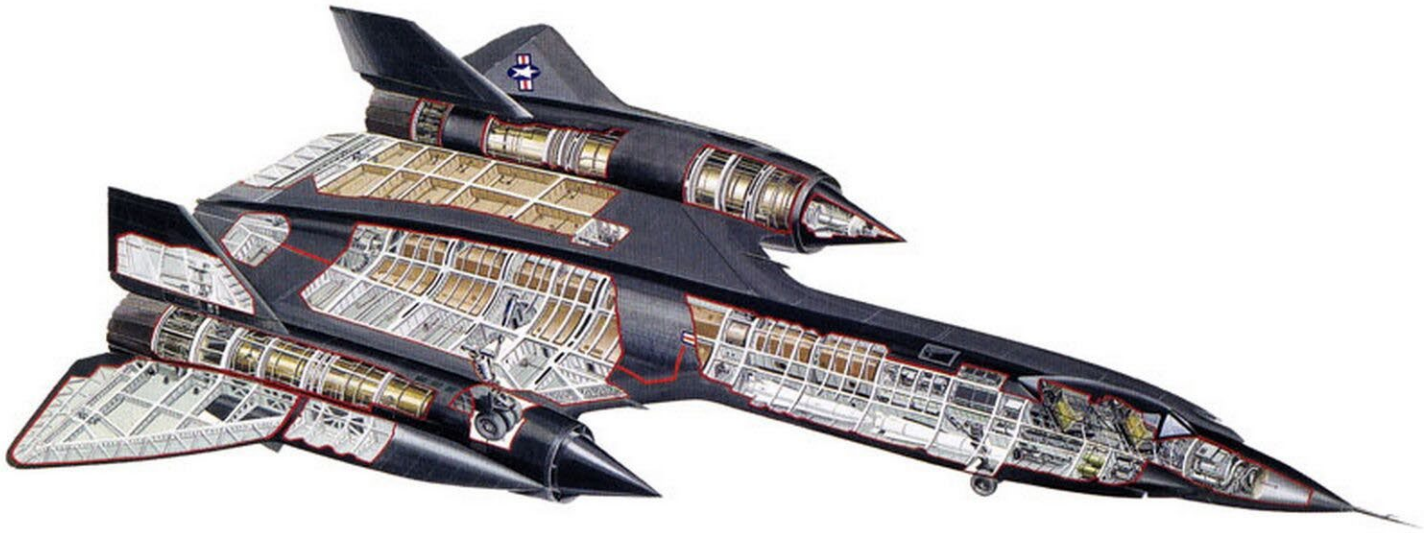
# San José State University
# Aerospace Engineering
# AE273 – Aircraft Subsytems - Spring, 2021



**Course and Contact Information**

| | |
|---|---|
| **Instructor:** | Professor Sean Montgomery |
| **Email:** | sean.montgomery@sjsu.edu or sean5montgomery@gmail.com |
| **Office Hours:** | Mondays and Wednesdays after class |
| **Class Days/Time:** | Mondays and Wednesdays 6:00 pm to 7:15 pm |
| **Classroom:** | Online |
| **Prerequisites:** | Graduate standing in AE or instructor consent |
| **Credit:** | 3 units |
| **GWAR:** | **This course satisfies the Graduate Writing Assessment Requirement** |

**Textbooks (both are required):**
*Lessons Learned in Aircraft Design:* The Devil is in the Details, by Jan Roskam, 2017.

*Aircraft Systems*: Mechanical, electrical and avionics systems integration, 3rd ed., by Ian Moir and Allan Seabridge. The SJSU library has a digital copy available for students.

## Course Description

Aircraft subsystem analysis and design: flight controls; avionics and electrical systems; cabin systems; landing gear and other mechanical systems; systems safety analysis**.**

## Course Goals

1. To familiarize students with aircraft subsystems operation, analysis, design, safety, and interdependencies.
2. To study design implementations of aircraft subsystems in a variety of aircraft types including historic and modern aircraft.
3. To develop design skills by designing all the subsystems for an aircraft.
4. To develop technical writing ability.

### Course Learning Outcomes (CLO)

Students completing AE273 should be able to analyze and design the following subsystems for various types of aircraft:

1. Flight control systems
2. Avionics and electrical systems
3. Cabin systems
4. Landing gear systems
5. Fuel systems
6. Hydraulic systems
7. Environmental systems
8. Analyze system safety for the above subsystems

Students must also communicate the results of their design in a comprehensive, well written final report, following AIAA guidelines.

