

**Lecture Instructor:**

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Lecture TA: To be announced

**Lab Instructor:**

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**Course Objectives:**

The primary objective of this course is to provide an introduction to several of the topics that a mechanical or aerospace engineer will need to master in order to successfully design experiments and interact with measurement systems. In addition to an introduction to several common physical measurement systems and sensors (like an accelerometer or strain gage) modern methods of computerized data acquisition, common statistical techniques, experimental uncertainty analysis and guidelines for planning and documenting experiments will be covered. Many of the subjects covered are the primary subject of complete courses, books or major technical bodies of work. This course is designed to provide a foundation to these areas of broad importance to countless real-world engineering activities. The pursuit of solutions to questions whose answers depend on sound experimental practices (even if they are numerical experiments like computation fluid dynamics or finite element analysis) will depend heavily on this foundation. Understanding how to interact with, manipulate and quantify the errors associated with digital data is essential to designing experimental practices capable of achieving meaningful objectives. The ability of computers to produce overwhelming quantities of information places demands on the experimentalist to carefully design experiments to acquire meaningful quality data not massive quantities of data.

The laboratory sessions are designed to reinforce the concepts presented in the lectures and to give you hands-on experience in using modern computerized data acquisition system and instrumentation. A secondary objective of the course is to teach good laboratory practice, work habits and experiment design.

We will make extensive use of spreadsheets for graphing data, performing statistical calculations and general computations. **If you are not proficient in the use of spreadsheets you are advised not to take MAE 334.**

### Textbook Information:

R.S. Figliola & D.E. Beasley, Theory and Design for Mechanical Measurements. John Wiley and Sons, NY, Fourth Edition, 2006. *The older 3<sup>rd</sup> edition is acceptable.*

John Wiley has a good website for the 4<sup>th</sup> edition of the text <http://www.wiley.com/college/figliola>

### Topics covered in the course:

1. Characteristics of signals (Ch. 2)
2. Behavior of measurement systems (0th, 1st & 2nd order, Ch. 3)
3. Analysis of sampled data (Ch. 4)
4. Uncertainty analysis (Ch. 5)
5. Analog devices and signal conditioning (Ch. 6)
6. Sampling of analog signals (Ch. 7)
7. Temperature measurements (Ch.8)
8. Pressure and Position measurements (Ch. 9 & Ch. 12)

### Class Grading Policy:

There will be a midterm and a cumulative final examination covering material from the lectures and the laboratories. Exams will be closed book, mostly multiple choice questions with a few short answer calculations. See the [Course Notes Page](#) for examination dates, material to be covered and examples of prior exams.

The course grade will be composed of the following components:

Midterm Examination (and pop quizzes) - 15%

Final Examination (and pop quizzes)- 25%

Laboratory Reports and Presentations - 60% (See the following section for the lab grading policy)

**There will be 10 unannounced in-class quizzes.** Quiz points earned prior to the midterm exam will be added to your midterm exam grade. Those earned after the midterm will be added to your final exam grade.

Your lab grade will be curved based on the grades of those students graded by a particular TA, not the entire class. If the other students in your lab section are receiving lower grades on average than you are then you can assume your final lab grade will be above a "C+" (of course the opposite scenario is also true.)

Your final numeric average will be based on the above ratios and then curved based on the class statistics. The class median will correspond to about a GPA of 2.5 (C+) and one standard deviation above the median will be approximately a B+ and one standard deviation below will be approximately a D+.

The exact math used to calculate your course numerical average is

$$\text{Average} = (\text{Midterm+Quizzes}) * 15\% + (\text{Final+Quizzes}) * 25\% + (\text{Curved Lab Average}) * 60\%$$

Both the midterm and final exams will be worth 100 points the quizzes will be worth 40 points (your quiz points obtained prior to the midterm will be added to your midterm exam grade and those obtained after the midterm be added to your final exam grade). This means there is a possibility of scoring above 100% on the midterm or final exam portion of your weighted average.

Remember because this class is curved based on the performance of your classmates not attending class and taking the quizzes will reduce your grade compared to those students who do take the quizzes.

"If you have any condition, such as a physical, learning or mental disability which will make it difficult for you to carry out the course work as outlined or require extended time on examinations, please notify me during the first two weeks of the course so we may discuss appropriate arrangements and/or reasonable accommodations."

### **Laboratory Rules and Grading Policy:**

1. Eating and drinking are not allowed in the laboratory.
2. Students work in groups of two. During Lab. #1 you will be asked to choose a laboratory partner. Data collection will be done with your partner. You and your partner will present your work together to your teaching assistant. You may submit a joint report with the understanding that the submission of the joint report implies that each student is satisfied that equal efforts have been contributed to the report preparation.

For Lab. #2 and on, groups will work together on data collection and make presentations to their TA. But each group member is responsible for their own spread sheeting, plotting and understanding of the experiment. Each student will also maintain and submit his or her own individual lab notebook (for separate grades). Do not attempt to submit replicas of your partner's charts and graphs. Any difficulties or problems you experience with your laboratory partner should be reported to the TA or course instructor. **Individual written reports are required.**

3. Attendance will be taken in each session. Students are expected to attend each laboratory session at the scheduled time. In case one partner is absent because of illness or other emergency, the other partner can elect to complete the experiment alone or to complete the experiment with another partner or group. In either case, the absent partner will be required to make up the lab or receive a zero. Written, valid excuses will be required documenting the cause of any absence if you expect to avoid a grade penalty.

4. Failure to produce a [VALID written excuse](#) will result in a 10% grade penalty. However, a makeup lab will still be required and expected to be submitted on time.

5. An oral presentation of your laboratory results and calculations based on your lab notebook will be due at your assigned time at the next laboratory session (usually one week after you perform the lab). The written report will be due as you begin the next experiment (usually two weeks after you perform the lab). Late reports will be assigned a penalty of 10% per day (Monday - Friday) except in cases of illness or other excused absence. Reports more than one week late will receive a grade of zero.

6. The lab notebook is to be a three ring binder or similar 3-hole folio. Entries in the lab notebook, as well as your written lab report, graphs and spread sheets, should be on single sheets of 8-1/2 x 11 paper. The report should also fit neatly into your notebook. Its organization will be described more completely in a lecture session.

7. At the beginning of the laboratory session the lab notebook must contain the [lab title sheet](#), a printout of the laboratory procedure and several pages of blank paper for note taking. (5% of grade)

8. At the completion of the laboratory session your laboratory notebook will be briefly reviewed by the lab TA. Neatness, thoroughness and quality of content are expected. [An example of "B" quality lab notes can be found here](#). An "A" quality set of notes would be neater, contain more sketches and more thorough descriptions of the lab procedure.

9. One week following the laboratory session you and your partner will present your results and calculations to the lab TA for his review and evaluation. You may also be asked to discuss your "during lab" notes, calculations, and/or demonstrate your Excel spread sheets as used in developing your results. (30% of grade) The next week (as the new experiment begins) you will submit individual written reports which are to [follow the prescribed format](#). (60% of grade). *For Lab. #1 only, group reports may be submitted.*