AA131: Spaceflight

Spring 2018

Course Description

This class is all about how to design and build spacecraft. It is designed to introduce undergraduate students to the engineering fundamentals of conceiving, implementing, and operating satellites and other space systems. Topics include orbital and attitude dynamics, mission design, and subsystem technologies. The space environment and the seven classic spacecraft subsystems — structure, power, propulsion, thermal, attitude determination and control, telemetry and command, and payload — will be explored. The course will center around a mission design project in which students work in groups to analyze a mission of their choice.

You should take this class if you want to develop a broad understanding of space mission design and spacecraft engineering.
TODO: Prerequisite stuff... Be inclusive explicitly - mention that math background is minimal

Instructors

Prof. Zac Manchester **Email:** zacmanchester@stanford.edu **Office:** Durand 267
TA: TODO: TBD

Logistics

- Lectures will be TODO: TBD in TODO: TBD.

- Office hours will be held TODO: TBD.

- Homework assignments will be due by TODO: TBD.

- Canvas will be used to distribute course materials and collect assignments.

- Slack will be used for general discussion and Q&A outside of class and office hours.

Course Objectives and Learning Outcomes

By the end of this course, students should be able to do the following:

1. Articulate why we go to space: Identify satellite applications and trade-offs with terrestrial solutions.

2. Identify the 7 classical spacecraft subsystems, their individual functions, and their interdependencies.

3. Derive low-level engineering requirements from high-level mission goals.

4. Analyze subsystem capabilities.

5. TODO: Risk assessment, flight heritage, etc.

Assignments and Exams

Each week, as part of the homework, students will be asked to analyze some aspect of their chosen mission. A write-up of this analysis should be completed by each group, and will be reviewed by the instructors and returned to students the following week. At the end of the quarter, these weekly assignments will be compiled into a final report. There will be one midterm exam. There will be no final exam. Instead, students will present the results of their mission design projects.

Grading

Grading will be based on:

- 20% Midterm exam

- 30% Weekly homework assignments

- 50% Completeness, consistency, and quality of the class project

Stanford's grading system is defined by the Faculty Senate as A=Excellent, B=Good, C=Satisfactory, D=Minimal Pass, and NP=Not Passed.

References

We'll primarily refer to one book during the course: *Spacecraft Mission Engineering: The New SMAD* by Wertz, Everett, and Pushcell. A copy will be placed on reserve in the library, but students are encouraged to purchase their own copy.

Stanford University and its instructors are committed to ensuring that all courses are financially accessible to all students. If you are an undergraduate who needs assistance with the cost of course textbooks, supplies, materials and/or fees, you are welcome to approach me directly. If would prefer not to approach me directly, please note that you can ask the Diversity & First-Gen Office for assistance by completing their questionnaire on course textbooks & supplies: http://tinyurl.com/jpqbarn or by contacting Joseph Brown, the Associate Director of the Diversity and First-Gen Office (jl-brown@stanford.edu; Old Union Room 207). Dr. Brown is available to connect you with resources and support while ensuring your privacy.

Course Policies

Late Homework: Students are allowed a budget of 2 late days for turning in homework with no penalty throughout the quarter. They may be used together on one assignment, or separately on two assignments. Beyond these two days, no other late homework will be accepted.

Make-Up Exams: There will be no make-up exams for the midterm. If extreme circumstances make you unable to attend, let me know as soon as possible. Note the university policy on examinations: "In submitting official study lists, students commit to all course requirements including the examination procedures chosen and announced by the course instructor."

University Policies

The Honor Code: It is expected that Stanford's Honor Code will be followed in all matters relating to this course. You are encouraged to meet and exchange ideas with your classmates while studying and working on homework assignments, but you are individually responsible for your own work and for understanding the material. You are not permitted to copy or otherwise reference another student's homework or computer code. If you have any questions regarding this policy, feel free to contact the professor.

Compromising your academic integrity may lead to serious consequences, including (but not limited to) one or more of the following: failure of the assignment, failure of the course, disciplinary probation, suspension from the university, or dismissal from the university.

Students are responsible for understanding the University's Honor Code policy and must make proper use of citations of sources for writing papers, creating, presenting, and performing their work, taking examinations, and doing research.

Accommodations: Students who may need an academic accommodation based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Professional staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty dated in the current quarter in which the request is being made. Students should contact the OAE as soon as possible since timely notice is needed to coordinate accommodations.

Schedule of Topics

Week 1: Course overview: Why we go to space

Week 2: Orbit mechanics

Week 3: Orbital maneuvers

Week 4: Attitude dynamics

Week 5: Attitude control

Week 6: Structure and Thermal Systems

Week 7: Power and Propulsion Systems

Week 8: Telemetry and Command

Week 9: The space environment, integration and testing

Week 10: Spacecraft opperations