## Course Requirements and Assignments

The course will be divided into two parts. During the first part, students will conduct detailed research on the subsystems for one or two aircraft. Students will share their research with the class through presentations. For the second part of the course, students will individually design the subsystems for an entire aircraft. Students will write intermediate reports for their design, culminating in a final comprehensive report and presentation. The final report must be a minimum of 4,000 words (not including figures, tables, appendices) and follow the format guidelines.

Reports will be graded for **English** (grammar, spelling, punctuation, etc.) as well as for technical content. Please see the general guidelines for professional reports below.

**Written reports not meeting minimum writing proficiency standards will be returned without a grade.** If your report is returned for English please seek help from the **SJSU Writing Center** http://www.sjsu.edu/writingcenter/tutoring/index.html

**Grading Weights:**

15% Group research presentations
15% Group research reports
10% Homework, quizzes, and collaboration
15% Design presentations
15% Intermediate design reports
30% Final design report (4,000 words minimum)

**Grading Scale:**

| | |
|---|---|
| A+ | >97% |
| A | >93% |
| A- | 90% - 93% |
| B+ | 87% - 90% |
| B | 83% - 87% |
| B- | 80% - 83% |
| C+ | 77% - 80% |
| C | 73% - 77% |
| C- | 70% - 73% |
| D | 60% - 70% |
| F | < 60% |

For issues related to Canvas, please contact the eCampus Help Desk.
Phone: (408) 924-2337
Submit a help ticket using the following URL: https://isupport.sjsu.edu/ecampus/ContentPages/Incident.aspx .
While logged into Canvas, click on the word Help on the upper right corner of the screen.

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**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 at http://www.sjsu.edu/gup/syllabusinfo/
AE Department Policies and SJSU policies are posted at http://www.sjsu.edu/ae/programs/policies/

**Spring 2021 Online**

**Zoom**
Class will meet online via Zoom. You can find the links to join these meetings under the "Zoom" section on Canvas. They are also posted on the Calendar.

**Technology Requirements**
Students are required to have an electronic device (laptop, desktop or tablet) with a camera and built-in microphone. SJSU has a free equipment loan program available for students. Students are responsible for ensuring that they have access to reliable Wi-Fi during tests and quizzes. See Learn Anywhere website for current Wi-Fi options on campus.

**Connection Issues**
If you experience connection issues with the Zoom class session, attempt to rejoin. If you are unable to resolve the issues, you may watch the recording of the class to see what you missed.

**Zoom Classroom Etiquette**
- Mute Your Microphone: To help keep background noise to a minimum, make sure you mute your microphone when you are not speaking.
- Be Mindful of Background Noise and Distractions: Find a quiet place to "attend" class, to the greatest extent possible.
    - Avoid video setups where people may be walking behind you, people talking/making noise, etc.
    - Avoid activities that could create additional noise, such as shuffling papers, listening to music in the background, etc.
- Position Your Camera Properly: Be sure your webcam is in a stable position and focused at eye level.
- Limit Your Distractions/Avoid Multitasking: You can make it easier to focus on the meeting by turning off notifications, closing or minimizing running apps, and putting your smartphone away (unless you are using it to access Zoom).
- Use Appropriate Virtual Backgrounds: If using a virtual background, it should be appropriate and professional and should NOT suggest or include content that is objectively offensive or demeaning.

**Recording Zoom Classes**
This course or portions of this course (i.e., lectures, discussions, student presentations) will be recorded for instructional or educational purposes. The recordings will only be shared with students enrolled in the class through Canvas. The recordings will be deleted at the end of the semester. If, however, you would prefer to remain anonymous during these recordings, then please speak with the instructor about possible accommodations (e.g., temporarily turning off identifying information from the Zoom session, including student name and picture, prior to recording).

Students are not allowed to record without instructor permission Students are prohibited from recording class activities (including class lectures, office hours, advising sessions, etc.), distributing class recordings, or posting class recordings. Materials created by the instructor for the course (syllabi, lectures and lecture notes, presentations, etc.) are copyrighted by the instructor. This university policy (S12-7) is in place to protect the privacy of students in the course, as well as to maintain academic integrity through reducing the instances of cheating. Students who record, distribute, or post these materials will be referred to the Student Conduct and Ethical Development office. Unauthorized recording may violate university and state law. It is the responsibility of students that require special accommodations or assistive technology due to a disability to notify the instructor.

# AE 273 – Aircraft Subsystems Course Schedule

Tentative schedule, subject to change.

