MEASUREMENT AND ANALYSIS COURSE SYLLABUS

SEMESTER: Spring 2005
COURSE NUMBER: MIM 505
INSTRUCTOR: Richard Whalen
OFFICE: 311 SN
PHONE: 373-4706
E-MAIL: r.whalen@neu.edu
Web: www.coe.neu.edu/~whalen
HOURS: MWX 11:45 -12:45

COURSE DESCRIPTION:
Introduce students to basic measurement and data analysis techniques. Students become familiar with various types of measurement systems and to set up and perform various experiments according to a given procedure. Topics include basic measurement methods of rotational frequency, temperature, pressure and power, and A/D conversion techniques and data acquisition. Data analysis topics include statistical analysis of data, probability and inherent uncertainty, basic measurement techniques, primary and secondary standards, system response characteristics, and computerized data acquisition methods. Includes experiments in thermodynamics, fluid mechanics and heat transfer. Develops and improves report writing skills.

COURSE PREREQUISITES:
MIM 315 (Statistics), MIM 380(Thermodynamics)

COURSE OBJECTIVES:
1. To learn techniques involved in analyzing measurement data and the errors associated with the measurement system used
2. To learn ways to measure physical quantities: force, strain, temperature, rotational frequency, power, flow and pressure.
3. To increase proficiency in report writing, particularly in the area of graphical presentation of data.
4. To be able to use data acquisition software and hardware to collect and analyze acquired data.

COURSE GOALS:

By completing the course, students will be given the opportunity to:
- become familiar with the vocabulary of basic measurement science
- understand basic measurement and data analysis techniques.
- understand the role of sensors in measurements.
- understand how errors effect measurement results, and how to determine the cause of certain types of errors in order to reduce them, and to account for the error that cannot be eliminated.
- become familiar with various types of measurement systems and to set up and perform experiments according to a given procedure.
- understand how testing is a part of the design process, and how test processes and criteria are developed.
- understand the relationship between analytical predictions and experimental results.

- be introduced to, and gain basic competence in, digital data acquisition systems.
- learn the basics of the LabVIEW application for controlling DAQ hardware and analyzing data.

COURSE TOPICS:

1. Errors: Expected Uncertainty & Probability and Statistics
2. Lab Safety, Report Writing and Graphing
3. Instrument Characteristics and Zero Order Systems
   - Force and Strain Measurements
   - Temperature Measurements
   - Pressure Measurements
   - Flow Measurements
   - Rotational Frequency Measurements
   - Power Measurements
   - Drag Force
4. Measurement System Behavior: First Order Systems
   - Computerized Data Acquisition
   - Heat Transfer Basics
   - Dynamic Response of a Thermocouple
5. Measurement System Behavior: Second Order Systems
   - Analysis of A U-Tube Manometer
6. LabView

TEXTBOOK: Theory and Design for Mechanical Measurements, 3rd Edition, Figliola and Beasley, Wiley, 2000.

COURSE GRADE:

To pass the course the student must have an average greater than 60%, attend all the labs **and** show a clear understanding of **all** indicator questions through lab reports, quizzes and exams. An indicator question is one that is directly related to the course objectives and topics as described above under **COURSE TOPICS**. Students will be presented with multiple opportunities to pass the indicator questions. To get an "A" in the course requires an average greater than 90.

Laboratory Reports/Lab Projects • 8 Labs • 1 Group Project/Oral Presentation	50%
Weekly Quizzes	25%
Homework	10%
Final Exam	15%

LAB POLICY

Lab attendance is required. No lab reports will be accepted unless a student has attended the lab. Attendance will be recorded during each lab session by the TA: it is the student's responsibility to make sure that the TA is aware of the student's presence. Students cannot attend another lab session without the prior approval of the course instructor. Lab reports are due one week after the student attends the lab session. Three

points will be deducted for each day a lab report is late. No reports will be accepted after two weeks late, or after the last day of accepting labs- one week prior to end of term- in which case grading will start from 50 %. Lab reports must be delivered to the TA's mailbox or my mailbox in 334 Snell. All reports should be signed in by a secretary in order to receive credit for the that days submission.

SUGGESTED REFERENCES:
Mechanical Measurements, Beckwith, Marangoni, and Lienheard.
Fundamentals of Engineering Thermodynamics, Moran and Shapiro
Mechanics of Materials, Beer and Johnston
Fundamentals of Fluid Mechanics, Munson, Young, and Okiishi
Heat Transfer", Incopera and Dewitt.
Applied Statistics and Probability for Engineers, Montgomery and Runger.
Fundamentals of Fluid Mechanics, Munson, Young, and Okiishi

Web Links:
www.omega.com/techref/
www.tmworld.com/
www.measurementsgroup.com/
http://www.convert-me.com/en/

CLASS/LABORATORY SCHEDULE:
The class meets twice a week in seq. B. In addition, the students must complete eight lab sections (data analysis, force and strain, temperature, data acquisition and dynamic response, power, rotational frequency, drag, and pressure measurements). The data acquisition and dynamic response experiment is done on an individual basis and includes the design and testing of a data acquisition program.

CONTRIBUTION TO PROFESSIONAL COMPONENTS:
This course contributes 4 quarter hours to the engineering topic requirement. It also contributes to the general education requirement by including the following ACE goals: effective written and oral communication and thinking skills, information literacy, and connections between theory and practice.

RELATIONSHIP TO PROGRAM OBJECTIVES:
The course partially satisfies educational objectives 1, 2, 4, 6, 7.

PREPARED BY: R. Whalen, January 2005.

NU Honor Code Agreement:
All University courses are conducted in accordance with the Northeastern University honor code. The honor code can be found on the College of Engineering website.
Ethical Behavior:

No collaboration is allowed, except where expressly permitted within lab groups. Plagiarism and cheating will not be tolerated; they will be dealt with in accordance with University policies as described in the Student Handbook. Although students are encouraged to discuss homework assignments and to work together to develop a deeper understanding of the topics presented in the course, submission of others work as your own is not permitted. Each student is expected to prepare and submit his/her own assignments, calculations, reports and other materials, except where an assignment has been expressly described as a group or team activity. If you have any questions regarding cooperation versus cheating, please ask the instructor to clarify the situation for you. Violators of University policy on cheating will be referred to the Student Court for review. Penalties may include, but are not limited to: zero credit on the work, probation, and inclusion of the court's findings in the student's permanent record.