

AAE 590: Space Flight Operations

Course Information

CRN:

- WN2: 19989
- EP1: 24830
- OX1: 25164

Meeting time (WN2): T/R 12:00 pm – 1:15 pm

Course credit hours: 3.0

Prerequisites: This course is open to seniors and graduate students. There are no fixed prerequisites within the AAE curriculum, and the course may be of interest to non-AAE majors.

Instructors

Dr. Justin R. Mansell

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Office hours: TBD

Course Description

Space Flight Operations will provide students with a technical foundation for the operation of Earth orbiting and planetary missions. The course begins with providing students a background in spacecraft design with an emphasis on the eventual operability of the mission. This will include lectures on mission concept studies, key design trades, verification and validation, as well as the development of technical resource budgets for power, propulsion, telecommunications, thermal control, and attitude control sizing. In the second segment of the course, students will learn about the operation of spacecraft in orbit. Characteristics and modeling of the space environment will be discussed to provide a foundation for introducing students to orbit determination, orbit prediction, and pass planning. Flight team organization, launch operations, and orbital rendezvous will also be presented if time permits. The third segment concerns anomaly detection and response. Students will learn about anomaly types and techniques for detecting them in spacecraft telemetry. Students will also learn how to troubleshoot anomalies using fault trees, manage risk, and perform contingency planning. In the final segment, the class will learn industry best-practices and discuss failure investigation reports for high-profile mission failures spanning human and robotic missions.

Learning Outcomes

The Space Flight Operations course is designed so that students will achieve the following learning outcomes:

- Understanding of the terminology associated with space flight operations
- Development of technical resource budgets, spanning mass, power, thermal, telecommunications, data volume
- Understanding of the roles and processes involved in operating a mission
- Ability to determine and predict the location of an Earth orbiting spacecraft for planning purposes
- Ability to identify and assess anomalies in spacecraft telemetry
- Ability to identify and mitigate mission risks
- Understanding of best practices for space mission design, management, and operations

Learning Resources, Technology, & Texts

Recommended Textbooks: These texts provide material that is supplementary to the lectures and are not required.

- Uhlig, T., Sellmaier, F., Schmidhuber, M., editors, *Spacecraft Operations*, Springer, 1st Edition, 2015, ISBN 978-3-7091-4848-8.
- Montenbruck, O. and Gill, E., *Satellite Orbits*, Springer, 1st Edition, 2000, ISBN 978-3-540-67280-7
- Griffin, M.D., French, J.R., *Space Vehicle Design*, AIAA, 2nd Edition, 2004, ISBN 1-56347-539-1

Brightspace: The course [Brightspace site](#) will be used to distribute course materials and facilitate forum discussions.

Additional Readings such as journal papers and technical reports will be also uploaded to the Brightspace site.

Instructor's Face-to-Face Office Hours

TBD

Virtual Office Hours

Virtual Office Hours are a synchronous session (through WebEx) to discuss questions related to lectures, readings, and/or assignments. Office hours will be held weekly (time TBD). To connect to the weekly session, go to [WebEx](#).

Assignments and Points

The course requirements include class discussion via the Brightspace forum and reading assignments from the text and additional sources including journal articles, technical reports, and failure investigation documents. Approximately five homework sets will be assigned, and students will submit a term paper. There will be one midterm exam. There is no final exam.

Evaluation of student performance in the course will be based upon the following graded work:

- Homework assignments (50%)
- Final term paper (20%)
- Midterm exam (25%)
- Brightspace forum discussion (5%)

Credit for the Brightspace forum discussion will be earned by:

- Asking or responding to questions regarding course material (e.g. homework assignments)
- Contributing questions and insights to forum threads posted by the instructor to spur class discussion
- Sharing articles, analyses, or personal experiences that are relevant to the course

Each student should make at least 3 substantial contributions to the forum throughout the semester to receive full credit for the forum discussion portion of the grade breakdown. "Substantial" means asking thought-provoking questions and making honest attempts to answer the questions of the instructor and your peers. If you are sharing an article on the forum, it should be accompanied by a brief summary (1-2 paragraphs) that explains why it is relevant to the class and how it demonstrates or contradicts something we learned in the course.

Grading Scale

Grades will be based upon the following scale. The instructor may choose to adjust the scale based upon the final grade distribution of the class:

A+: 98 – 100%
A: 93 – 97.99%
A-: 90 – 92.99%
B+: 88 – 89.99%
B: 83 – 87.99%
B-: 80 – 82.99%
Etc.

Missed or Late Work

Late homework is not accepted unless previously arranged with the instructor. Make-up exams will only be offered in the event of a pre-arranged absence, or a medical problem with a doctor's note.

