



SYS 632: Designing Space Missions and Systems

School of Systems and Enterprises
Fall 2023

Instructor: Prof Pam Magee and TA Kaylon Paterson

Canvas Course Address: <https://sit.instructure.com/courses/69450/pages/sys-632-home-page>

Course Schedule: Monday-Sunday

Contact Info: pmagee@tsti.net, mobile: 719-440-3200 (eastern time zone) and kpaterso@stevens.edu Please refrain from using the “mail” or “inbox” feature in Canvas.

Virtual Office Hours: **TBD weekly group meeting: In Zoom, 7-8 or 8-9 pm eastern one night weekly.** Typically also available M-Fr 8 a.m. to 5:15 p.m. **eastern time** for pre-coordinated individual calls; additional availability can also be pre-arranged. Not typically available 9:45-11:15 a.m. eastern time M/W/Fr days

Virtual session URL: <https://stevens.zoom.us/j/2130351067>

Prerequisite(s): None

Corequisite(s): None

Cross-listed with: None

COURSE DESCRIPTION

This course examines the real-world application of the entire space systems engineering discipline to robotic space mission design. Taking a process-oriented approach, the course starts with basic mission objectives and examines in depth the principles and practical methods for mission design and operations. Interactive discussions focus on initial requirements definition, operations concept development, architecture trade-offs, payload design, bus sizing, subsystem definition, system manufacturing, verification and operations.

STUDENT LEARNING OUTCOMES

At the end of the course you should walk away with...

- Enhanced understanding of the big picture for space missions and systems
- Working, technical knowledge of how the elements of a space mission work, how the functions of a space system are implemented in practice, and the key trades that lead to a successful mission
- Practical experience with using data and systems engineering processes in the Space Technology Series to develop conceptual designs for space missions and systems
- An organized framework for future space learning—on your own, in academic courses, or other short courses

COURSE FORMAT AND STRUCTURE

This course is fully online. To access the course, please visit stevens.edu/canvas. For more information about course access or support, contact the Technology Resource and Assistance Center (TRAC) by calling 201-216-5500.

This course combines lectures, readings, homework, case studies and quizzes to develop an understanding of the concepts, principles, performance metrics, and design of robotic space missions.

The course is divided into thirteen modules that are completed over the same number of weeks. Graded homework, case studies, quizzes and exams are distributed throughout the course to reinforce learning, encourage participation and to encourage you to stay caught up on the material. Each student will complete a study plan and review it with an instructor three times during the semester.

Course Logistics

- Our weeks will run from Monday to Sunday. I will post information for the entire semester by the end of Orientation Week or soon after. It will be organized by the week it is assigned.
- When homework and study plans are due, they are **due by midnight eastern on the due date listed** in the course schedule. Each student will sign up for their Case Study due dates. Quizzes will close on Mondays at **midnight eastern time**.
- Deadlines are an unavoidable part of being a professional and this course is no exception. Course requirements must be completed and posted or **submitted on or before specified due date** and delivery time deadline. **Due dates and delivery time deadlines are defined as Eastern Time** (as used in Hoboken, NJ). Please note, students living in distant time zones or overseas must comply with this time and due date deadline policy. Avoid any inclination to procrastinate.
- To encourage you to stay on schedule, due dates have been established for each assignment; 20% of the total points will be deducted for assignments received 1-6 days late (**without prior coordination**); assignments received more than 1 week late will receive 0 points. Some flexibility will be allowed for work travel or illness, please coordinate this ASAP.

- Assignments requiring file submission must be submitted as **one .pdf per assignment**. All assignments will be reviewed within Canvas and feedback will be provided within Canvas versus file upload.

How to Approach this course:

- Review the material in the course handout during or prior to the week it is assigned
- Watch the online lectures and answer the review questions (via link below each lesson)
- Review the reference chapters in the course text
- Keep up with the homework (individual questions are generally assigned the week after the relevant content is covered in the course lesson). Ask questions early!
- Prepare for quizzes/exams by reviewing all of the above
- Read and respond to your classmates' case studies well before the due date

Instructor's Online Hours

I will be available via email and will respond as soon as I am available (generally within 24-48) hours. I live in the Eastern time zone and will typically not read work e-mails between 8 p.m. and 7 a.m. The best time to reach me by phone will be M-Fr 8 a.m. to 5:15 p.m. eastern time; additional availability can be pre-arranged. Most weeks, I will not be available M/W/Fr 9:45-11:15 a.m. eastern time.

