

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

Fall 2017

Course and Contact Information

Instructor:	Prof. Gonzalo Mendoza
Office Location:	Engineering 272F
Telephone:	(316) 210-6241 (Cell)
Email:	Gonzalo.Mendoza@sjsu.edu GEMendoza@txtav.com
Office Hours:	TR 3:00 – 4:15 by phone; F 12:00 – 3:00 & by appointment
Class Days/Time:	F 9:00-11:45
Classroom:	Engr. 164
Prerequisites:	Must be “senior” in good academic standing. 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 offer an opportunity for going beyond a paper product (design report) into actual manufacturing and flight-testing of model airplanes.
2. To develop students' creative abilities in solving open-ended, airplane design problems.
3. To develop an appreciation of the interrelationships between aerodynamics, propulsion, structures, flight mechanics, stability & control, manufacturing, maintenance, and cost in an integrated airplane design.
4. To develop students' engineering judgment as well as their confidence in making and accepting responsibility for design decisions.
5. 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.
6. 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.
7. To make students aware of their professional and ethical responsibilities as practicing engineers.

8. Discuss the role of identity, equality, social actions, and culture in aerospace engineering practice. (Integration of Area S and Engineering.)

Course Learning Objectives

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

GE Area 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.
BSAE LO–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.
BSAE LO–H: Recognition of the need for, and ability to engage in life-long learning.

- Engr195A **Reflection Paper 3** (700-800 words): In this reflection paper, you are to critically engage the topic of the social construction of identity in your life. Please discuss and provide examples of how at least one of your identities (i.e., religious, gender, ethnic, racial, class, sexual orientation, disability and/or age, among others) is shaped, or has been shaped, by cultural and societal influences within contexts of equality and inequality. Please integrate course material (concepts, theories, discussions, lectures, readings). Please cite at least one course reading.
- AE171A – **Essay 1** (minimum 500 words): Consider your identity as a future aerospace engineer. How is your identity shaped by cultural and societal influences within contexts of equality and inequality?

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

BSAE LO–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.
BSAE LO–H: Recognition of the need for, and ability to engage in life-long learning.

- Engr195A **Reflection Paper 2** (700-800 words): Consider technological innovations and developments in your field. In your paper: 1) Describe, in detail, an example of how one such innovation/development (using any example that you want post-1970) has either increased or decreased environmental or social justice and inequality in the U.S. Make sure to discuss what the technological development is and its environmental or social consequence(s). 2) Looking forward, can you predict any other possible unintended environmental and/or consequences from this branch of technology? 3) Next, discuss how your current or past projects have or will contribute to environmental and/or social justice or injustice in the United States. Include at least two citations. You can cite two course readings or you can have one citation from a course reading and one citation from the movie "Secrets of Silicon Valley." Either way you need two. Citing lecture will not count as one of these citations for this paper.
- AE171A – **Essay 2** (minimum 500 words): Describe how airplanes have contributed to the historical, social, political, and economic processes producing diversity, equality and/or structured inequalities in the U.S and the world. Include at least two citations, not including course readings or lecture.

GE Area 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).

BSAE LO–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.
BSAE LO–H: Recognition of the need for, and ability to engage in life-long learning.

- Engr195A **Reflection Paper 2** (700-800 words): Consider technological innovations and developments in your field. In your paper: 1) Describe, in detail, an example of how one such innovation/development (using any example that you want post-1970) has either increased or decreased environmental or social justice and inequality in the U.S. Make sure to discuss what the technological development is and its environmental or social consequence(s). 2) Looking forward, can you predict any other possible unintended environmental and/or consequences from this branch of technology? 3) Next, discuss how your current or past projects have or will contribute to environmental and/or social justice or injustice in the United States. Include at least two citations. You can cite two course readings or you can have one citation from a course reading and one citation from the movie "Secrets of Silicon Valley." Either way you need two. Citing lecture will not count as one of these citations for this paper.
- AE171A – **Essay 3** (minimum 500 words): Describe a historical example of how airplanes have increased (or hindered) social justice in the U.S. and the world. Include at least two citations, not including course readings or lecture.