**Course Schedule**

| Week | Date | Topics, Readings, Assignments, Deadlines |
|---|---|---|
| 1 | | Fuel systems |
| 2 | | Hydraulic systems |
| 3 | | Landing gear systems |
| 4 | | Miscellaneous systems |
| 5 | | Electrical systems |
| 6 | | Avionics systems |
| 7 | | Cabin systems |
| 8 | | Environmental systems |
| 9 | | Flight control systems |
| 10 | | System safety |
| 11 | | Flight control systems design due |
| 12 | | Landing gear and hydraulic systems design due |
| 13 | | Cabin and environmental systems design due |
| 14 | | Intermediate design presentations |
| 15 | | Electrical and avionics systems design due |
| 16 | | Fuel and miscellaneous systems design due |
| Final Presentations | | |

# GENERAL GUIDELINES ON PROFESSIONAL REPORT WRITING

Each report must meet minimum standards of professionalism. Unprofessional reports will be **severely downgraded even if** the technical content is correct. The following items explain some of the features of a professional report.

1. All reports must be prepared with a **word processor**.
2. Organize reports using a **decimal numbering system**. The chapters, Sections, Sub-Sections should be indicated as follows:
   **4. TITLE OF CHAPTER**
   4.1 TITLE OF SECTION
   4.1.1 Title of Sub-Section
   4.1.1.1 Title of sub-sub-section
3. Many reports require **calculations**. At least one "hand" calculation **must** be performed and documented for each case in a separate sub-section. These hand-calculations do not have to be typed but should be clearly written and well organized. **If they are lengthy (i.e. more than 2 pages)**, they should be placed in a separate appendix but the results should be discussed in the main body of the report.
4. **All** pages must be numbered. Start the introduction at page 1. Pages in the main body of the report are numbered: 1, 2, 3, etc. Preliminary pages such as Table of Contents, List of Symbols etc. are numbered sequentially: i, ii, iii, iv, etc.
5. A minimum **margin** of **one inch** must be observed on all pages including graphs, figures, tables, computer print-outs, etc.
6. The report must be written in good **English.** All words must be properly spelled. You are expected to proofread your reports before handing them in.
7. Avoid using sentences longer than 2 lines. If you do not, your report will have a high "**Fog Index**" (i.e. it will be difficult to read).
8. **Do not** use I, You, We, They, etc. in a technical report. Also, **do not** treat an airplane or airplane components as persons, i.e., DO NOT write: *the airplane's landing gear is of the retractable type.* Instead, write: *the landing gear of the Cessna 182 is of the retractable type* or, even better, *the airplane has a retractable landing gear.*
9. **Do not use** the words: **'in order to ...'**. Remember, the words 'in order' are nearly always out of order!
10. Make use of the technique called **"bulletizing"**.
    Instead of: *in this chapter, the results of calculations of wing-loading, maximum lift coefficients, thrust-to weight ratio, lift-to-drag ratio and cruise lift coefficients are presented.*
    Write: *In this chapter the following characteristics of the Spartan Jet are presented:*
    - *Wing Loading*
    - *Maximum Lift Coefficients*
    - *Thrust-to-Weight Ratio*
    - *Lift-to-Drag Ratio*
    - *Cruise Lift Coefficient*
11. Make sure that no **symbols** are **omitted** from your equations. Again, it is important to proofread your reports before handing them in!
12. All **equations** must be numbered and numbered sequentially. Within a chapter use a decimal numbering system. For example:
    $$X = Y + Z \qquad (4.17)$$
13. **References** must follow APA rules, found here: < http://www.apastyle.org/learn/faqs/index.aspx>

14. All **figures** and **graphs** must be **numbered** and numbered sequentially. They must also have descriptive **titles**. Titles must appear **below** the figure. All **axes** must have scale and descriptive **labels** including **units** whenever appropriate. **Curves** must also have descriptive **labels**. All lettering must be at least 3 mm high to be legible! For example:

