AERO 402 501 AEROSPACE VEHICLE DESIGN II

Fall 2013

MW 4:10 - 5:25 PM 122 HRBB
TTh 11:10 AM - 12:25 PM Team Design Labs HRBB

NOTE: We meet on Mondays as a matter of weekly routine, our other meeting times will be as arranged. Students will schedule additional time in the team design labs, as appropriate.

INSTRUCTORS OFFICE OFFICE HOURS * CONTACT INFORMATION

Mr. Wayne Lutz 743A HRBB MW 1:00 – 4:00 PM and TTh 9:00 - 11:00 AM
Mr. Yogesh Babbar 028 HRBB available in WT lab 979-587-8298 yogeshbabbar@tamu.edu

* or by email or appointment at 979 847-8852 or wlutz@tamu.edu

LEARNING OBJECTIVES

Aircraft Vehicle Design II is intended to familiarize aerospace engineering students with wind tunnel and flight testing to validate preliminary aircraft designs. The student will respond to the given 401 RFP by constructing, planning, and testing wind tunnel and scaled flight vehicles to validate, as far as possible, compliance with the given mission specification. Students will participate in the approval process required to reserve personnel, facilities and airspace per regulations. Students will document the progress of validation by writing a professional quality wind tunnel test plan, wind tunnel test result report, flight test plan, and flight test report. Students will participate in several activities created to emphasize safety in design, test, flight and participation. Continuing the tasks assigned in the previous semester AERO 401, the student will respond to a given RFP. A significant portion of the design work will be done by hand, but specialized airplane software tools will also be used for certain aspects of the design process, as indicated by the instructor. Students will document the progress of the design by submitting several professional quality project reports and operating checklists. The required contents for each of these documents are detailed in class.

By the end of this course, students will be able to:

1. Analyze and validate flight vehicle performance constraints, and determine suitable configurations for a specified mission.

2. Working successfully as a member of a team, conduct and document a detailed and complete assessment and validation of a flight vehicle.

3. Understand the system relationships and interactions between aerodynamics, structures and materials, dynamics and control, propulsion, performance, and internal systems on the design and fabrication of a flight vehicle.

4. Recognize the importance of considering safety, reliability, and maintenance considerations in flight vehicle design and testing to validate engineering designs.

5. Communicate testing results in technical reports, briefings, and presentations.
CONTRIBUTIONS TO PROFESSIONAL COMPONENT

1. This is the second course in a two-semester capstone design sequence. The course is based on knowledge and skills acquired in earlier coursework.

2. Incorporates engineering standards and realistic constraints and considers economic, environmental, sustainability, manufacturability, ethical, health and safety, social and political considerations in the design process.

3. Part of the engineering topics portion of the curriculum.

4. Prepare students for engineering practice.

RELATIONSHIP TO PROGRAM OUTCOMES

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Assessment Method</th>
<th>ABET Outcome</th>
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<tbody>
<tr>
<td>Analyze and interpret customer requirements for a flight vehicle, size a flight vehicle to satisfy performance constraints, and determine suitable configurations for a specified mission</td>
<td>Technical Presentations, Course reports, schedules, and Safety and Flight Readiness Review</td>
<td>3(a), 3(c), 3(e) and AIAA Program Criteria “design competence which includes integration of aeronautical or astronautical topics.” AIAA Program Criteria on technical topics.</td>
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<tr>
<td>Working successfully as a member of a team, construct and validate, as far as possible, a complete flight vehicle based upon previous design review results.</td>
<td>Team flight evaluation, Technical operations plan and check lists, readiness reviews, and team reviews.</td>
<td>3(a), 3(c-g), 3(k) and AIAA Program Criteria “design competence which includes integration of aeronautical or astronautical topics.” AIAA Program Criteria on technical topics.</td>
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<tr>
<td>Understand the system relationships and interactions between aerodynamics, structures and materials, dynamics and control, propulsion, performance, and internal systems on the design of a flight vehicle.</td>
<td>Validate previous AERO 401 technical presentations, Systems Engineering Integration, Critical Design Review presentation, and readiness reviews.</td>
<td>3(a), 3(c-g), 3(k) and AIAA Program Criteria “design competence which includes integration of aeronautical or astronautical topics.” AIAA Program Criteria on technical topics.</td>
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<tr>
<td>Recognize the role of civil and military regulations and the importance of considering safety, reliability, and maintenance considerations in flight vehicle design.</td>
<td>Validate previous AERO 401 presentations, Systems Engineering Integration, and readiness reviews.</td>
<td>3(c-g), 3(I-k) and AIAA Program Criteria “design competence which includes integration of aeronautical or astronautical topics.” AIAA Program Criteria on technical topics.</td>
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<tr>
<td>Communicate design results in technical briefings and presentations.</td>
<td>Design status reports, assigned technical reports, and readiness reviews. presentation</td>
<td>3(g)</td>
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Example 402 reports & supplements: \AUS\Class Notes\AERO 402 - Airplanes\Fall 2013


