email to an outside email client at their own risk.

ENTRANCE EXPECTATIONS:

PREREQUISITE: EE 250, ME 320 and EM 253 for ME majors.
COREQUISITE: I&ME 350; ME 324 for MET majors.

The entrance expectations include an understanding of basic statistics, solid mechanics, thermodynamics, fluid mechanics, heat transfer, materials science, mathematics, circuit theory, and computer software skills

COURSE OBJECTIVES:

The purpose of ME 360 is to introduce students with the theory and methods for conducting experimental work in the laboratory or industrial setting. Topics covered include data handling, statistics, measurement errors, uncertainty analysis, dynamic systems and system response, basic LabVIEW training, experimental planning, electric circuits (Wheatstone Bridge), computerized data acquisition, calibration, temperature measurement, pressure & flow measurements, displacement measurement, piezoelectrics (ultrasonic NDE, pressure, accelerometer measurements), and strain gages (load cells).

GENERAL INFORMATION:

Measurements and Instrumentation techniques are among the most important tools used by Engineers and Scientists. Experimental methods utilize measurement systems and various types of instrumentation to design, evaluate and control a variety of systems and testing equipment. Standard engineering practice includes validation testing - using measurement and instrumentation techniques - to confirm engineering analysis results. An engineering test is often the only substitute, and many times the fastest option for analysis in cases where a purely analytical approach would be difficult, inaccurate or impossible. The objective of this course is to give students baseline knowledge of measurements & instrumentation theory and practice, in order to support their present and future needs in engineering testing and research. This course will involve the incorporation of testing theory and hands on experimental setup & testing to enable the students with the ability to setup, perform, and properly analyze experimental results.

The curriculum contains aspects of solid mechanics, fluid mechanics, dynamics, mathematics, electronics, materials science, and other engineering subjects. While many theoretical mathematical derivations often utilize calculus, a stronger understanding and application of algebra is essential to arrive at the correct results.

CLASS SCHEDULE:

Lecture, ME360-01; 9:30 -10:45 AM, Tuesday & Thursday, ROBH 301
Laboratory, ME360-02; 10:00 - 11:50 AM, Wednesday, EPS 008F
Laboratory, ME360-04; 4:10 - 6:00 PM, Wednesday, EPS 008F
Laboratory, ME360-05; 1:10 – 3:00 PM, Wednesday, EPS 008F

COURSE FORMAT:

ME360 consists of separate Lecture (twice weekly) and Lab (once weekly) meetings. The lecture provides measurement system background & theory, and the lab provides an opportunity to apply methods in a hands-on laboratory environment. Scheduling of lecture topics has been coordinated with lab exercises to provide "just in time" delivery of subject matter. A good cross-section of commonly used transducers and measurement systems will be discussed in lecture and utilized in laboratory exercises.

Proper instrument usage is emphasized in the laboratory, as is the proper acquisition, handling and processing of gathered data. There is a significant communication emphasis since all experimental results are documented in formal laboratory reports. Both manual and computerized data acquisition methods will be utilized, and appropriate computer software programs will be used.

COURSE OUTCOMES:

Upon completion of this course, students will have demonstrated an understanding of basic LabVIEW programming skills while understanding the function, operation, response behavior and sources of error in common transducers and sensors for measuring temperature, displacement, strain, and pressure. The student will be able to apply statistics and uncertainty analysis to measurement systems and acquired data. Furthermore, the student will establish competence in laboratory reporting in addition to the proper instrumentation of test systems and appropriate capture and interpretation of experimental test data.

SPECIAL NEEDS INFORMATION:

Students with special needs or requiring special accommodations should contact the instructor or the campus Disabled Student Services Office at the earliest opportunity.

STUDENT CONDUCT

Students are expected to conduct themselves in accordance with the MSU Student Conduct Guidelines (http://www2.montana.edu/policy/student_conduct/), including the areas of academic honesty, behavior, and responsibilities.

ASSESSMENT AND EVALUATION:

The course outcomes will be evaluated, and the final letter grades will be based, on the following criteria:

Homework	15%
Midterm 1, 2, & 3	50%
Lab Reports	35%

(Attendance is mandatory for all laboratories otherwise an incomplete will be posted)

Note: no grading curve is used and student final grades on not based on the respective performance of peers

Examinations missed due to unexcused absences cannot be made up. If you know in advance that you must miss any exam, notice must be made PRIOR to the week of the exam and options will be discussed with you. Three equally weighted midterms will be administered according to the class schedule with the final midterm scheduled according to the registrar. Point totals required to receive a particular letter grade will be determined by the instructor at the conclusion of the course. **Plus and minus grading will be used at the discretion of the instructor**. Inappropriate conduct, late arrival to lecture/labs, poor group performance, and cheating or plagiarism will affect the final grade.

A: 90 – 100%
B: 80 – 90%
C: 70 – 80%
D: 60 – 70%
F: <60%

The course objectives may be evaluated by means of midterm and semester end alumni surveys in the form of an un-graded quiz and/or questioner.

The Board of Regents C- Grade Policy is presented on-line at http://www.montana.edu/wwwcat/academic/acad6.html. It is in the 2006-2008 Catalog on Page 61. This Minimum Competency Requirements policy affects new freshmen, new transfers, and continuing students in different ways.

ME, MET, and IE students who are exempt from the Board of Regents C- policy must understand that a D- grade is not considered passing by the M&IE Department. A grade of D- in any required course must be repeated, with a D or higher grade earned, for it to apply to degree requirements.

COURSE WEB SITE: For course information, laboratory/course scheduling, and homework assignments see **http://www.coe.montana.edu/me/faculty/sofie/**

LABORATORY FORMAT, RULES, AND PREPARATION:

Labs meet weekly per the semester Laboratory schedule found on the course web site. Handouts describing each lab exercise will be available on the web, the week prior to the lab exercise. A short laboratory lecture will be given prior to each laboratory exercise by the laboratory instructor and/or graduate teaching assistant. Each student is responsible for preparation prior to the beginning of the lab period.

Lab Sections will be divided into groups of 3-4 students for al laboratory experiments, and students will remain within the same group for the entirety of the class. Experiments generally involve setting up apparatus and gathering data in a cooperative group effort. For most labs, data can be obtained well within the two hour lab period. Once all required data is acquired, students may leave the laboratory upon consent of the instructor. Laboratory reports will be completed as a team activity and a single grade will be given to the group. Each group member will rotate the authoring of the laboratory report according to the laboratory report guidelines. Laboratory reports will be collected at the beginning of the lab period following execution of the experiment. No reports will be accepted after that. Graded reports will be available about one week later.

LABORATORY SAFETY:

Come to the laboratory dressed for work, no loose and baggy clothing, no open toe shoes, sandals, or bare feet. As a professional engineer or scientist, laboratory safety will be one of your primary responsibilities, practice it now. Failure to demonstrate standard laboratory safety protocols can directly impair your lab performance and your final grade. Additional safety measures for the laboratory and group projects will be detailed during the lab sections.