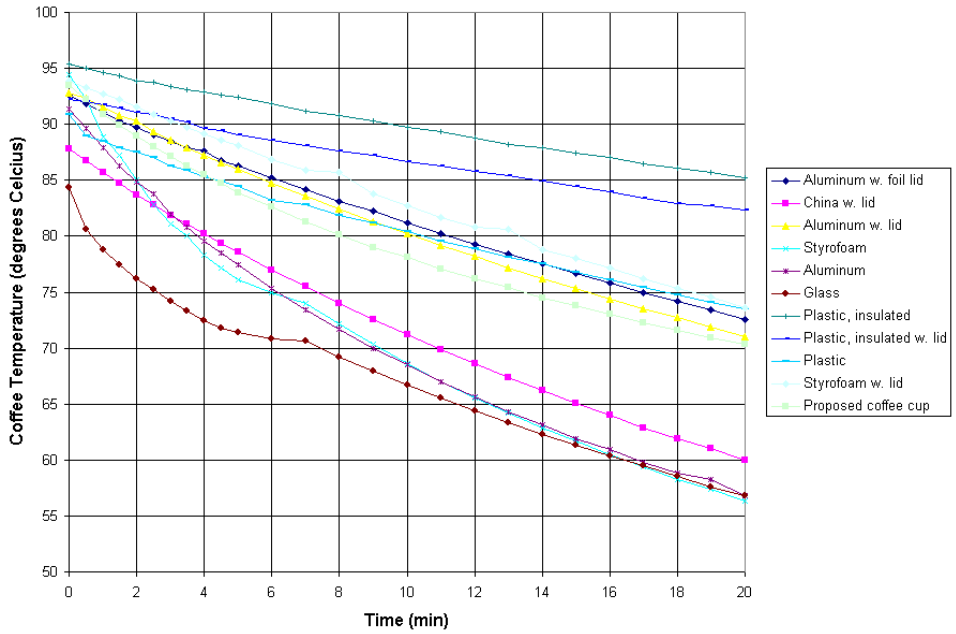



Figure 3.1 – Coffee temperature decline in various cups.

15. All **tables** must be **numbered** and numbered sequentially. They must also have descriptive **titles**. Titles must appear **above** the table. Again, all lettering must be at least 3 mm high to be legible!

Table 5.1 - The heaviest ten airplanes. MTOW = Maximum take-off weight, MLW = Maximum landing weight, TOR = Take-off run (SL, ISA+15°, MTOW), LR = Landing run (SL, ISA+15°, MLW)

| Type | MTOW [tons] | MLW [tons] | TOR [m] | LR [m] |
|---|---|---|---|---|
| Antonov An-225 | 640 | | | |
| Airbus A380-800F | 590 | 427 | | |
| Boeing 747-8I | 439.985 | 306.175 | | |
| Antonov An-124 | 405 | | | |
| Airbus A340-500 | 368 | 240 | 3050 | 2010 |
| Boeing 777-300ER | 351.535 | 251.29 | | |
| MD-11 | 273.314 | 195.04 | 3115 | 2118 |
| Ilyushin IL-96M | 270 | 175 | | |
| Boeing 787-9 | 244.94 | | | |
| L-1011-500 | 231.54 | 166.92 | 2636 | |

16. When presenting **aerodynamic data** in a table, graph or figure it is mandatory that you include the following information:
    - Reference geometries: S, c and b in ft (or inches) and m (or cm).
    - Moment center information in fractions of the m.g.c.
    - Airplane weight consistent with the presentation of the data.
    - Airplane configuration information, such as:
        - Clean
        - Flaps down, gear up
        - Flaps down, gear down
        - Thrust or power setting
        - Speed brake deployment
        - Flight condition
        - Cg location in fractions of the mgc
17. Remember: **tables, graphs** and **figures** are much easier to understand than **prose** so use them as much as possible.

18. Do not put **lengthy derivations** in the main body of the report. Put such material in an appendix (or appendices) and **summarize** the result in the main part of the report.
19. **Plagiarism** will result in **total loss of credit for the entire report**! If you decide to use material, which was not generated by you, clearly identify the source of such material.
20. A **list of symbols** must be included in your report. This list must define all symbols used anywhere in the report (including figures, appendices, etc.). Do not include symbols which are not used in your report! Do not copy a list of symbols from another reference! The list of symbols must be presented in the following manner:

| **Symbol** | **Definition** | **Units (SI)** |
|---|---|---|
| W | Weight | lbs (N) |
| | | |
| Greek Symbols | | |
| $\alpha$ | Angle of attack | deg or rad |
| | | |
| Subscripts | | |
| $( )_{TO}$ | Takeoff | ------- |
| | | |
| Acronyms | | |
| APU | Auxiliary Power Unit | ------- |

21. Never make an **unsubstantiated claim**! Example: if you claim that you have optimized airplane weight, you are expected to prove it. If you cannot, do not make the claim!
22. **Avoid** the use of **superlatives, (**e.g. *this is the best airplane ever designed* or *the wing area selected is the smallest possible for this type of airplane*).
23. If you **extrapolate** data or if you extrapolate existing technology, discuss the consequences to your design of not being able to achieve the extrapolated characteristics.
24. Include **units** (both systems) with all your results.
25. Appendices must be sequenced using capital letters and must have specific titles. For example:
    Appendix A - Hand Calculations
    Appendix B - Design Parameters of Comparable Aircraft