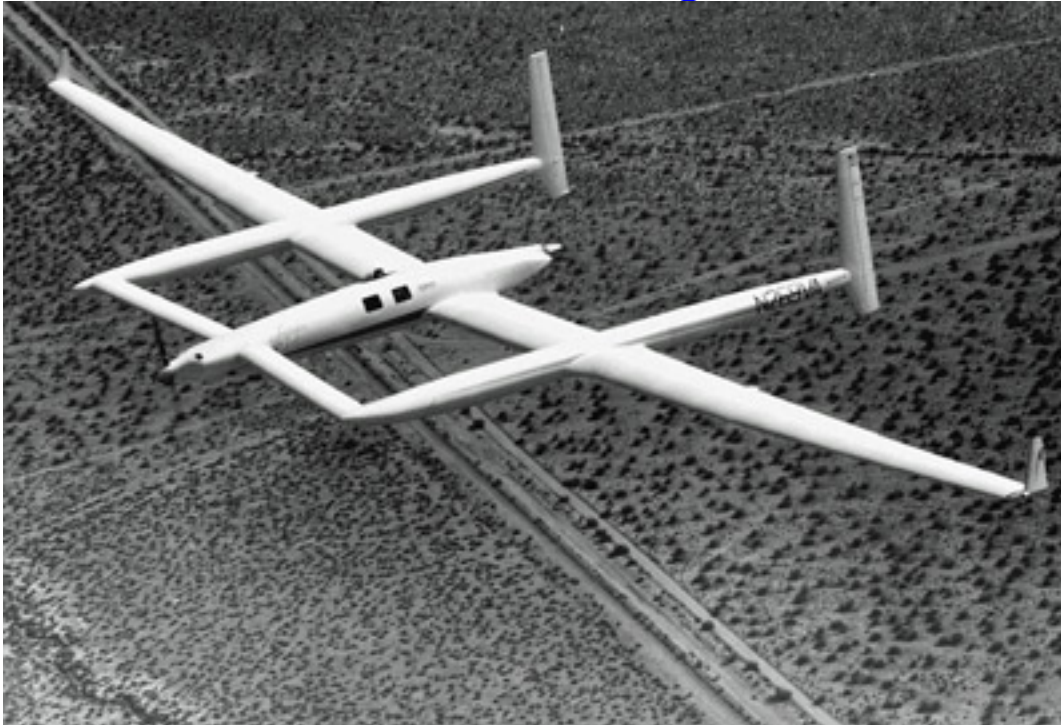


San José State University
Aerospace Engineering
AE 171 A – Aircraft Design I – Fall 2016



INSTRUCTOR INFO

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Office Hours: TR 3:00 – 4:15 by phone
WF 12:00 – 3:00 & by appointment

CLASS DAYS / TIME

WF 9:30-10:45

CLASSROOM

Engr.164

PREREQUISITES

Grade “C-” or better in: AE20, AE114, AE162, AE165,
Engr.100W
Senior in good standing.

CO-REQUISITES

AE164, AE168, Engr195A

TEXTBOOK

J. Roskam: Airplane Design, Parts I-VIII, Roskam Aviation and
Engineering Corp., Rt. 4, Box 274, Ottawa, Kansas, 66067
Course website: <www.engr.sjsu.edu/nikos/courses/AE171>

DESCRIPTION This is the first course in a two-semester sequence in which students work in teams to design an airplane.

More specifically, students complete the conceptual and preliminary design of an airplane. This includes mission specification, figures of merit, weight sizing, performance constraint analysis, configuration design, fuselage design, wing and high-lift system design, empennage design, landing gear design, weight and balance analysis, stability and control analysis, drag polar estimation, and resizing, as needed. Students are encouraged to participate in professional society design / build / fly competitions.

