

ASTE 331b Syllabus

USC Department of Astronautical Engineering

ASTE 331b Spring 2020: Spacecraft Systems Engineering

3 units

Lecture: Friday 1:00-3:50 PM, GFS 223

Instructor:

Jim Chase, **RRB Rm ?**, Office Phone: 213-821-5817, Email (preferred): chasejam@usc.edu

Office Hours:

- Every Friday: 4-5pm (please confirm immediately after class or in advance)
- Alternating Fridays: 9am-12pm (by appointment), 1/31, 2/14, 2/28, 3/13, 3/27, 4/10, 4/24, 5/8
- Otherwise, contact me for possible alternative times

TA: Andrew Antony, Email: aantony@usc.edu

NOTE: ASTE 331b is the second semester of a two-semester course. The first semester covered the space environment and spacecraft subsystems. The second semester will be about space systems engineering and the design process, along with a spacecraft design project done in teams.

Learning Objectives:

After completing this two-semester course, a student will be able to:

- Understand the fundamental physics of spacecraft systems
- Understand the relationship between mission requirements and system performance requirements
- Design subsystems to meet performance requirements
- Make design choices taking system tradeoffs into account
- Understand the steps in performing a complete spacecraft system design

Text:

There are two required textbooks:

1. Vincent L. Pisacane, Fundamentals of Space Systems, 2nd ed. Oxford, 2005. ISBN 1. 978-0195162059.
2. Space Mission Engineering: The New SMAD, James R. Wertz, David F. Everett and Jeffery J. Puschell, eds. Microcosm, 2011. ISBN 978-1881883159.

Pisacane is a true textbook and explains things starting from first principles. SMAD is more of a reference; its explanations are quite terse, but it is more up to date and has more information on actual missions.

For the second semester spring class, I may also pull material from this source:

3. NASA Systems Engineering Handbook Revision 2, Last Updated 9/18/2017, Editor: Garrett Shea
<https://www.nasa.gov/connect/ebooks/nasa-systems-engineering-handbook>

Midterm Exam: Friday, April 10th, in class. (TBC)

Final Project Presentation: Friday May 8, 1:00 PM-3:50 PM in the regular classroom. (TBC)

Homework: Assigned weekly. Due on Fridays in class.

Grading: Attendance 5%, homework, 25%; midterm exam, 25%; final project, 45%.

Software Used:

Matlab: A general-purpose numeric computation environment, with some symbolic capability. An interpreted C-like language, extended with vector and matrix syntax, is coupled with mathematics and graphics libraries. The student who is comfortable with Matlab will be able to do numeric solution of any problem he or she is faced with, as well as provide graphical representation of the solutions.

NX (Siemens): A package for computer-aided design (CAD) and analysis. Used in AME coursework, so if you do not already have it installed, you will soon need to in any case. In this class, NX is used for structural analysis, particularly analysis of resonant vibration frequencies.

ANSYS Structures: A package for computer-aided mechanical and thermal analysis of structures. In this class, Ansys is used for thermal analysis of spacecraft.

STK (Systems Toolkit): A package for setting up, simulating, and visualizing the operation of space missions. Launch, orbits and stationkeeping, attitude dynamics and control, communications, and ground station operations can all be simulated. ASTE has a site license for STK through a donation from the company, Analytical Graphics Inc. (AGI). For installation and licensing of STK, see <http://asteclasses.usc.edu/stk>

Course Material:

The times and topics given below are approximate, and the list may change as the semester progresses. We will see how things go and take more or less time on each topic as seems appropriate.

Week	Date	Topics (will evolve)	Reading (in work)		
			Pisacane	SMAD	NASA SE Handbook
1	1/17	Introduction to Space Systems Definition of Major Elements What is Systems Engineering? The Project Lifecycle Design Project: Overview			
2	1/24	Formulation, Part 1 - The Customer - Science, Mission Design, & Payload - Architecture & Concept of Operations - Requirements Flowdown Design Project - Concept Selection (group work)			
3	1/31	Formulation, Part 2 - Design, Trades, & Resources - Modeling, Simulation, & MBSE - Key Products - Proposal Outline Design Project - Introduction to System Trades Model (STM) - Teams describe their initial concepts			

4	2/7	Payload Design - Imaging & Remote Sensing Payloads Design Project - STM Q&A			
5	2/14	Strength & Stiffness Analysis			
6	2/21	Thermal Analysis			
7	2/28	Onboard propulsion, stationkeeping, navigation, & attitude control			
8	3/6	End-to-end Information System, including command & telemetry			
9	3/13	Flight System Avionics			
	3/20	No class (spring break)			
10	3/27	Flight System Reliability Risk Management			
11	4/3	Verification & Validation Anomaly Investigations & War Stories			
12	4/10	Cost Estimation Mid-Term Exam			
13	4/17	Flight Software			
14	4/24	Mission Operations			
15	5/1	Review			
	5/8	Final Project Presentation			

Academic Conduct

Plagiarism — presenting someone else's ideas as your own, either verbatim or recast in your own words — is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, Behavior Violating University Standards. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and University policies on scientific misconduct.

Support Systems

Student Counseling Services (SCS) — (213) 740-7711 — 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. <https://engemannshc.usc.edu/counseling/>

National Suicide Prevention Lifeline — 1-800-273-8255

Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. <http://www.suicidepreventionlifeline.org>

Relationship & Sexual Violence Prevention Services (RSVP) — (213) 740-4900 — 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender-based harm. <https://engemannshc.usc.edu/rsvp/>

Sexual Assault Resource Center

For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: <http://sarc.usc.edu/>

Office of Equity and Diversity (OED)/Title IX compliance — (213) 740-5086

Works with faculty, staff, visitors, applicants, and students around issues of protected class.

Bias Assessment Response and Support

Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. <https://studentaffairs.usc.edu/bias-assessment-response-support/>

Student Support & Advocacy — (213) 821-4710

Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. <https://studentaffairs.usc.edu/ssa/>

Diversity at USC — <https://diversity.usc.edu/>

Tabs for Events, Programs and Training, Task Force (including representatives for each school), Chronology, Participate, Resources for Students