

Mechanical Engineering and Mechanics

MEM 331: Experimental Mechanics I

Winter 2006

Designation: Required

Catalog Description: Covers static, mechanics of material and dynamic testing methods, including sensors and data acquisition, strain gauges and experimental stress analysis, tension and compression, torsion, bending, testing of mechanisms, and simulation of dynamic systems.

Prerequisites: MEM 230, Co-Requisite MEM 238

Textbook(s) and other required material:

Required: **Laboratory Manual:** Available for download at:
<http://www.mem.drexel.edu/courses/mem331/>
ADAMS – Dynamic simulation software system available on all cluster computers in the MEM undergraduate laboratory.

Course Objectives:

1. Familiarize the student with laboratory testing equipment used in experimental mechanics
2. Use laboratory equipment to demonstrate the mechanical behavior of common engineering materials and mechanisms
3. Develop computer-based models to describe the theoretical behavior of mechanisms
4. Analyze experimental data and correlate experimental results to theoretical models
5. Enhance technical report writing and data presentation skills

Topics:

1. Statistical analysis of data
2. Explanation of experimental test equipment
3. Application of sensors to laboratory investigations
4. Uni-axial stress-strain relationships
5. Bending of beams
6. Torsion of solid and thin-wall bars
7. Dynamic analysis of a four-bar linkage
8. Dynamic analysis of other mechanisms
9. Laboratory Component
 1. Sensor calibration, sensor operation, data acquisition from sensors.
 2. Design and testing of a sensing platform using force sensors*

3. Application of strain gauges to beam bending and determination of Poisson's ratio*, combined loading*
4. Torsional testing and determination of the modulus of rigidity*
5. Analysis and testing of a four-bar linkage*
6. Analysis and simulation of dynamic systems*

*For these laboratory investigations, a pre-laboratory problem is solved independently by each student to enhance their understanding of the theoretical basis for the laboratory work.

Class Schedule:

This is a laboratory course. It meets for 3 hours each week. Each class consists of a 1-hour lecture followed by 2 hours of hands-on laboratory investigation.

Contribution to Professional Component:

Report writing and data presentation skills are developed by the preparation of technical reports. These skills combined with hands-on experimental mechanics skills and experience with numerical techniques, contribute towards the knowledge base needed to successfully practice the profession of mechanical engineering.

Relationship to Program Outcomes:

Outcomes a - k	Content	Explanation	Evidence
a. An ability to apply knowledge of mathematics, science and engineering	2	Students are required to apply knowledge of Mathematics, Statics, Dynamics, and Mechanics of Materials to set-up and perform experiments.	Laboratory reports
b. An ability to design and conduct experiments as well as to analyze and interpret data	2	This is a laboratory course and therefore the main focus of the course is on the ability to design and conduct experiments and to analyze and interpret experimental and numerical data.	Laboratory reports
c. An ability to design a system, component or process to meet desired needs	2	Students are designing experiments to test the behavior of materials under different loading conditions and designing experiments to test behavior of dynamic systems.	Laboratory reports
d. An ability to function on multidisciplinary teams	2	Students learn to work in teams of three to four students per team. All experiments including the final laboratory reports are done in teams.	Laboratory reports are prepared by each team and represent the collaborative efforts of all students on the team
e. An ability to identify, formulate and solve engineering problems	2	The students learn to identify, formulate and solve engineering problems in mechanics and then test and verify their design through hands-on experiments.	Laboratory reports
f. An understanding of professional and ethical responsibility	1	Students are exposed to ethical and professional responsibility issue through team work and by meeting requirements	Laboratory reports Oral presentation Team meetings

		demands (laboratory design, reports, presentation) under given time constraints	
g. An ability to communicate effectively	1	This is brought about through oral presentation of the student reports and through communication between the team members and the instructors.	Classroom discussions Oral presentations Team meetings
h. The broad education necessary to understand the impact of engineering solutions in a global/societal context	1	The impact of solid, practical and hands-on knowledge in conducting and designing experiments in various Industrial and societal discipline (Automotive, Space, Medicine) are emphasized.	Lecture notes
i. A recognition of the need for and an ability to engage in lifelong learning	1	The need for lifelong learning of improvements and development of numerical and experimental tools in engineering are emphasized.	Classroom discussions
j. A knowledge of contemporary issues	0	NA	
k. An ability to use the techniques, skills and modern engineering tools necessary for engineering practice	2	Students use numerical tools such as MATLAB, EXCEL and ADAMS and modern experimental devices such as sensors, data acquisition boards and mechanical and dynamic components in setting-up and conducting experiments	Laboratory reports

Prepared by:

Dr. Sorin Siegler, November 20, 2006