Instructor Info
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gonzalo.mendoza@sjsu.edu

Class Days / Time
F 13:30 – 15:45

Final Project Presentation
May 8th, 2015, 13:30

Classroom
Engr.164

Prerequisite
Graduate standing in AE or instructor consent

Credit
3 units

GWAR
This course satisfies the Graduation Writing Assessment Requirement

Textbook
J. Roskam: Airplane Design, Parts I-VIII
Roskam Aviation and Engineering Corp.
Route 4, Box 274, Ottawa, Kansas, 66067.

Description
This is a project course in which students complete the preliminary design of an airplane of their choice. The design process involves defining the mission requirements, weight sizing, performance sizing, fuselage design, wing, high-lift system and lateral controls design, landing gear design, weight and balance, stability and control, drag polars, and final drawings. In their final report students will also discuss any environmental, economic and safety considerations for their airplane.

Goals
1. To provide graduate level experience in airplane design.
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.

Learning
Objectives

Each student completing AE271 will be able to:

1. Describe the pros and cons of unconventional aircraft configurations such as canards, 3-surface, swept-forward wings, flying wings, tailless, V/STOL, stealth, etc.
3. Design the fuselage, the wing, the empennage, and the landing gear of an airplane.
4. Perform weight and balance analysis of an airplane.
5. Perform a stability and control analysis of an airplane.
6. Compute the drag polars of an airplane.
7. Construct the V-n diagram of an airplane.

Grading

Design reports* = 40%
2 Progress presentations & examinations @ 10% each = 20%
Special topic individual project** = 20%
Written exam = 10%
Intelligent technical discussions online = 10%

850 points < A-, A, A+
700 points < B-, B, B+
650 points < C

*A minimum of 70% score is required in both components of this assignment (see below) to approve the course and meet minimum writing proficiency requirements.

**Written reports not meeting minimum writing proficiency standards will be returned without a grade. Revised reports may be re-submitted (once each) with a penalty of 20 points in the scale of 1 to 100.

Homework

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

Exams

A brief written exam to cover basic concepts and definitions is scheduled for April 24th.

Special project

The special individual project is designed to evaluate the student’s ability to research and prepare a well thought out report on a subject of his or her choosing. Subjects must be related to Aerospace Engineering concepts and/or their impact in society. Topics related to ethics, safety, or environmental impacts of aerospace products are of particular interest. The project consists of an individually written proposal followed by a developed paper on the chosen subject. The content of the proposal and paper is as follows:

- Proposal (February 13th)
  - Abstract
  - Problem Statement
  - Objective (what are you doing to address the problem)
  - Approach (how to achieve the Objective)
  - References
    - Minimum of 2 publications for the proposal (1 must be from scholarly publications).

- Report (April 3rd)
  - Table of Contents
  - Updated Abstract
  - Introduction
  - Discuss background and problem in additional detailed, outline problem solution
  - Sections as required to describe design / solution / research
  - Conclusions
  - References
**AE 271 – Advanced Aircraft Design**

- Minimum of 5 references, at least 2 from scholarly sources, with the other 3 from other reputable publications.
- In this context, Wikipedia is a source of leads, not of actual knowledge

### Approximate Weekly Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture Topic(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Aircraft design overview. Mission requirements. Figures of merit</td>
</tr>
<tr>
<td>02</td>
<td>Configuration design. Conventional and unconventional configurations. Case study de Havilland D.H.106 lessons</td>
</tr>
<tr>
<td>03</td>
<td>Aircraft sizing</td>
</tr>
<tr>
<td>04</td>
<td>Fundamentals of controllability / high speed control issues. Case studies Alaska DC-9 accident, Swearingen SJ30-2 loss of control, Zodiac 601XL and Grob SpN flutter encounters</td>
</tr>
<tr>
<td>05</td>
<td>Pilot forces, control system design. Aircraft component design</td>
</tr>
<tr>
<td>06</td>
<td>Fundamentals of stability and control 1. Longitudinal stability and control concepts. Case study, McDonnell Douglas MD-11 design challenges</td>
</tr>
<tr>
<td>08</td>
<td>Stability and controllability regulatory requirements. Control Harmony. Flight evaluation</td>
</tr>
<tr>
<td>09</td>
<td><strong>Critical Design Review</strong></td>
</tr>
<tr>
<td>10</td>
<td>Design and construction requirements and technology. Case study B-707 Lusaka accident. Aloha B-737 accident</td>
</tr>
<tr>
<td>11</td>
<td>Landing gear design, modeling, and testing. Structural strength requirements: Loads. V-n diagrams</td>
</tr>
<tr>
<td>15</td>
<td>Design for safety</td>
</tr>
<tr>
<td>16</td>
<td><strong>Final Design Review</strong></td>
</tr>
</tbody>
</table>
GENERAL COMMENTS 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 nor 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 the airplane has a retractable landing gear.

9. Never 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:

   \[ X = Y + Z \]  \hspace{1cm} (4.17)

13. All references must be numbered sequentially as they appear in your report. See examples below (1 is a book, 2 is a technical report, 3 is a journal article, 4 is a conference paper, 5 is an internet reference). In your report refer to each of them with a number in a bracket.

   For example: The vortex increases the lift of the flat plate [2] or Mourtos [2] found that the existence of the vortex increased the lift on the flat plate at any given angle-of-attack.


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.](image)

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>
<thead>
<tr>
<th>Type</th>
<th>MTOW [tons]</th>
<th>MLW [tons]</th>
<th>TOR [m]</th>
<th>LR [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antonov An-225</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Airbus A380-800F</td>
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<td>Antonov An-124</td>
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<td>Airbus A340-500</td>
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<td>240</td>
<td>3050</td>
<td>2010</td>
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<td>Boeing 777-300ER</td>
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<td>251.29</td>
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<td>MD-11</td>
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<td>195.04</td>
<td>3115</td>
<td>2118</td>
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<td>270</td>
<td>175</td>
<td></td>
<td></td>
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<tr>
<td>Boeing 787-9</td>
<td>244.94</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>L-1011-500</td>
<td>231.54</td>
<td>166.92</td>
<td></td>
<td>2636</td>
</tr>
</tbody>
</table>
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
     - C.g. location in fractions of m.g.c.

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. Give credit where credit is due!

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:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Definition</th>
<th>Units (SI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>Weight</td>
<td>lbs (N)</td>
</tr>
<tr>
<td>Greek Symbols</td>
<td></td>
<td></td>
</tr>
<tr>
<td>α</td>
<td>Angle of attack</td>
<td>deg or rad</td>
</tr>
<tr>
<td>Subscripts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( )TO</td>
<td>Takeoff</td>
<td>---------</td>
</tr>
<tr>
<td>Acronyms</td>
<td></td>
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<tr>
<td>APU</td>
<td>Auxiliary Power Unit</td>
<td>---------</td>
</tr>
</tbody>
</table>

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