EMEC 361: Measurement and Instrumentation Laboratory

Catalog Data (1 credit lab)
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. Hands-on laboratory experience.

Textbook

Instructor
James Black, Roberts Hall 402 james.black2@montana.edu (office hours posted on D2L)

Entrance Expectations
COREQUISITE: EMEC 360

Students are expected to be familiar with basic statistics and probability, algebra and differential equations, solid mechanics, thermodynamics, fluid mechanics, heat transfer, materials science, and electronic circuits, as well as have a working understanding of computer software. This course requires completion of group laboratory exercises and reports, as well as sufficient performance hands-on practical examinations.

Prior to laboratory, students must (1) read through the laboratory handouts (2) watch any associated laboratory videos available on D2L (3) complete prelab exercises and submit on D2L and (4) outline and write any relevant LabVIEW code to be used during the laboratory. Students are expected to come to the laboratory prepared to setup equipment and complete the laboratory exercises described in the lab handout.

Course Objectives and Outcomes
The purpose of EMEC 361 is to introduce students to the methods for conducting experimental work in an engineering lab or industrial setting. The course will cover data handling, statistics, measurement errors, dynamic systems / system response, basic LabVIEW training, experimental planning, electronic circuits (e.g. Wheatstone Bridge), computerized data acquisition, calibration, measurement of temperature, pressure, flow, displacement, piezoelectrics (ultrasonic NDE, pressure, accelerometer measurements), and strain gages (load cells).

Upon successful completion, students will have demonstrated an understanding of basic LabVIEW programming and comprehend the function, operation, response behavior, and sources of error in common transducers and sensors for measuring various physical quantities. Furthermore, students will be able to apply statistics and uncertainty analysis to measurement systems and acquired data. Finally, the student will be familiar with the proper instrumentation of test systems, appropriate collection of experimental test data, and interpretation and reporting of results.
Schedule
LAB Mondays, Tuesdays and Wednesdays, 401 Roberts Hall
ASSIGNMENTS See D2L for list of assignments and course schedule.

A tentative schedule is posted on D2L including: laboratory exercises, due dates, practice sessions, and lab final times. Students are expected to check this schedule weekly for changes and updates.

Course Website
All course information will be posted on Desire2Learn (D2L). D2L announcements and MSU email accounts will serve as the official university means of communication. Per MSU policy, students are expected to check their email at least twice weekly to stay current with University-related communications. Certain communications (e.g. scheduling) may be time-sensitive. Failure to process your email effectively is not an acceptable excuse for missing official communications.

Computer and Laboratory Usage
Students will be expected to learn the LabVIEW software package during the laboratory exercises. LabVIEW is an essential engineering tool widely used throughout both industry and academia.

Labs meet weekly per the semester Laboratory schedule found on D2L. Handouts describing each lab exercise will be available on the web prior to the lab exercise. Students are required to watch video lectures posted on D2L prior to attending laboratory. Each student is responsible for preparation in advance of the scheduled lab.

Lab Sections will be divided into groups of ~4 students for all laboratory experiments, and students will remain within the same group for the entirety of the class. Lab attendance is mandatory, and students missing a lab will receive a D. Experiments generally involve setting up apparatus and gathering data in a cooperative group effort. For most labs, data can be obtained within the two hour slated period. Once all required data is acquired, students may leave the laboratory with consent of the instructor or teaching assistant. Laboratory reports will be completed as a team activity and a single grade will be given to the entire group. Laboratory reports will be submitted to D2L via electronic dropboxes. No reports will be accepted after the stated deadlines.

LabVIEW software will be utilized several times during the course, as well as on the laboratory final. Note that the computers in Barnard Hall (EPS) 134 and any ME Department computers having the CAD lab image have copies of LabVIEW installed for students to practice outside of scheduled laboratory periods. To practice, setup a simulated device in Measurement and Automation Explorer.

Special Needs Information
Students with special needs or requiring special accommodations should contact the instructor or the campus Disabled Student Services Office at (406) 994-2824 at their earliest opportunity.
Student Conduct and Plagiarism

Students are expected to conduct themselves in accordance with the MSU Student Conduct Guidelines with particular attention to the areas of academic honesty, behavior, and responsibilities. As mentioned above and in conjunction with Section 310 of the Student Handbook, students are expected to be prompt and prepared for class. Late work will not be accepted.

Plagiarism and cheating are unacceptable. Lab reports will be screened for plagiarism using MSU’s electronic tools, and submitted work with evidence of plagiarism will receive a grade of zero. All lab reports will be scanned for evidence of plagiarism, and if evidence of plagiarism is found involving your work in current or future semesters, disciplinary action will be taken with the Dean of Students. Montana State University has a license agreement with Turnitin, a web-based service that verifies the originality of student work by comparing a submitted paper to information available on the internet, databases of journal articles, and millions of student papers previously submitted to Turnitin. In this course, some or all of your work will be submitted to Turnitin. All materials submitted to Turnitin will be retained by Turnitin in its database to be used solely for the purpose of verifying the originality of papers subsequently submitted to Turnitin.

