Detailed Syllabus - read entire page

Cost Effective Space Mission Operations (SYS 637)

School of Systems and Enterprises

Spring 2023

Instructors: Prof. Pam Magee and TA Kaylon Paterson

Canvas Course Address: **https://sit.instructure.com/courses/63919 (https://sit.instructure.com/courses/63919)**

Course Schedule: Monday - Sunday. This course runs on a Monday to Sunday schedule. Most assignments are due on Monday by midnight eastern time and quizzes typically close Monday by midnight eastern. The intent of the assignment due dates is to allow all of you (despite time zone) to have the entire weekend to finish assignments if necessary. Do not wait until the last minute to start assignments. I prefer not to answer questions on Sundays and am often busy on Saturdays.

Contact Info: email: **pmagee@tsti.net (mailto:pmagee@tsti.net)** (or **pmagee@stevens.edu (mailto:pmagee@stevens.edu)**); 719-440-3200; NOTE: my phone blocks all calls not in my list of contacts, please text me before calling so I know to allow a call.

Virtual Office Hours: Weekly, optional Q&A sessions in Zoom, between 7pm and 9pm eastern one night each week. Usually 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 8:45-10:15 a.m. eastern time M/W/Fr

Virtual session URL: All required lessons are pre-recorded and available in Canvas. Zoom links will be provided as needed for study plan calls and weekly/optional Q&A sessions.

Prerequisite(s): Graduate Status or approved by advisor

Co-requisite(s): None

Cross-listed with: None

COURSE DESCRIPTION

This course explores the challenge of designing and implementing real-world mission operations in a practical, cost-effective way. Taking a process-oriented approach, the course provides an in-depth view of the entirety of space mission operations, including the concept of operations and all activities that are performed in support of a space mission. Interactive discussions focus on initial requirements definition, operations concept development, and functional allocation among spacecraft, payload, ground system and operators. Students get extensive hands-on experience with a variety of mission operations modeling tools to understand physical constraints and appreciate the impact of programmatic trade-offs.

NOTE: Will be required to use Stevens' AppSpace to run Systems Tool Kit software during this course.

STUDENT LEARNING OUTCOMES

At the end of this course the student should be able to...

- Define and explain the critical activities of space mission operations
- Discuss the inputs, outputs and uses for a space Mission Operations Concept and be able to critically analyze one of these key documents
- Describe the elements that contribute to mission operations complexity and perform trade-off analyses to reduce that complexity
- Analyze mission orbits to determine ground system pass characteristics
- Describe key elements of mission ground systems
- Compare and contrast operations concepts for military, civil, scientific and human space missions
- Develop and analyze, aspects of simulated satellite pass plans

COURSE FORMAT AND STRUCTURE

This course is **fully online**. To access the course, please visit stevens.edu/canvas

(http://stevens.edu/canvas) . For more information about course access or support, contact the Technology Resource and Assistance Center (TRAC) by calling 201-380-6599.

Course Logistics

This course combines course videos (CV), Handout (HO) readings, Course Reference Text readings, case studies, hands-on exercises, and a final exam to develop an understanding of the concepts, principles and practical techniques of space mission operations planning and execution.

The course is divided into six blocks that are completed over thirteen weeks. Graded exercises, 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.

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
- Review the reference chapters in the course text
- Keep up with the assignments. Ask questions early!
- Prepare for quizzes/exams by reviewing all of the above

Instructor's Online Hours

I will be available via email or phone and respond as soon as I am available (generally within 24-48). If you do not hear back in this time frame please reach out to me again. If you feel you are being neglected in any way, please contact me.

Virtual Office Hours

Virtual Office Hours are a synchronous session through Zoom to discuss questions related to weekly readings and/or assignments.