**Supplementary Texts**


“A Systems Engineering Approach to Aircraft Design”, Prof. Dimitri N. Mavris
Director, Aerospace Systems Design Laboratory (ASDL), 2012


Jane's all the World's Aircraft, Jane's Publishing Incorporated, New York, NY.


“Systems Engineering – A fundamental Concept of Design”, Dr. Armund J. Chaput, Adjunct Professor, University of Texas, Austin, TX, 2012 (excerpt: ASE 361 Course Material)

DESIGN SOFTWARE

Airplane CAD (ACAD), Lockheed-Martin Tactical Aircraft Systems, Fort Worth, TX.


METHOD OF EVALUATION

The grade is based upon attendance & team participation, test reports & plans, wind tunnel & flight vehicle design plans and reports, wind tunnel tests, completed flight vehicle, safety, and peer (team member) evaluations.

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Team Status Reports</td>
<td>10%</td>
</tr>
<tr>
<td>Wind Tunnel Model Design</td>
<td>10%</td>
</tr>
<tr>
<td>Wind Tunnel Test Plan &amp; Report</td>
<td>15%</td>
</tr>
<tr>
<td>Flight Vehicle Design &amp; Operations</td>
<td>25%</td>
</tr>
<tr>
<td>Flight Test Plan &amp; Report</td>
<td>15%</td>
</tr>
<tr>
<td>Flight Test Airworthiness</td>
<td>10%</td>
</tr>
<tr>
<td>Individual Work</td>
<td>5%</td>
</tr>
<tr>
<td>Peer Performance Evaluation</td>
<td>5%</td>
</tr>
<tr>
<td>Safety Performance Evaluation</td>
<td>5%</td>
</tr>
<tr>
<td>Violation of safety</td>
<td>( - 100%)</td>
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Each student will receive a grade as a member of the design team (one grade assigned for a given task or project report). Also, an Individual Work grade may be based upon each member’s contribution to the AERO 402 design effort over the entire semester. A description of specific tasks will be provided in class.

Grade Breakdown

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Assigned Reviews, Task, Reports</td>
<td>35%</td>
</tr>
<tr>
<td>Flight Operations Results</td>
<td>50%</td>
</tr>
<tr>
<td>Flight Test Plan &amp; Report</td>
<td>15%</td>
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Grading Scale

- 90 - 100 A
- 80 – 89 B
- 70 – 79 C
- 60 – 69 D
- below 60 F

Standards

Safety is paramount. Violations of standards of safe conduct will not be tolerated. You are responsible.
All students are required to take the 3 A&M/TEES on-line safety courses for students. These safety courses are available at http://labsafety.tamu.edu/training/:

1. Hazard Awareness in Engineering Research
2. Laboratory Safety
3. Shop & Tool Safety Training

Full participation is expected. Absences are not permitted unless excused (within University Rules). Since this is a team effort, no late reports will be accepted. Failure to turn in a report by the assigned time and date will result in a penalty. No grades of incomplete will be assigned.

