MAE 175A
Aerospace Engineering Laboratory (4 units)

Class/Laboratory Schedule: Six lecture hours per week, three hours lab, three hours outside preparation. 12 hours/week total

Course Coordinator(s): Raymond de Callafon

Textbook, Required Materials:
Lecture notes on wind tunnel, materials vibration, and control experiments. Lecture notes and copies of Fundamentals of Measurement Error, James L. Taylor, NEFF Instrument Corp., for error analysis.

Catalog Description: Analysis of aerospace engineering systems using experimental facilities in undergraduate laboratories: wind tunnel, gyroscope control, vibration table, and 2D helicopter flight dynamics. Students operate facilities, obtain data, complete engineering analysis and write major reports.

Prerequisites: senior standing; MAE 143B or CENG 120; and MAE 170, or consent of instructor.

Course Type: Required Course

Course Objectives:

Objective 1: Application of the theoretical concepts of fluid, solid and electromechanical control systems in a laboratory environment. Aerospace topics and applications include aerodynamic drag, helicopter blade vibration, and gyroscope control

Objective 2: Working with real experimental data, comparing experiments with predictions and simulations based on theoretical models, and performing statistical and error analysis

Objective 3: Operating laboratory equipment and performing data analysis

Objective 4: Designing and conducting experiments, as well as designing feedback control algorithms

Objective 5: Planning of laboratory work in a group of four students to promote coordination and communication between students and develop teamwork skills

Objective 6: Discussion of professional responsibility and engineering ethics in lectures and laboratory environment

Objective 7: To provide students with experience in an engineering laboratory along with data analysis and modeling

Course Content and Modules (per objective):

Objective 1
1. During the course, students perform three out of the four different laboratory experiments (wind tunnel; material testing; control design)

2. Experimental work is constructed in such a way that theoretical background of underlying engineering principles is tested thoroughly

Objective 2
1. Experimental data is compared with theoretical simulations in Matlab to verify estimated parameters and validity of the models being used
2. Both National Instruments VI interfaces, Matlab and Excel are used to collecd analyze experimental data
3. Statistics and error analysis is presented in separate lectures and applied to experimental data gathered in the laboratory environment

Objective 3
1. Students learn how to use the laboratory equipment to perform standard data acquisition
2. Experimental data is analyzed to estimate key parameters of the system under investigation

Objective 4
1. Experiments are planned and designed in coordination with the group of students and the course advisors
2. The control experiments are used to design control algorithms and implement these algorithms on the electromechanical system

Objective 5
1. Students demonstrate team work by working in groups of four which motivates coordination and cooperation between students
2. Students will present their progress and work in the form of written reports, which develops the writing and organization skills of the students

Objective 6
1. Three mandatory special lectures are devoted to discussing engineering ethics
2. Engineering ethics issues are discussed on the basis of a case study and are accompanied with a questionnaire

Objective 7
1. Experience in operating large experimental facilities for engineering fluid studies (wind tunnel) is obtained
2. Experience with electromechanical vibration systems and control system design (helicopter vibration, gyroscope control) is evaluated in this course

Course Topics:
1. Operation of laboratory facilities
2. Data acquisition processes
3. Statistics
4. Error Analysis
5. Report writing
6. Group coordination
7. Engineering ethics
8. Measurements on and analysis of fluid mechanics systems
9. Measurements on and analysis of solid mechanics systems
10. Measurements on vibration systems
11. Analysis of feedback control systems

PREPARED BY:
R. de Callafon, via April 2008.
Reviewed: TWG, August 2011, 2012
Updated: June 2025