Statement on Academic Writing and Student Responsibilities:

Students writing in an academic setting are responsible for approaching all assignments with rigor, integrity, & in compliance with University Code of Student Conduct. This responsibility includes:

1. consulting and analyzing sources that are relevant to the topic of inquiry;
2. clearly acknowledging when they draw from the ideas or the phrasing of those sources in their own writing;
3. learning and using appropriate citation conventions within the field in which they are studying; and
4. asking their instructor for guidance when they are uncertain of how to acknowledge the contributions of others in their thinking and writing.

When students fail to adhere to these responsibilities, they may intentionally or unintentionally “use someone else’s language, ideas, or other original (not common-knowledge) material without properly acknowledging its source” (http://www.wpacouncil.org/positions/WPAplagiarism.pdf). When the act is intentional, the student has engaged in plagiarism.

Plagiarism is an act of academic misconduct, which carries with it consequences including but not limited to receiving a course grade of “F” and a report to the Office of the Dean of Students. Unfortunately, it is not always clear if the misuse of sources is intentional or unintentional, which means that you may be accused of plagiarism even if you do not intentionally plagiarize. If you have any questions regarding use and citation of sources in your academic writing, you are responsible for consulting with your instructor before the assignment due date. In addition, you can work with an MSU Writing Center tutor at any point in your writing process, including when you are integrating or citing sources. You can make an appointment and find citation resources at www.montana.edu/writingcenter.
Assessment and Evaluation
The course outcomes will be evaluated based upon homework assignments, lab reports, and exams and the final letter grades will be weighted as follows:

<table>
<thead>
<tr>
<th>Assessment Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Pre-Lab Quizzes</td>
<td>10%</td>
</tr>
<tr>
<td>Lab Performance</td>
<td>10%</td>
</tr>
<tr>
<td>Reports</td>
<td>65%</td>
</tr>
<tr>
<td>Independent Lab</td>
<td>15%</td>
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</tbody>
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In conjunction with MSU policies, students will only be excused from laboratory if representing MSU in an official capacity (e.g. sports participation). Any student with an MSU-approved excuse must contact James Black at least 1 week prior to the absence to reschedule. *Late lab reports will not be accepted*. Point totals required to receive a particular letter grade will be determined by the instructor at the conclusion of the course, and the use of plus and minus grades will be at the discretion of the instructor. Inappropriate conduct, *late arrival to labs*, poor group performance, class participation, cheating, and plagiarism will affect the final grade.

General Background Information
The accurate measurement of physical quantities is a necessary tool for both engineers and scientists. Experimental testing methods utilize measurement systems and various types of instrumentation to design, evaluate, and control diverse systems and testing equipment. Standard engineering practice includes validation testing – the use of measurement and instrumentation techniques – to confirm analytical results. An engineering test is often the only substitute, and frequently the fastest option, for verifying analysis in cases where a purely analytical approach would be inaccurate or impossible. The objective of this course is to give students baseline knowledge of the practice of measurement and instrumentation in order to support their present and future needs in engineering testing and research. This course will involve the application of theory and hands-on experimental setup and testing to provide students with the ability to setup, perform, and analyze experiments with proper engineering and scientific rigor.

The curriculum contains aspects of many engineering disciplines including: solid mechanics, fluid mechanics, dynamics, mathematics, electronics, and materials science.

Laboratory Safety
Engineering experimentation can be dangerous. As a professional engineer or scientist, laboratory safety will be a primary responsibility. Therefore the following rules apply: no loose or baggy clothing, no open toed shoes, no sandals, and no bare feet. Students with long hair must tie it back prior to the beginning of the laboratory. Failure to demonstrate standard laboratory safety protocols can directly impair your safety and that of your labmates and may impact your final grade. Additional safety measures for the laboratory and group projects will be detailed during the lab sections.
GTA Assistance

This class is fortunate to have the support of one or more graduate student teaching assistants (GTA) to assist and facilitate with student learning. These GTAs should be treated with respect and all interactions should be professional. The MSU Student Code of Conduct (http://www.montana.edu/policy/student_conduct/#codeofconduct) requires this of all students. Violations of this policy with GTAs (or anyone else) will not be tolerated and will be handled according to the procedures described in the policy. GTAs have very specific assignments from the course instructor and therefore may not have comprehensive knowledge of all course requirements and content. If questions arise requiring clarification of class content or subject material, please direct them to the course instructor. In their instruction role, the GTAs may be responsible for assigning grades. If a student disagrees with the decision made by the GTA then they are to bring that concern directly to the course instructor and not challenge the GTA regarding their decision.