Attendance Policy during COVID-19

Students should stay home and contact the Protect Purdue Health Center (496-INFO) if they feel ill, have any symptoms associated with COVID-19, or suspect they have been exposed to the virus. In the current context of COVID-19, in-person attendance will not be a factor in the final grades, but the student still needs to inform the instructor of any conflict that can be anticipated and will affect the submission of an assignment or the ability to take an exam. Only the instructor can excuse a student from a course requirement or responsibility. When conflicts can be anticipated, such as for many University-sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency conflict, when advance notification to an instructor is not possible, the student should contact the instructor as soon as possible by email, through Brightspace, or by phone. When the student is unable to make direct contact with the instructor and is unable to leave word with the instructor's department because of circumstances beyond the student's control, and in cases of bereavement, quarantine, or isolation, the student or the student's representative should contact the Office of the Dean of Students via [email](#) or phone at 765-494-1747. Our course Brightspace includes a link on Attendance and Grief Absence policies under the University Policies menu.

Classroom Guidance Regarding Protect Purdue

The [Protect Purdue Plan](#), which includes the [Protect Purdue Pledge](#), is campus policy and as such all members of the Purdue community must comply with the required health and safety guidelines. Required behaviors in this class include: staying home and contacting the Protect Purdue Health Center (496-INFO) if you feel ill or know you have been exposed to the virus, properly wearing a mask [in classrooms and campus building](#), at all times (e.g., mask covers nose and mouth, no eating/drinking in the classroom), disinfecting desk/workspace prior to and after use, maintaining appropriate social distancing with peers and instructors (including when entering/exiting classrooms), refraining from moving furniture, avoiding shared use of personal items, maintaining robust hygiene (e.g., handwashing, disposal of tissues) prior to, during and after class, and following all safety directions from the instructor.

Students who are not engaging in these behaviors (e.g., wearing a mask) will be offered the opportunity to comply. If non-compliance continues, possible results include instructors asking the student to leave class and instructors dismissing the whole class. Students who do not comply with the required health behaviors are violating the University Code of Conduct and will be reported to the Dean of Students Office with sanctions ranging from educational requirements to dismissal from the university.

Any student who has substantial reason to believe that another person in a campus room (e.g., classroom) is threatening the safety of others by not complying (e.g., not wearing a mask) may leave the room without consequence. The student is encouraged to report the behavior to and discuss next steps with their instructor. Students also have the option of reporting the behavior to the [Office of the Student Rights and Responsibilities](#). See also [Purdue University Bill of Student Rights](#).

Academic Integrity

While it is acceptable to consult with classmates regarding homeworks, the work submitted should be your own. Duplicate assignments will receive a zero grade. Term papers should cite work that is referenced. Plagiarism will not be tolerated.

Purdue prohibits "dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty." [Part 5, Section III-B-2-a, Student Regulations] Furthermore, the University Senate has stipulated that "the commitment of acts of cheating, lying, and deceit in any of their diverse forms (such as the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest." [University Senate Document 72-18, December 15, 1972]

Do not distribute course materials without written permission from the instructor. Among the materials that may be protected by copyright law are the lectures, notes, and other material presented in class or as part of the course. Notes taken in class are generally considered "derivative works" of the instructor's presentation and materials and are thus subject to the instructor's copyright in such presentations and materials. No individual is permitted to sell or otherwise barter notes, either to other students or to any commercial concern, for a course without the express written permission of the course instructor.

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either [emailing](#) or by calling 765-494-8778. While information may be submitted anonymously, the more information that is submitted provides the greatest opportunity for the university to investigate the concern.

The [Purdue Honor Pledge](#) "As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue"

Nondiscrimination Statement

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. [Link to Purdue's nondiscrimination policy statement.](#)

Students with Disabilities

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247.

Emergency Preparation

The Purdue homepage (www.purdue.edu) will provide news of campus closures and emergency information. In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Information about these changes will be available from Blackboard and/or via e-mail. You are expected to check your Purdue email on a frequent basis.

Mental Health Statement

- **If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try [WellTrack](#).** Sign in and find information and tools at your fingertips, available to you at any time.
- **If you need support and information about options and resources,** please see the [Office of the Dean of Students](#) for drop-in hours (M-F, 8 am- 5 pm).
- **If you're struggling and need mental health services:** Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact [Counseling and Psychological Services \(CAPS\)](#) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office of the second floor of the Purdue University Student Health Center (PUSH) during business hours.

Violent Behavior Policy

Purdue University is committed to providing a safe and secure campus environment for members of the university community. Purdue strives to create an educational environment for students and a work environment for employees that promote educational and career goals. Violent Behavior impedes such goals. Therefore, Violent Behavior is prohibited in or on any University Facility or while participating in any university activity.

Disclaimer

This syllabus is subject to change, at the discretion of the instructor.