Furthermore, students integrate general education (GE) student learning outcomes into their design project. Students are challenged to think about and discuss in class as well as in their reports, the relationship of aerospace engineering to the broader community both in the U.S. and worldwide. This discussion include ethics, safety and liability issues, as well as 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 [airplane 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 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.
7. 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.
8. To make students aware of their professional and ethical responsibilities as practicing engineers.
9. 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 C: *Ability to perform conceptual and preliminary design of aircraft or spacecraft to meet a set of mission requirements within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.*

1. Define an appropriate set of mission requirements and sketch the mission profile of an airplane.
2. Define, calculate, and evaluate measures of merit (MOM) for an airplane.
3. Perform a literature search and collect data to show the need for a particular airplane. (**ABET Outcome H:** *Recognition of the need for, and ability to engage in life-long learning.*)
4. Identify the critical mission requirements of an airplane.
5. Evaluate the configuration of airplanes and describe the connection between configuration choices (ex. high wing, tandem landing gear) and mission requirements.
6. Describe the pros and cons of the various conventional aircraft configurations.
7. Describe the pros and cons of unconventional aircraft configurations such as canards, 3-surface, swept-forward wings, flying wings, tailless, V/STOL, stealth, etc.
8. Select an appropriate configuration for an airplane with a specified mission.
9. Estimate the takeoff weight of an airplane based on the mission requirements using the weight fraction method.
10. Calculate the takeoff weight sensitivities of an airplane to changes of critical parameters such as L/D, sfc, etc.
11. Perform trade studies between range and payload (with AAA).
12. 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.
13. Prepare CAD drawings of the cockpit and the fuselage of an airplane based on specific payload requirements.
14. Design the wing, high-lift system, and lateral controls of an airplane (by hand and with AAA).
15. Design the empennage and the directional controls of an airplane (by hand and with AAA).
16. 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.
17. Perform a weight and balance analysis for an airplane and draw the c.g. excursion diagram (by hand and with AAA).
18. Perform static longitudinal and directional stability analysis for an airplane and draw the corresponding x – plots.
19. 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.

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

ABET Outcome D: *Ability to collaborate with people from different cultures, abilities, backgrounds, and disciplines to complete aerospace engineering projects.*

21. Work harmoniously and effectively in a team to solve engineering problems related to the design of an airplane and to communicate the results in technical reports and oral briefings.
22. 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.
23. 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

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

ABET Outcome F: *Understanding of professional and ethical responsibility.*

25. 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 E: *Ability to communicate effectively through technical reports, memos, and oral presentations as well as in small group settings.*

26. Write high quality design reports (i.e., using correct language and terminology, correct technical information, and professionally prepared graphs and tables).
27. 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-LO1: *Describe how identities (i.e. religious, gender, ethnic, racial, class, sexual orientation, disability, and/or age) are shaped by cultural and societal influences within contexts of equality and inequality.*

ABET Outcome G: *Broad education to understand current events, how they relate to aerospace engineering, as well as the impact of engineering solutions in a global and societal context.*

ABET Outcome H: *Recognition of the need for, and ability to engage in life-long learning.*

- Engr195A – Testimony 1 (250-500 words): Discuss and provide examples of how your identities (i.e., religious, gender, ethnic, racial, class, sexual orientation,

disability and/or age, among others) are shaped by cultural and societal influences within contexts of equality and inequality.

- Engr195A – Testimony 2 (250-500 words): How does language affect our identities? How do we use language and labels to authenticate our identities to others and ourselves?
- AE171A – **Reflection Paper 1** (500 words): Based upon your response to Engr195A Testimony 1, *consider your identity as a future aerospace engineer. How is your identity shaped by cultural and societal influences within contexts of equality and inequality?*

S-LO2: *Describe historical, social, political, and economic processes producing diversity, equality, and structured inequalities in the U.S.*

ABET Outcome 3G: *Broad education to understand current events, how they relate to aerospace engineering, as well as the impact of engineering solutions in a global and societal context.*

ABET Outcome 3H: *Recognition of the need for, and ability to engage in life-long learning.*

- Engr195A – Reflection Paper 2 (250-500 words): “Secrets of Silicon Valley”
- AE171A – **Reflection Paper 2** (500 – 750 words): Using the case studies provided in Engr195A, describe how airplanes in general and your project in particular, fit into the historical, social, political, and economic processes producing diversity, equality, and structured inequalities in the U.S.