For the Case Study online discussions, I will read them as they are posted and Kaylon or I will reply within the discussion to as many as possible. One of us will leave personal feedback within Canvas for each student. If we do not reply to your Case Study 1 assignment within the discussion forum, I will make sure to do so for Case Study 2.

Virtual Office Hours

Virtual Office Hours are a synchronous session (through Zoom) to discuss questions related to weekly readings and/or assignments. Office hours will be held **Wednesday (or Tuesday based on student availability)** evenings from 8:00-9:00 pm eastern time. To connect to the weekly session, click on Zoom and click on Join next to 2023F SYS -632-WS: Weekly Q&A.

Online Etiquette Guidelines

Your instructor and fellow students wish to foster a safe online learning environment. All opinions and experiences, no matter how different or controversial they may be perceived, must be respected in the tolerant spirit of academic discourse. You are encouraged to comment, question, or critique an idea but you are not to attack an individual. Our differences, some of which are outlined in the University's inclusion statement below, will add richness to this learning experience. Please consider that sarcasm and humor can be misconstrued in online interactions and generate unintended disruptions. Working as a community of learners, we can build a polite and respectful course ambience. Please read the Netiquette rules for this course:

- Do not dominate any discussion. Give other students the opportunity to join in the discussion.

- Do not use offensive language. Present ideas appropriately.
- Be cautious in using Internet language. For example, do not capitalize all letters since this suggests shouting.
- Avoid using vernacular and/or slang language. This could possibly lead to misinterpretation.
- Keep an “open-mind” and be willing to express even your minority opinion.
- Think and edit before you push the “Send” button.
- Do not hesitate to ask for feedback.

COURSE SCHEDULE

*** All Handout readings are required. SMAD Core textbook readings should be used as a reference after watching the video lessons and when completing the homework.**

Week Start-ing	Topics	Handout Reading up to Page	Text Reference Chapters*	Graded Event (due Monday of the following week)
9/1	Course Intro, Applied Space Systems Engineering, Space Mission Design	1-46	1	Personal Study Plan and Profile, Case Study 1 (variable due dates)
9/11	Intro to Orbits and Trajectories, Space Environments	47-74	US Ch 3, 4, 5 SMAD 8	Homework 1
9/18	Understanding Orbits, Describing and Using Orbits	75-112	6	HW2, Quiz 1
9/25	Orbit Maneuvers, Orbit Design and Selection	113-160	6	
10/2	Ascent /Entry, Launch System Services	161-190	US 10 SMAD 18.1,18.2	HW 3 & 4, Quiz 2
10/9	Spacecraft Architecture Development	191-204	2, 3	Mid-term Exam, HW 5
10/16	Payload Design, Spacecraft Allocated Architecture, Spacecraft Subsystem Design	205-252	9, 10	Mid-term Study Plan Review, Case Study 1 Peer Reviews Due
10/23	Subsystem Design (Electrical Power, ADCS/GNC)	253-294	11.4, 11.1, 11.7	HW 6, Case Study 2 (variable dates)
10/30	Subsystem Design (Space Propulsion, Communications)	295-326	11.2, 13, 17	HW 7 & 8, Quiz 3
11/6	Subsystem Design (Data Handling)	327-349	11.3, 16	HW 9
11/13	Subsystem Design (Thermal Control, Spacecraft Structures & Configuration)	350-384	11.5,11.6	HW 10
	Skip week of Thanksgiving Break			
11/27	System Realization, Space Mission Operations	385-434	12,14,15	HW 11 & 12
12/4	Evaluating Mission Risk and Cost, Review	435-460	19, 20	HW 13 & 14, Quiz 4, Final Plan Review and Self-Assessment

12/11	Review	Review All	Case Study 2 Peer Reviews Due, Final Exam (15-18 Dec 2023)
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*All text references are for *Space Mission Analysis and Design* (SMAD) Core except where noted.

COURSE MATERIALS

Textbook(s)

Required: *Core Capabilities for Space Mission Analysis and Design* (SMAD Core) available here: <https://spacetechnologyseries.com/~spacet9/books/SMADCore.html>

Recommended but not required: *Understanding Space: An Introduction to Astronautics* (US) [Sellers, et al.] <https://spacetechnologyseries.com/~spacet9/books/Understanding-Space.html>

Other Readings

N/A

Materials

N/A

COURSE REQUIREMENTS

Attendance

Weekly course attendance is not required as all lessons are pre-recorded and available on-demand. The personal study plan assignments include a requirement to meet with the professor or TA in a group or as an individual.