Online Etiquette Guidelines

Your instructor and fellow students wish to foster a safe online learning environment. No matter how different or controversial they may be perceived, all opinions and experiences must be

respected in the tolerant spirit of academic discourse. You are encouraged to comment, question, or critique an idea, but you cannot 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 ambiance. Please read the Netiquette rules for this course:

- Do not dominate any discussion. Allow other students 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 as it could 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

Homework assignments and readings are due Monday by midnight eastern time typically one week after the week they are assigned (unless otherwise specified). All assignments/exercises are posted in Canvas via the link for each individual assignment. **Due dates are clearly indicated in each assignment**. Quizzes close on Monday's at midnight eastern time, unless otherwise specified. In the table below, "CV" refers to course videos. CESMO is the required course textbook, Cost-Effective Space Mission Operations (CESMO) 2nd Edition. "HO" refers to the course handout contained in Canvas. *The handout is a compilation of all video lesson slides.*

Week Starting	Topic(s)	Lessons/Readings	Assignment
Orientation 9 Jan Week 1 18 Jan	Course Intro; Mission Operations Overview; FalconSAT Case Study	CV: 1.1, 1.2 HO : 1.1,1.2; FalconSAT Case Study Reference Text: CEMSO: 1, 2 ASSE: 1 US: 11, 15	Personal Study Plan and Profile

23 Jan	“Failure is Not an Option” video; ConOps Overview	CV: 2.1 HO : 2.1 Reference Text: CESMO 4	Failure Not an Option Ex Quiz 1
30 Jan	ConOps Development; Operations complexity; Cygnus Case Study	CV: 2.2 HO : 2.2; Cygnus Case Study Reference Text: CEMSO: 5 ASSE: 3	Complexity Ex
6 Feb	QuickLook (QL) ConOps Overview; Understanding and Using Orbits pt 1	CV: 3.1.1 HO : 3.1 pt 1 Reference Text: CEMSO: 10 US: 4-6	QL Ex; Quiz 2
13 Feb	Understanding and Using Orbits pt 2	CV: 3.1.2 CV 3.1.3 HO : 3.1 pt 2 Reference Text: CEMSO: 10 US: 4-6	SMAD Spreadsheet Maneuver EX; Kepler's T Problem Exercise
20 Feb	Perturbations & Orbit Prediction	CV: 3.2.1 CV: 3.2.2 HO : 3.2 pt 1&2 Reference Text: CEMSO: 10 US: 8	Quiz 3
27 Feb	STK Introduction	STK Tutorial	STK OPS Scenarios 1 & 2
6 Mar		CV: 4.1.1 HO : 4.1 pt 1	STK OPS

(skip Spring Break)	TT & C	Reference Text: CESMO: 12 SMAD: 11.2	Scenario 3
20 Mar	Communication Architecture / Link Analysis	CV: 4.1.2 HO : 4.1 pt 2 Reference Text: CESMO:11,12 SMAD:13	SMAD Spreadsheet Link Analysis EX
27 Mar	Ground Systems & Comm Architecture	CV: 4.2 HO : 4.2 Reference Text: CESMO:11,12 SMAD:13	SMAD/STK Link EX; Quiz 4
3 Apr	Space Environment & Spacecraft Design	CV: 5.1 HO : 5.1 Reference Text: US: 3, 11-14	NetworKing EX
10 Apr	Contingency Planning & Anomalies Echo Star Case Study	CV: 5.2 HO : 5.2; Echo Star Case Study Reference Text: CESMO: 16	Anomaly EX; Quiz 5
17 Apr	Launch & EO Ops Planning & Execution Organization & Training	CV: 6.1, 6.2 HO: 6.1, 6.2 Reference Text: CESMO: 8 & 9	Quiz 6; Final Study Plan Review & Self-Assessment
5 May	Final Exam	Review All	Exam must be taken on between 12 and 15 Ma

COURSE MATERIALS

- **Required:** Cost-Effective Space Mission Operations (CESMO) 2nd Edition [Squibb et al. McGraw-Hill]
  Online Course Videos (CV) and Space Mission Operations Course Handout (HO)
  Course Handout
- **Recommended:**

  Understanding Space: An Introduction to Astronautics (US) [Sellers, et al. Inkling];
  Space Mission Analysis & Design (SMAD) Core [edited by Larson and Wertz, Inkling book via CEI];
  Applied Space Systems Engineering (ASSE) [Larson et al., CEI]

COURSE REQUIREMENTS

Attendance: N/A; all lessons are pre-recorded

Participation: N/A

Homework: Each graded assignment is detailed in the assignment section for this course on Canvas. Course materials are the only valid source for class assignments unless specifically stated otherwise. All assignments **should be submitted in pdf or MS Excel format**, as specified.

