

THE UNIVERSITY OF TEXAS AT AUSTIN
The Department of Aerospace Engineering & Engineering Mechanics

ASE 389P.8 – Satellite Control Systems
Spring 2017

SYLLABUS

Unique Number 13497

Instructor Dr. Renato Zanetti
Office: WRW 401D, 512-471-5145, renato@utexas.edu
Office Hours: M and Th 2:30-3:30

Class Time: TTH 9:30-11:00
Class Location: GAR 1.134

Web Page: Course documents will be posted on the course **Canvas** website.

Course Objectives:

This course examines the methods of designing a closed loop satellite attitude control system. Case studies in satellite control systems will be presented. Special topics may be treated at the end of the course.

Prerequisites:

Advanced Spacecraft Dynamics (ASE 372K)
Flight Control Systems (470L)
Both courses completed with at least a C grade

Knowledge, Skills, and Abilities Students Should Have Before Entering This Course:

This course combines dynamics and control topics that are traditionally thought separately at the undergraduate level. Basic knowledge of satellite motion in a gravity field, torque free motion of a rigid body, and stability analysis of linear systems are assumed.

Knowledge, Skills, and Abilities Students Gain from this Course (Learning Outcomes):

Students taking this course will gather skills in applied problems pertaining to attitude determination and control of satellites.

Impact on Subsequent Courses in the Curriculum:

Students may combine information from this course with other course offerings to obtain a complete understanding of the aerospace Guidance, Navigation, and Control discipline.

Relationship of Course to Program Outcomes: This course contributes to the following ABET Criterion 3 outcomes and those specific to the EAC accredited program.

| Outcome | | Outcome | |
|---|---|---|---|
| a. An ability to apply knowledge of mathematics, science, and engineering | √ | g. An ability to communicate effectively | |
| b. An ability to design and conduct experiments, as well as to analyze and interpret data | | h. The broad education necessary to understand the impact of engineering solutions in a global/societal context | |
| c. An ability to design a system, component, or process to meet desired needs | √ | i. A recognition of the need for and an ability to engage in life-long learning | √ |
| d. An ability to function on multi-disciplinary teams | | j. A knowledge of contemporary issues | √ |
| e. An ability to identify, formulate, and solve engineering problems | √ | k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice | √ |
| f. An understanding of professional and ethical responsibility | | | |

ABET Program Criteria Achieved:

| Criterion | | Criterion | | Criterion | |
|--------------------------|---|--------------------------------------|---|----------------------------------|---|
| A. Aerodynamics | | G. Orbital Mechanics | | M. Preliminary/Conceptual Design | √ |
| B. Aerospace Materials | | H. Space Environment | √ | N. Other Design Content | |
| C. Structures | | I Attitude Determination and Control | √ | O. Professionalism | |
| D. Propulsion | | J. Telecommunications | | P. Computer Usage | √ |
| E. Flight Mechanics | | K. Space Structures | | | |
| F. Stability and Control | √ | L. Rocket Propulsion | | | |

Professionalism Topics:

No specific topics on professionalism are contained within this course.

Design Assignments:

Some homework assignments will include elements of design.

Laboratory Assignments:

None.

Computer:

Solutions to homework problems can be done using a variety of software languages (including MATLAB, Mathematica, Maple, Fortran, C, Java, etc.). Familiarity with MATLAB is desired but not required, although typically all students will use Matlab. In some cases it is required that the student turn in the source code.

Text:

Recommended:

Wie, *Space Vehicle Dynamics and Control*, AIAA Education Series, 1998

Class Format:

Traditional lectures and discussion will be held during each class period. Homework assignments will be given approximately every three weeks. There will be one midterm exam and a comprehensive final.

Class Website: This class will use Canvas—a Web-based course management system with password protected access at <http://canvas.utexas.edu/> —to distribute course materials, to communicate and collaborate online, to post grades, and for course announcements. You can find support in using Canvas at the ITS Help Desk at 475-9400, Monday through Friday, 8 a.m. to 6 p.m., so plan accordingly.

Class Topics

- Attitude Representation
- Attitude Kinematic equations
- Passive attitude control systems
- Feedback attitude control systems
- Attitude Determination
- Attitude Filtering

Grading:

| | | |
|---------------------|------------------------------------|-----|
| Homeworks | (~1 per 3 weeks) | 10% |
| In-class midterm 1 | (~Th Mar 9) | 30% |
| Final Project | (Due Last Day of Class) | 25% |
| Comprehensive Final | (Tuesday, May 16, 9:00-12:00 noon) | 35% |

Grades are awarded by merit; not by a predetermined distribution, nor a particular grade range.

The target range for grades are:

A: 90-100

B: 80-90

C: 70-80

D: 60-70

F: 0-60

although the threshold for a particular grade may be shifted downwards (not upwards). Attendance, class participation, and improvement throughout the semester can be (will likely be) considered in borderline grade cases.

Homework Policy: Each homework assignment will posted on Canvas and will be also due electronically on Canvas by the submission deadline. Under typical circumstances, late assignments will not be accepted. The main objectives of the assignments are to gain computer experience and practice problems that will prepare students for exams.

Format:

Homework should be concise, legible, professional, and demonstrate all important steps in the solution. Computer generated plots should be legible with axes and important information properly labeled. Always include units.

Examinations: The exams will assess the students' understanding of the material covered in class and the homework assignments. We will have 1 midterm exam and 1 comprehensive final exam.

Attendance: Regular class attendance is expected. Repeated unexcused absence from class is a justification for a downward adjustment of the student's grade. Medical and professional absences are accepted. In all cases the student should notify the instructor of any planned absences before that class if at all possible. By UT Austin policy you must notify me of your pending absence at least fourteen days prior to the date of observance of a religious holy day. If you must miss a class, an examination, a work assignment, or a project in order to observe a religious holy day, you will be given an opportunity to complete the missed work within a reasonable time after the absence.

Important Dates: Refer to <http://registrar.utexas.edu/calendars> for important dates regarding drops, payments, holidays, finals etc.

Academic Integrity: The core values of The University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity, and responsibility. Each member of the university is expected to uphold these values through integrity, honesty, trust, fairness, and respect toward peers and community.

Each student in this course is expected to abide by the University of Texas Honor Code. [See the UT Honor Code above.] Any work submitted by a student in this course for academic credit will be the student's own work. You are encouraged to study together and to discuss information and concepts covered in lecture and the sections with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else (hard copy or electronic).

Should copying occur (including plagiarism/copying from internet source or any other source), both the student who copied work from another student and the student who gave material to be copied will both automatically receive a zero for the assignment. Penalty for violation of this Code can also be extended to include failure of the course and University disciplinary action. During examinations, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. Any collaborative behavior during the examinations will result in failure of the exam, and may lead to failure of the course and University disciplinary action.

Course Evaluation: The Measurement and Evaluation Center forms for the College of Engineering will be used during the last week of class to evaluate the course and the instructor. I will not have access to these evaluations until about one month after the end of the semester.

Special Notes:

Students with Disabilities: The University of Texas at Austin provides upon request appropriate academic adjustments for qualified students with disabilities. For more information, contact me or the Office of the Dean of Students at 471-6259, 471-4641 TDD or the College of Engineering Director of Students with Disabilities at 471-4321.