Schedules are tight. Schedule maintenance requires conscientious effort by all team members.

Reports are due by the dates set.

Report contents must adhere to the requirements of a professional document.

Written work must be professional and neat. All reports must meet minimum standards of professionalism. Unprofessional reports will be severely downgraded even if the technical contents are correct.

Reports may require calculations. At least one sample calculation must be performed by hand and documented for each case (this serves as a verification of the algorithm). This includes calculations which are done using the AAA program or your own program. Inclusion of AAA figure outputs in the reports is encouraged.

All reports are to be typed (word processor). Sample calculations must be on green engineering paper. All engineering drawings must be drawn using a CAD software package. Reports which are not word processed, do not provide sample calculations, and drawings which are not drawn with CAD will be returned with no grade.

All reports must be bound. (Examples are provided, but teams and each team member are expected to provide reports that are professional, original, complete … Be an engineer and think creatively).

PERSONNEL RESPONSIBILITIES and SCHEDULE

The process of moving a conceptual design (AERO 401) through final design and “proof” (AERO 402) requires scheduling, planning, design refinement, fabrication, tunnel tests, ground tests, application for clearance & safety, administration, personnel, documentation and reports. Several tasks are identified below.

Please note:
- For each task, each design team manager will assign a Lead Engineer to manage that task.
- Several tasks may overlap and will need to be addressed by the team members concurrently.
- All team members are responsible to "sign off" (approve completion) of each task.
- Major team reports are identified with due dates.
- Many tasks (e.g., hardware purchase, FAA approval, etc) require lead time and administrative action by A&M staff; these tasks will be addressed during entire course.
- Flight tests will target the end of Week 14 with contingency plans due to weather delays for the (exam) weekend of Week 15.
- All course activity will end on Wednesday of Week 16.

Weeks 1 – 7: Wind Tunnel Investigations - Scale Model

Task WT.1 Prepare 3-D Solidworks Drawings for Rapid Prototyping Machine.
Task WT.2  Study and prepare 3x4 tunnel, balance, instrumentation, software for WT tests. Prepare & submit WT test plan.
Task WT.3  Conduct WT tests.

Wind Tunnel Model Plan submit prior to RP construction
Preliminary WT test plan submit 1 week prior to entry
Wind Tunnel Test Report(includes final WT test plan) submit NLT Week 7, Monday

Weeks 1 – 12:  Wind Tunnel Tests

Task FVD.1  Design and fabrication plan for final design configuration. draft due NLT Week 9, Monday
(including quality SolidWorks model of Flight Vehicle)
Define and order material for vehicles. order by NLT Week 10, Monday

Task FVD.2  Vehicle construction(include construction of practice kits) perform tasks, Weeks 6-12

Task FVD.3  Ground tests – engine tests, weight and balance, loads, deformation, joint slop, etc. due NLT Week 12, Thursday
Design and Fabrication report due NLT Week 13, Thursday

Weeks 1 – 14:  Flight Tests

Task FT.1  Reserve facilities and pilot time. initiate NLT Week 2, Monday
Establish FAA and TAMU Safety approval. Prepare flight schedule, flight test plan.

Task FT.2  Flight Test Plan

Task FT.3  Flight Test Operations
Flight Test Operations (weather contingency)

Task FT.4  Flight Test Report & Vehicle Worthiness Project Summary Due Week 16, Thursday

Task FT.5  Program closeout (equipment storage, material organization). Due NLT Week 16 Thursday)

Documentation

Team Status Reports: Required Contents
Each team is required to submit a weekly activity report due at the Monday class. The report is brief (2 pages max), but must be organized in this manner. Note: Teams may negotiate report dates with Instructor, per Team Schedule (TBD in Class in Week 1)

AERO 402 Weekly Activity Report for the Company Name

Date:

1. ACCOMPLISHMENTS OF THE REPORT PERIOD
   Item | Engineer | Projected Hours | Actual Hours

2. OUTSTANDING ITEMS REMAINING FROM LAST MEETING(S)
   Item | Engineer | Projected Hours | Actual Hours To Date

3. CRITICAL ISSUES (“Action Items”) TO BE RESOLVED AND SCHEDULE STATUS
   Item

4. WORK PLAN FOR UPCOMING REPORT PERIOD
   Item | Engineer | Projected Hours

5. TIME SHEET

   Engineer | Total Hours (for week) | Total Hours (for course – to date)

Design Report Grading Guidelines

1. Professionalism
   a) overall professional execution
   b) figure quality
   c) plot scaling
   d) units

2. Completeness
   a) Chapters, Sections, and steps
   b) required parameters
   c) clear statement of purpose

3. Technical
   a) technical correctness
   b) understanding of design procedure or mission specification
   c) accuracy and reporting of calculations
   d) reporting data or analysis

4. Background Research
   a) complete analysis
   b) figures or data properly cited
   c) complete discussion

Aggie Honor Code and Scholastic Dishonesty:

Upon accepting admission to Texas A&M University, a student immediately assumes a commitment to uphold the Honor Code, to accept responsibility for learning and to follow the philosophy and rules of the Honor System.
Students will be required to state their commitment on examinations, research papers, and other academic work. Ignorance of the rules does not exclude any member of the Texas A&M University community from the requirements or the processes of the Honor System. For additional information please visit: www.tamu.edu/aggiehonor/  
The code simply states … “An Aggie does not lie, cheat, or steal or tolerate those who do.” … it is your code.  
As your professor, I pledge to you that I will defend your code. I will not tolerate any form of academic dishonesty and I pledge to work to punish violators to the fullest extent. As a student in my course, you are required to follow all aspects of your Honor Code. The student will be automatically dropped from the course with a grade of F assigned by the instructor.  
**Plagiarism:**  
As commonly defined, plagiarism consists of passing off as one’s own the ideas, words, writings, etc., which belong to another. In accordance with this definition, you are committing plagiarism if you copy the work of another person and turn it in as your own, even if you have the permission of that person. Plagiarism is the worst of academic sins, for the plagiarist destroys the trust among colleagues without which research cannot be safely communicated. If you use the work of another person of persons in your reports or presentations, then reference the person so that due credit may be given. If you are not sure about whether a particular action could be considered plagiarism on your part, then ask the instructor.  
**Copyrights:**  
The handouts used in this course are copyrighted. By "handouts" we mean all materials generated for this class, which include but are not limited to syllabi, lab problems, in-class materials, review sheets, and additional problem sets. Because these materials are copyrighted, you do not have the right to copy the handouts, unless the author expressly grants permission.  
**AMERICAN WITH DISABILITIES ACT (ADA) POLICY STATEMENT**  
The American with Disabilities Act (ADA) is a federal antidiscrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Department of Student Life, Services for Students with Disabilities in Room 118 of Cain Hall, or call 845-1637.  
**GENERAL REPORT STANDARDS AND REGULATIONS**  
1. Project Reports (Wind Tunnel, Flight Readiness, etc.) must be presented on time, on the dates assigned. Once the date and task assignments are defined in class by the instructor, the deadlines will not be extended for any reason, regardless of the availability of computers in the Lab, etc.  
2. Work must be professional and neat. All tasks must meet minimum standards of professionalism. Unprofessional products (report, models, check lists) will be severely downgraded even if the technical contents are correct.
3. As a general rule, follow the same reporting formats and procedures practiced in AERO 401. It is in the student’s best interest to follow similar formats in each subsequent report/checklist to facilitate including these documents in later assignments.

Note: Portions of this syllabus were extracted from contents of the previous AERO 402 course syllabus, posted by Dr. Thomas Strganac, Aerospace Engineering Department, Texas A&M University.