Participation

This course contains two Case Study (group discussion) assignments as well as a “getting to know you” discussion assignment. Each student is required to participate in the “getting to know you” discussion at the beginning of the semester. Each student is also required to post Case Studies discussions on dates they choose during Orientation Week. Before the assigned Case Study due dates in Canvas, each student must reply to at least **three** classmates’ Case Study posts (for a total of at least 6 replies during the semester).

Homework

Homework should be submitted via Canvas no later than the dates assigned in Canvas. HW is due by midnight eastern time on Monday of the week after it is assigned. Upload **one pdf file** containing your written math solutions and typed short answer solutions. Feedback will be provided in Canvas within one week of assignment submission. *Early submission of HW is encouraged.* Any HW submitted **prior to Friday evening** each week will be quickly reviewed and feedback provided along with a chance to edit HW and re-submit by Monday. If you submit your HW early, please post a submission comment alerting me to this.

Quizzes

This course includes 4 quizzes. They each contain five multiple choice or true/false questions. You will have 25 minutes to complete each quiz. The quizzes are **not** cumulative. They will be graded automatically by Canvas and feedback will be available

within Canvas as soon as each quiz is closed to all students. Quizzes close Monday night by midnight eastern time.

Project(s)

N/A

Exams

This course has a midterm exam and a final exam. These exams contain multiple choice and true/false questions. They will be available during the following periods: Midterm - 13-16 Oct, Final Exam - 15-18 Dec. The midterm exam covers content from weeks 1-5 of the course. The **final exam covers all course content**. The exam questions are based on the readings, lesson videos and homework.

TECHNOLOGY REQUIREMENTS

Baseline technical skills necessary for online courses

- Basic computer and web-browsing skills
- Navigating Canvas

Technology skills necessary for this specific course

- Live web conferencing using Zoom
- Ability to view video lessons embedded in the Canvas course

Required Equipment

- Computer: current Mac (OS X) or PC (Windows 7+) with high-speed internet connection
- Webcam: built-in or external webcam, fully installed (please use camera when speaking during Zoom calls)
- Microphone: built-in laptop or tablet mic or external microphone

Required Software

- Microsoft Word or Pages
- Microsoft Excel or Number

GRADING PROCEDURES

Grades and feedback for quizzes and exams will be available via Canvas as soon as the time period for completing these graded events closes for all students. An instructor or TA will post feedback on case studies within the discussion thread or in Canvas feedback. Detailed written feedback will be provided for homework problems within Canvas within a week of their due date and prior to the next scheduled quiz/exam. Study plan reviews include one-on-one or group discussions with your instructor unless waived by both instructor and student.

Grades will be based on:

Personal Study Plan (2%) and Intro Discussion (1%)	3%
Class Participation (Discussions, Case Studies)	10%
Quizzes (4 @ 2% each)	8%
Homework Problems	25%
Mid-term Exam	20%

Mid-term Study Plan Review	1%
Final Study Plan Review and Self-Assessment	3%
Course Survey (PLEASE!)	0%
Final Exam	30%

Late Policy

All assignments are due on the date/time indicated in the course modules unless otherwise pre-coordinated. Late work will be penalized by 20% of the total points for assignments received 1-6 days late; assignments received more than 1 week late will receive 0 points. However, I recognize that many students have full-time jobs and family responsibilities along with this course. If you know you will be late on an assignment, please notify your instructor at least 24 hours in advance to request an extension. Extensions will be granted on a case by case basis for cause. Requests for extensions AFTER the stated due date may not be granted except for extenuating personal circumstances.

Academic Integrity

Generative AI Technologies

You may use AI programs e.g. ChatGPT to help generate ideas and brainstorm. However, you should note that the material generated by these programs may be inaccurate, incomplete, or otherwise problematic. Beware that use may also stifle your own independent thinking and creativity.

You may not submit any work generated by an AI program as your own. If you include material generated by an AI program, it should be cited like any other reference material (with due consideration for the quality of the reference, which may be poor).

Any plagiarism or other form of cheating will be dealt with under relevant Stevens policies.

Graduate Student Code of Academic Integrity

All Stevens graduate students promise to be fully truthful and avoid dishonesty, fraud, misrepresentation, and deceit of any type in relation to their academic work. A student's submission of work for academic credit indicates that the work is the student's own. All outside assistance must be acknowledged. Any student who violates this code or who knowingly assists another student in violating this code shall be subject to discipline.

