

MAE MAE175A Aerospace Engineering Laboratory

Designation: Required course

Catalog Data:

MAE 175A Aerospace Engineering Laboratory (4)

Analysis of aerospace engineering systems using experimental facilities in undergraduate laboratories: wind tunnel, water channel, vibration table, material testing machine, electromechanical and control systems. Students operate facilities, obtain data, complete engineering analysis and error analysis, and write major reports. Engineering ethics is also covered.

Prerequisites: Grade of C- or better in MAE101C or CENG 103C, MAE143B, MAE170 and senior standing in engineering major.

Prerequisites by Topic:

Hydrostatics, Bernoulli equation, lift and drag, heat transfer, elasticity, anelasticity, deformations, equations of motion, vibration analysis, analysis and design of linear PID control.

Textbook, Required Materials:

Lecture notes on water tunnel, wind tunnel, materials and control experiments. Lecture notes and copies of Fundamentals of Measurement Error, James L. Taylor, NEFF instrument Corp., 1988 for error analysis. Lecture notes are available on the MAE171A web page at <http://maelabs.ucsd.edu/mae171/>.

Class/Laboratory Schedule: 2 lecture hours and 6 laboratory hours per week

Course Topics:

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

Course Objectives:

(Numbers in parenthesis refer to MAE Program Outcomes)

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, gyroscope control (1a, 2b, AE12, AE13).

Objective 2: Working with real experimental data and compare experiments with predictions and simulations based on theoretical models and perform statistical and error analysis (1a, 2b).

Objective 3: Students operate laboratory facilities themselves to teach operation of laboratory equipment and perform data analysis (2b).

Objective 4: Design and planning of experiments and design of feedback control algorithms (2b, 11k).

Objective 5: Planning of laboratory work in a group of four students to promote coordination and communication between students and develop teamwork skills (2b, 4d).

Objective 6: Discussion of professional responsibility and engineering ethics in lectures and laboratory environment (6f).

Objective 7: To provide students with experience in an engineering laboratory along with data analysis and modeling (2b, 11k).

Methods of Evaluation:

1. Written reports. Students perform three different experiments and each experiment is evaluated on the basis of a written report.
2. Mandatory ethics classes and accompanying discussion and questionnaire to discuss engineering ethics on the basis of a case study.
3. Final exam. A final exam tests the students on the application of statistics and error analysis and the links between the laboratory work and the theory.

Performance Criteria:

(Numbers in parentheses refer to the methods of evaluation used to assess student performance.)

Objective 1

1. During the duration of the course, students are exposed to three out of the four different laboratory experiments (water tunnel; wind tunnel; material testing; control design). (1,2)
2. Experimental work is constructed in such a way that theoretical background of underlying engineering principles is tested thoroughly. (1,2)

Objective 2

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

Objective 3

1. Students learn how to use the laboratory equipment to perform standard data acquisition. (1,2)
2. Experimental data is analyzed by using the data to estimate parameters of the system under investigation. (1,2)

Objective 4

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

Objective 5

1. Students demonstrate team work by requiring to work in groups of four and motivate coordination and cooperation between students. (2)
2. Students will present their progress and work in the form of written reports to motivate the writing and organization skills of the students.(2)

Objective 6

1. Three mandatory special lectures are devoted to discuss engineering ethics (3).
2. Engineering ethics issues are discussed on the basis of a case study and are accompanied with a questionnaire (3).

Objective 7

1. Experience in operating large experimental facilities for engineering fluid studies (water and wind tunnel) is obtained (1,2).

2. Experience in operating load frame facilities for stress and strain experiments (1,2).
3. Experience with electromechanical vibration systems and control system design (helicopter vibration, gyroscope control) is evaluated in this course (1,2).

CONTRIBUTION OF COURSE TO PROFESSIONAL COMPONENT:

Engineering Science

PREPARED BY:

R.A. de Callafon, R. Cattolica and K. Vecchio, March 2001.

Revised: K. Nomura, June 2007.