

San José State University

# Aerospace Engineering

## AE 172 A – Spacecraft Design I – Fall 2023

**INSTRUCTOR INFO**

Dr. Periklis Papadopoulos

(408) 924-7168

[periklis.papadopoulos@sjsu.edu](mailto:periklis.papadopoulos@sjsu.edu)

Office Hours: TR 8:30 - 9:00 am &amp; 8:45 – 10:00 pm

**CLASS DAYS & TIME** TR 9:00 – 10:15**PREREQUISITES** Grade “C” or better in: AE20, AE162, AE165, Engr.100W  
Senior in good standing.**CO-REQUISITES** AE164, AE168, Engr195A**TEXTBOOK** Instructor Notes**DESCRIPTION** This is the first course in a two-semester sequence in which students work in teams to design a spacecraft.

More specifically, students complete the conceptual and preliminary design of a spacecraft. Students also integrate general education (GE) learning outcomes into their design project, as they are challenged to think about and discuss in class and in their reports, the relationship of aerospace engineering to the broader community both in the U.S. and worldwide. This discussion includes ethics, safety and liability issues, and issues of identity, equality, social actions, and culture in relationship to aerospace engineering practice.

***COURSE GOALS***

1. To provide senior engineering students a capstone experience in spacecraft design.
2. To offer an opportunity for going beyond a paper product (design report) into actual manufacturing and launching of microsattellites.
3. To develop students' creative abilities in solving open-ended, spacecraft design problems.
4. To develop an appreciation of the interrelationships between aerodynamics,

- propulsion, structures, flight mechanics, stability & control, manufacturing, maintenance, and cost in an integrated spacecraft design.
5. To develop students' engineering judgment as well as their confidence in making and accepting responsibility for design decisions.
  6. To make students aware of engineering standards pertaining to space systems design, such as the General Environmental Verification Standard and the TechEdSat Interface Control Standards.
  7. To develop students' [oral](#) and [written](#) communication skills, necessary to describe the assumptions, methods, and results of engineering analysis, synthesis, and decision making associated with spacecraft design.
  8. To make students aware of the importance of [teamwork](#) in the design of a spacecraft and provide them with an opportunity to develop team and leadership skills.
  9. To make students aware of their professional and ethical responsibilities as practicing engineers.
  10. Discuss the role of identity, equality, social actions, and culture in aerospace engineering practice. (Integration of Area S and Engineering.)

### **COURSE LEARNING OBJECTIVES**

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

***ABET Outcome 2:*** Ability to design aerospace vehicles that meet specified requirements and subject to public health, safety and welfare, global, cultural, social, environmental, and economic constraints.

1. Define an appropriate set of mission requirements for a spacecraft.
2. Define, calculate, and evaluate measures of merit (MOM) for a spacecraft.
3. Perform a literature search and collect data to show the need for a particular spacecraft. (***ABET Outcome 7:*** Ability to acquire knowledge as needed, using appropriate learning strategies.)
4. Design spacecraft hardware subject to specific requirements, public health, safety and welfare, global, cultural, social, environmental, and economic constraints, and are in compliance with the general environmental verification (GEVS) and the TechEdSat interface control standards.
5. Apply the complete product development cycle: basic idea / societal need / market study / economic and budget analysis.
6. Create the baseline design of a spacecraft.
7. Establish the final design of a spacecraft.
8. Evaluate / analyze the operation of a spacecraft as well as any data relayed.

***ABET Outcome 5:*** Ability to function effectively on a team, whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

9. Work harmoniously and effectively in a team to solve engineering problems related to the design of a spacecraft and to communicate the results in technical reports and oral briefings.
10. Communicate effectively in a team environment, negotiate and resolve conflicts, motivate and coach others in your team, organize and delegate work as needed, develop a team vision and set team goals, and manage resources.

11. Evaluate your own performance as well as that of your teammates using specific criteria, such as the quality of their work, their commitment to the team / project, leadership skills, responsibility, abilities, communication skills, and personality.

***Project Management***

12. Develop a milestone schedule (timeline) for an engineering project and follow it.

***ABET Outcome 4:*** Ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, considering the impact of engineering solutions in global, economic, environmental, and societal contexts.

13. Identify possible courses of action, discuss the pros and cons of each one, and decide on the best one, given a job-related scenario that requires a decision with ethical implications.

***ABET Outcome 3:*** Ability to communicate effectively with a range of audiences.

14. Write high quality design reports (i.e., using correct language and terminology, correct technical information, and professionally prepared graphs and tables).
15. Give clear, informative, technically correct oral presentations using professionally prepared visual aids.

**GE / SJSU STUDIES LEARNING OUTCOMES**

Upon successful completion of this course, students will be able to:

**S-LO4:** Recognize and appreciate constructive interactions between people from different cultural, racial, and ethnic groups within the U.S.

***ABET Outcome 5:*** Ability to function effectively on a team, whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

***ABET Outcome 7:*** Ability to acquire knowledge as needed, using appropriate learning strategies.

AE172A – Write a **1000-word essay** that depicts the negative conditions, and attendant inequality for a social matter of interest, construct an argument that a selected technology is expected to advance justice by reducing negative conditions that are asymmetrically or unequally experienced by populations in society, and offer their thoughts on how these matters of justice inform their view of their future career as an engineer. Please note that an “adequate” score in all 4 criteria in the rubric is insufficient to attain the required 70% grade. You must have a higher score in at least one of the four criteria.

**GRADING**

| Grade | Minimum Score |
|-------|---------------|
| A+    | 950           |
| A     | 900           |
| A-    | 850           |

|    |              |
|----|--------------|
| B+ | 800          |
| B  | 750          |
| B- | 700          |
| C+ | 675          |
| C  | 650          |
| C- | 625          |
| F  | 624 or lower |

- 70% based on team performance (design reports); individual scores are determined by peer evaluations.
- 20% based on additional assignments:
  - GE Area S / ABET Outcome 7: Essay.
  - ABET Outcome 4: Case studies on safety, ethics, and liability issues
  - **NB: Even if you score 100% on the technical (design) part of the course, you will NOT receive a passing grade UNLESS you also average 70% or higher on all assignments within each of the following categories:**
    1. Assignments that address ABET Outcome 2
    2. Assignments that address Student Outcome 4
    3. Assignment that addresses GE / SJSU Studies Area S
- 10% based on my personal evaluation of each student. Elements to be considered: attitude, class attendance, participation in class activities and professional societies.

## TOPICS

### Week Topics (AE 172A)

- 01 Introduction to spacecraft design.
- 02 Mission requirements.
- 03 Systems specification documentation; standards pertaining to space systems design: General Environmental Verification Standard (GEVS), TechEdSat Interface Control Standards.
- 04 System decomposition.
- 05 Subsystem design.
- 06 Subsystem specification documentation; General Environmental Verification (GEVS) and TechEdSat Interface Control standards.
- 07 Subsystem design review.
- 08 System design and integration.
- 09 System / subsystems coupling.
- 10 **Discussion:** How spacecraft fit into the historical, social, political, and economic processes producing diversity, equality, and structured inequalities in the U.S. and the world.
- 11 Case study on *spacecraft safety, ethics and liability issues*
- 12 **Discussion:** Consider the technological innovations in spacecraft design, describe a historical example, and indicate how it has increased social justice in the U.S. and the world.
- 13 Subsystems design review.
- 14 Detailed design review.
- 15 Case study on *spacecraft safety, ethics and liability issues*
- 16 Final design review