San José State University
Aerospace Engineering
AE 171 A – Aircraft Design I – Fall 2023

COURSE AND CONTACT INFORMATION

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Office Hours:	W-TR 3:00 – 4:15 & by appointment
Class Days/Time:	F 8:30-11:15
Prerequisites:	Senior in good academic standing. C or better in AE20, AE162, AE165, Engr100W Completion of Core GE
Co-requisites:	AE164, AE168, Engr.195A.

COURSE DESCRIPTION

This is the first course in a two-semester sequence, in which students work in teams to complete the conceptual and preliminary design of an aircraft. Students are challenged to consider the relationship of aerospace engineering to the broader community. Meets GE areas S and V when course is taken in combination with: AE 171B, ENGR 195A and ENGR 195B.

COURSE GOALS

1. To provide senior engineering students a capstone experience in aircraft design.
2. To offer an opportunity for going beyond a paper product (design report) into actual manufacturing and flight-testing of model airplanes.
3. To develop students' creative abilities in solving open-ended, airplane 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 airplane 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 aircraft design, such as the FAA Accepted ASTM Consensus Standards – LSA, the FAA Title 14 CFR Part-107 standards for small unmanned aircraft systems, the AMA Safety 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 airplane design.
8. To make students aware of the importance of teamwork in the design of an airplane 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 GE Area S and Engineering.)

COURSE LEARNING OBJECTIVES

Upon successful completion of this course, students will 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 and sketch the mission profile of an airplane.
2. Identify appropriate public health, safety and welfare, global, cultural, social, environmental, and economic constraints for an airplane, and ensure compliance with the FAA Accepted ASTM Consensus Standards – LSA, the FAA Title 14 CFR Part-107 standards for small unmanned aircraft systems, and the AMA Safety Standards.
3. Define, calculate, and evaluate measures of merit (MOM) for an airplane.
4. Perform a literature search and collect data to show the need for a particular airplane. ***(ABET Outcome 7:*** *Ability to acquire knowledge as needed, using appropriate learning strategies.)*
5. Identify the critical mission requirements of an airplane.
6. Evaluate the configuration of airplanes and describe the connection between configuration choices (ex. high wing, tandem landing gear) and mission requirements.
7. Describe the pros and cons of the various conventional aircraft configurations.
8. Describe the pros and cons of unconventional aircraft configurations such as canards, 3-surface, swept-forward wings, flying wings, tailless, V/STOL, stealth, etc.
9. Select an appropriate configuration for an airplane with a specified mission.
10. Estimate the takeoff weight of an airplane based on the mission requirements using the weight fraction

method.

11. Calculate the takeoff weight sensitivities of an airplane to changes of critical parameters such as L/D, sfc, etc.

12. Perform trade studies between range and payload.

13. Construct a matching graph based on specific performance constraints (stall speed, cruise speed, takeoff and landing distance, maneuverability requirements) and use it to predict the required thrust/power and wing area of an airplane.

14. Prepare CAD drawings of the cockpit and the fuselage of an airplane based on specific payload requirements.

15. Design the wing, high-lift system, and lateral controls of an airplane.

16. Design the empennage and the directional controls of an airplane.

17. Design the landing gear of an airplane using tip-over and ground clearance criteria and (for retractable landing gear) show the retraction feasibility with appropriate drawings.

18. Perform a weight and balance analysis for an airplane and draw the c.g. excursion diagram.

19. Perform static longitudinal and directional stability analysis for an airplane and draw the corresponding x – plots.

20. Perform a critical evaluation of the landing gear design, the empennage, the weight and balance, and the stability and control analysis to ensure that an airplane is not prone to tip-over problems, too much c.g. travel, too much or too little stability and / or a minimum control speed problem.

21. Estimate the drag polars of an airplane for the takeoff, cruise (low and high speed), and landing configurations.

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.*

22. 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.

23. 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.

24. 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

25. 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.*

26. 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.*

27. Write high quality design reports (i.e., using correct language and terminology, correct technical information, and professionally prepared graphs and tables).

28. 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.*

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.