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

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

BSAE LO–H: *Recognition of the need for, and ability to engage in life-long learning.*

- Engr195A **Reflection Paper 1** (700-800 words): Students will read excerpts from Ernest Callenbach’s *Ecotopia*. Students will apply this reading to their current lived experience in the U.S. Beyond fulfilling the S-LO4, students will address the specific course learning objective “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” by comparing one element in our current society to Callenbach’s described society.
- AE171A – **Essay 4** (minimum 500 words): Consider a negative side effect of airplanes: noise. Read the four references pertaining to aircraft noise (Swift, 2010; Morrison et al, 1998; FAA; ICAO) 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 all your sources, including the ones listed below.

BSAE LO–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. (**BSAE LO–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.

BSAE LO–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.

BSAE LO–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.

BSAE LO–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.

Relationship of CLOs to BSAE Student Learning Outcomes

	<i>BSAE Student Learning Outcomes</i>								
	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>	<i>G</i>	<i>H</i>	<i>I</i>
<i>Course Learning Outcomes</i>									
1 – 20	B		C					C	C
21 – 24				C	C			C	
25						C		C	
26 – 27					C				
32 - 34							C	C	
GE Area S – LO1							C	C	
GE Area S – LO2							C	C	
GE Area S – LO3							C	C	
GE Area S – LO4				C			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.

Required Text

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

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.

Final Examination / Evaluation

The 2nd oral presentation and oral examination will take place at the time of the scheduled final exam. The final project reports will also be due at this time.

Grading

The course grade is determined as follows:

- 70% based on team performance (design reports); individual scores are determined by peer evaluations.
- 20% based on additional assignments:
 - GE Area S / BSAE LO–G, LO–H: Essays 1, 2, 3, and 4.
 - Design questions
 - BSAE LO–F: Case studies on safety, ethics, and liability issues (reflection papers).
 - **NB-1: 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 BSAE LO–F
 2. Assignments that address GE Area S / BSAE LO–G, LO–H
 - **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 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.

Determination of Grades

Grade	Minimum Score
A+	950
A	900
A-	850
B+	800
B	750
B-	700
C+	675

C	650
F	649 or lower

AE171A – Aircraft Design I – Fall 2017
Approximate Weekly Schedule

Week	Date	Topics, Readings, Assignments, Deadlines
1	8/25/2017	Design and the brain. The aircraft design process
2	9/1/2017	Team building, the team process.
3	9/8/2017	Mission requirements, constraints, measures of merit.
4	9/15/2017	Configuration design (conventional).
5	9/22/2017	Configuration design (unconventional).
6	9/29/2017	Field Trip: Hiller Aviation Museum
7	10/6/2017	<i>1st oral presentation and oral examination.</i> <i>Essay 1 (GE Area S) Due</i>
8	10/13/2017	Weight sizing; weight sensitivities.
9	10/20/2017	Performance sizing.
10	10/27/2017	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. <i>Essay 2 (GE Area S) Due</i>
11	11/3/2017	Case study on <i>aircraft safety, ethics and liability issues: V-Tail Bonanza</i>
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	11/10/2017	Design of the fuselage, wing, high-lift system, and lateral controls.
14	11/17/2017	Design of the empennage, longitudinal, and directional controls. <i>Essay 3 (GE Area S) Due</i>
15	12/1/2017	Case study on <i>aircraft safety, ethics and liability issues: The Crash of AA191</i> <i>Essay 4 (GE Area S) Due</i>
Final Exam	12/8/2017	<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 Policies <http://www.sjsu.edu/ae/programs/policies/>

Faculty Web Page and MYSJSU Messaging

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on [Canvas Learning Management System course login website](http://sjsu.instructure.com) at <http://sjsu.instructure.com>. You are responsible for regularly checking with the messaging system through [MySJSU](http://my.sjsu.edu) at <http://my.sjsu.edu> (or other communication system as indicated by the instructor) to learn of any updates.