S-LO3: *Describe social actions, which have led to greater equality and social justice in the U.S. (i.e. religious, gender, ethnic, racial, class, sexual orientation, disability, and/or age).*

ABET Outcome G: *Broad education to understand current events, how they relate to aerospace engineering, as well as the impact of engineering solutions in a global and societal context.*

ABET Outcome H: *Recognition of the need for, and ability to engage in life-long learning.*

- Engr195A – Reflection Paper 1 (750-1250 words): Describe social actions within the borders of the United States that have led to greater equality and social justice in your life (i.e., religious, gender, ethnic, racial, class, sexual orientation, disability, and/or age). Discuss how your current or past projects have or will contribute to social justice in the United States.
- Engr195A – Reflection Paper 2 (250-500 words): In his essay, Dyson gives historical examples of technological innovations, which he claims have increased social justice. Consider the technological innovations in AE and describe another example, indicating how it has increased social justice in the U.S.
- AE171A – **Reflection Paper 3** (500 words): Consider the technological innovations in aerospace engineering in general and aircraft design in particular, describe a historical example and indicate how it has increased social justice in the U.S. and the world.

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

ABET Outcome D: *Ability to collaborate with people from different cultures, abilities, backgrounds, and disciplines to complete aerospace engineering projects.*

ABET Outcome H: *Recognition of the need for, and ability to engage in life-long learning.*

- Engr195A Website Analysis (750 words): Organization Website Analysis
Environmental and social justice issues are addressed at many different levels and in different ways by groups and organizations. This assignment addresses the broad GE learning objective of “recognizing and appreciating constructive interactions between people from different cultural, racial, and ethnic groups in the U.S.” and the specific course learning objective to “Identify, compare, and contrast how local community organizations, groups, and agencies address social issues relevant to the environment and quality of life in the Santa Clara Valley.
- AE171A – **Reflection Paper 4** (500 words): Consider a negative side effect of aerospace technology: noise. Read the following articles and research the procedures regarding airplane noise in your own town or region. What civic organizations promote the reduction of airplane noise in your community? Either visit one of these groups’ websites or visit the group in person and describe the interactions between this group and the larger community. Your paper must cite your sources, including the ones listed below.

Articles:

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.

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

FAA Advisory Circulars, Noise Standards: Aircraft Type and Airworthiness Certification, Available:

http://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.list/parentTopicID/112

ICAO, Environmental Protection, Aircraft Noise, Available:

<http://www.icao.int/environmental-protection/Pages/noise.aspx>

COURSE RELATIONSHIP TO BSAE PROGRAM OUTCOMES

	3A	3B	3C	3D	3E	3F	3G	3H	3I
<i>Learning Objectives</i>									
1 – 20	B		C					C	C
21 – 24				C	C			C	
25						C		C	
26 – 27					C				
32 - 34							C	C	
S – LO1							C	C	
S – LO2							C	C	
S – LO3							C	C	
S – LO4				C				C	

NB: The letters inside the table indicate the highest level of skill achieved by the LOs on the left hand side. “B” corresponds to levels 3 or 4 in Bloom’s Taxonomy; “C” corresponds to levels 5 or 6 in Bloom’s Taxonomy.

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 3H: Reflection Papers 1, 2, 3, and 4.
 - Design questions
 - ABET Outcome 3F: Case studies on safety, ethics, and liability issues: Reflection Paper on V-Tail Bonanza, Reflection Paper on AA
 - ABET Outcome 3G: Reflection Papers 1, 2, and 3.
 - **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 3F
 2. Assignments that address ABET Outcome 3G
 3. Assignments that address Student Outcome 3H

4. Assignments that address GE / SJSU Studies Area S

- 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.

TOPICS

Week	Topics (AE 171A)
01	Design and the brain. The aircraft design process.
02	Team building, the team process.
03	Mission requirements, constraints, measures of merit.
04	Configuration design (conventional).
05	Configuration design (unconventional).
06	Field Trip: Hiller Aviation Museum
07	<i>1st oral presentation and oral examination.</i>
08	Weight sizing; weight sensitivities.
09	Performance sizing.
10	Discussion: How airplanes 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 <i>aircraft safety, ethics and liability issues:</i> V-Tail Bonanza
12	Discussion: Consider the technological innovations in aircraft design, describe a historical example, and indicate how it has increased social justice in the U.S. and the world.
13	Design of the fuselage, wing, high-lift system, and lateral controls.
14	Design of the empennage, longitudinal, and directional controls.
15	Case study on <i>aircraft safety, ethics and liability issues:</i> The Crash of AA191
16	<i>2nd oral presentation and oral examination.</i>

University Policies

Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs' [Syllabus Information web page](http://www.sjsu.edu/gup/syllabusinfo/) at <http://www.sjsu.edu/gup/syllabusinfo/>.

AE Department and SJSU policies are also posted at <http://www.sjsu.edu/ae/programs/policies/>