Texts

Roskam, J (1989). *Airplane Design, Parts I-VIII*, Roskam Aviation and Engineering Corporation, Rt. 4, Box 274, Ottawa, Kansas 66067, USA

Daniel P. Raymer, Aircraft Design: A Conceptual Approach. AIAA Education Series. ISBN 0-930403-51-7

Other Required Reading

FAA Advisory Circulars, Noise Standards: Aircraft Type and Airworthiness Certification, available at <http://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.list/parentTopicID/112>

Hoover, K. & Fowler, W.T. *Studies in Ethics, Safety, and Liability for Engineers – The Crash of American Airlines Flight 191*, The University of Texas at Austin, available at < http://www.tsgc.utexas.edu/archive/general/ethics/aacrash.html>

Hoover, K. & Fowler, W.T. & Stearman, R.O. *Studies in Ethics, Safety, and Liability for Engineers – The V-Tail Bonanza*, The University of Texas at Austin, available at < http://www.tsgc.utexas.edu/archive/general/ethics/vtail.html>

ICAO, Environmental Protection, Aircraft Noise, available at <http://www.icao.int/environmental-protection/Pages/noise.aspx>

Morrison, S.A., Watson, T. & Winston, C. (1998, September). Fundamental Flaws of Social Regulation: The Case of Airplane Noise. AEI-Brookings Joint Center, available at <http://www.brookings.edu/research/papers/1998/09/airplane-winston>

Swift, H. (2010, July). A review of the literature related to potential health effects of aircraft noise. Partner Project 19 Final Report. Partnership for Air Transportation Noise and Emissions Reduction: an FAA / NASA / Transport Canada – sponsored Center-of-Excellence.

Course Requirements and Assignments

Course assignments consist of several design reports, design quizzes, technical discussions, a written test, and collaboration with the AE20 and AE30 students.

Final Examination / Evaluation

The Team "Critical Design Review" oral examination will take place in lieu of a final exam.

GRADING

Grade	Minimum Score
A+	950
A	900
A-	850
B+	800
B	750
B-	700
C+	675
C	650
F	649 or lower

The course grade is determined as follows:

- 60% based on team performance (design reports and presentations); individual scores are determined by peer evaluations (see Teamwork section at the end of this document).
- 22% based on individual technical performance (written tests and participation in technical discussions)
- 18% 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 ABET Outcome 4
3. Assignment that addresses GE / SJSU Studies Area S

NB-2: Your papers will suffer a significant point reduction and/or may be returned ungraded if they are deficient in one or more of the following areas:

- ***Grammar and spelling are not at an acceptable level for an advanced GE course / capstone, senior design experience.***
- References are not included or are not cited in the text.
- References listed do not follow APA or AIAA rules.
- Fewer than 3 journal or peer reviewed articles are used / cited in your paper.
- Supporting materials are too old (older than 5 years)
- Turnitin.com plagiarism check was positive (except in the “References” section)
- Assignment was submitted late.

- 10% based on your collaboration with and mentoring of AE20 and AE30 students. In particular, you are expected to:
    - Explain your design project to AE20 / AE30 student teams assigned to you.
    - Assign simple CAD and programming tasks related to your project to each AE20 / AE30 team.
    - Be available to meet with AE20 / AE30 student teams assigned to you and provide mentoring to them as needed.

Approximate Weekly Schedule

Week	Topics, Readings, Assignments, Deadlines
1	Teamwork. Introduction to Aircraft Design. Class Expectations. Team formation.
2	Mission Requirements and General Design. Discussion on Cultural Shaping of our Identity as Engineers in the Context of Equality and Inequality. Review Weight Sizing and Sensitivities.
3	Performance sizing. FAA Accepted ASTM Consensus Standards – LSA; FAA Title 14 CFR Part-107 standards for small unmanned aircraft systems; AMA Safety Standards.
4	Complete performance sizing. Configuration design. Design of the fuselage, cockpit. Powerplant integration and other initial considerations.
5	Wing and empennage configuration. Weight and Balance Analysis.
6	Project review. Mission Spec and Comparative Study Report due
7	Longitudinal Stability Analysis. Project societal impact discussion.
8	Landing Gear Positioning. Project Review. Essay (GE Area S) due.
9	Landing Gear Design. Weight and Performance Sizing Report due.
10	Catch up week.
11	Review of Initial Ethics Case in Aircraft Design. Wing Devices. Configuration Design Report and Schematics due (10/29).
12	Wing Devices.
13	Miscellaneous topics. Test (take home, 100% individual effort).
14	Catch up week. Project Review. Weight and Balance Report due (11/23). Online Ethics Discussion.
15	Critical Design Review (Presentation, see rubric in Canvas). Basic Stability and Control Report Due.
16	Project Review. Online Discussions Closed.