All graduate students are bound to the Graduate Student Code of Academic Integrity by enrollment in graduate coursework at Stevens. It is the responsibility of each graduate student to understand and adhere to the Graduate Student Code of Academic Integrity. More information including types of violations, the process for handling perceived violations, and types of sanctions can be found on the [Office of Graduate Academics web page](#).

EXAM CONDITIONS

The following procedures apply to quizzes and exams for this course. As the instructor, I reserve the right to modify any conditions set forth below by printing revised Exam Conditions on the quiz or exam.

1. Students may use the following materials during quizzes and/or exams. Any materials that are not mentioned in the list below are not permitted.

Material	Permitted?	
	Yes	No
Handwritten Notes Conditions: i.e. size of note sheet	Yes	
Typed Notes Conditions: i.e. size of note sheet	Yes	
Textbooks Conditions: i.e. specific books	Yes	
Readings Conditions: i.e. specific documents	Yes	
Other (specify) Feedback for course Homework - consider printing or saving to your computer prior to exam	Yes	

2. Students work with or students during quizzes and/or exams.

3. Specific Parameters: N/A

are not allowed to talk to other

ACCOMMODATIONS

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. The Office of Disability Services (ODS) works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, psychiatric disorders, and other disabilities to help students achieve their academic and personal potential. They facilitate equitable access to the educational programs and opportunities offered at Stevens and coordinate reasonable accommodations for eligible students. These services are designed to encourage independence and self-advocacy with support from the ODS staff. The ODS staff will facilitate the provision of accommodations on a case-by-case basis.

For more information about Disability Services and the process to receive accommodations, visit <https://www.stevens.edu/student-diversity-and-inclusion/disability-services>. If you have any questions please contact the Office of Disability Services at disabilityservices@stevens.edu or by phone: 201.216.3748.

Disability Services Confidentiality Policy

Student Disability Files are kept separate from academic files and are stored in a secure location within the Office of Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

INCLUSIVITY

Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in academic discourse and innovation. In this class, the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations,

disabilities, socioeconomic backgrounds, and nationalities will be respected and viewed as a resource and benefit throughout the semester. Suggestions to further diversify class materials and assignments are encouraged. If any course meetings conflict with your religious events, please do not hesitate to reach out to your instructor to make alternative arrangements.

You are expected to treat your instructor and all other participants in the course with courtesy and respect. Disrespectful conduct and harassing statements will not be tolerated and may result in disciplinary actions.

Name and Pronoun Usage

As this course includes group work and class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your pronouns and/or name, please inform the instructor of the necessary changes.

Religious Holidays

Stevens is a diverse community that is committed to providing equitable educational opportunities and supporting students of all ethnicities and belief systems. Religious observance is an essential reflection of that rich diversity. Students will not be subject to any grade penalties for missing a class, examination, or any other course requirement due to religious observance. In addition, students will not be asked to choose between religious observance and academic work. Therefore, students should inform the instructor at the beginning of the semester if a requirement for this course conflicts with religious observance so that accommodations can be made for students to observe religious practices and complete the requirements for the course.

MENTAL HEALTH RESOURCES

Part of being successful in the classroom involves a focus on your whole self, including your mental health. While you are at Stevens, there are many resources to promote and support mental health. The Office of Counseling and Psychological Services (CAPS) offers free and confidential services to all enrolled students who are struggling to cope with personal issues (e.g., difficulty adjusting to college or trouble managing stress) or psychological difficulties (e.g., anxiety and depression). Appointments can be made by phone (201-216-5177), online at <https://stevensportal.pointnclick.com/confirm.aspx>, or in person on the 2nd Floor of the Student Wellness Center.

EMERGENCY INFORMATION

In the event of an urgent or emergent concern about your own safety or the safety of someone else in the Stevens community, please immediately call the Stevens Campus Police at 201-216-5105 or on their emergency line at 201-216-3911. These phone lines are staffed 24/7, year-round. For students who do not reside near the campus and require emergency support, please contact your local emergency response providers at 911 or via your local police precinct. Other 24/7 national resources for students dealing with mental health crises include the National Suicide Prevention Lifeline (1-800-273-8255) and the Crisis Text Line (text “Home” to 741-741). If you are concerned about the wellbeing of another Stevens student, and the matter is *not* urgent or time sensitive, please email the CARE Team at care@stevens.edu. A member of the CARE Team will respond to your concern as soon as possible.