Quizzes: Six timed block quizzes containing multiple-choice and true/false questions will be taken online through Canvas. Grading will be automatic after quiz submission, detailed feedback will be provided the day after the quiz closes to all students.

Project(s): N/A

Exams: The Final Exam will be a comprehensive multiple choice final taken during finals week. The numerical workout problems, answered submitted as part of the multiple choice final exam, will be provided up to 10 days in advance.

Personal Study Plan and Profile	3%
“Failure is not an Option” Exercise	5%
Quizzes (6 @ 3% each)	18%

Complexity Exercise	4%
ConOps Exercise	5%
SMAD Spreadsheet Maneuver Exercise	5%
Kepler TOF Problem Exercise	3%
STK Ops Scenarios 1 & 2 Exercises	5%
STK Ops Scenario 3 Exercise	5%
SMAD Spreadsheet Link Analysis Exercise	5%
SMAD / STK Link Analysis Exercise	5%
NetworKing Exercise	5%
Anomaly Resolution Exercise	5%
Final Study Plan Review and Self-Assessment	2%
Final Exam	25%
Course Feedback (PLEASE!)	0%

TECHNOLOGY REQUIREMENTS

Baseline technical skills necessary for online courses

- Basic computer and web-browsing skills
- Navigating Canvas

Technology skills necessary for this specific course

- Ability to use various software packages to accomplish course exercises.
- Live web conferencing using Zoom (for office hours, study plan calls)

Required Equipment

- Computer: PC (Windows 10+) or current Mac (OS X) with high-speed internet connection
- *Desired:* Webcam: built-in or external webcam, fully installed
- Microphone: built-in laptop or tablet mic or external microphone

Required Software

- Microsoft Word or Pages
- Microsoft Excel or Numbers
- **Systems Tool Kit (STK) provide by Ansys (formerly Analytical Graphics); software will be run via Stevens' AppSpace Cloud service**

GRADING PROCEDURES

GRADING PROCEDURES

Grades for quizzes and exams will be available via Canvas as soon as the time period for completing these graded events closes for all students. Written feedback will be provided for assignments in Canvas within a week of their due date when possible.

Late Policy:

- The presumptive score for late work is a "0" unless arrangements have been made with your instructor ***PRIOR*** to the due date.

Academic Integrity

The Graduate Student Code of Academic Integrity binds students in graduate courses (600 level and above).

- Students in this course are bound by the Stevens Graduate Student Code of Academic Integrity.

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 at **https://my.stevens.edu/provost/grad-academics-and-student-success (https://my.stevens.edu/provost/grad-academics-and-student-success)** .

EXAM ROOM 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 Room Conditions on the quiz or exam.

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

Device	Permitted?	
	Yes	No
Laptops	x	
Cell Phones	x	

Tablets	x	
Smart Watches	x	
Google Glass	x	
Other (Specify)		x

2. 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	x	
Typed Notes	x	
Textbooks	x	
Readings	x	
Other (specify)		x

3. **Students are not allowed to work with or talk to other students during quizzes and the**

final exam

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 such disabilities in order to help students achieve their academic and personal potential. They facilitate equal 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 (https://www.stevens.edu/student-diversity-and-inclusion/disability-services)** . If you have any questions please contact: Phillip Gehman, the Director of Disability Services Coordinator at Stevens Institute of Technology at **pgehman@stevens.edu (mailto:pgehman@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

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 name and/or pronouns, please inform the instructor of the necessary changes.

Inclusion Statement

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.

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 are can be made by phone (201-216-5177).

EMERGENCY INFORMATION

In the event of an urgent or emergent concern about the safety of yourself or 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 (mailto:care@stevens.edu)** . A member of the CARE Team will respond to your concern as soon as possible.