Syllabus

AOE 4066 (Spring)

1. **Course Name:** Air Vehicle Design
2. **Credit and Contact Hours:** 3 Credit Hours (3H + 3C)
3. **Lectures:** Tuesdays & Thursdays, 3:30 – 4:45 PM, enter *'classroom'*
4. **Instructor:** Enter pertinent info *(name, office, phone, e-mail)*
5. **Co-instructor:** Enter pertinent info *(name, office, phone, e-mail)*
6. **Office Hours:** Enter start & end times or enter '*By appointment'*
7. **Textbook**
   - Nicolai, L.M. and Carichner, G.E., *Fundamentals of Aircraft and Airship Design, Volume I—Aircraft Design,* AIAA Education Series, AIAA, Washington D.C., 2010.
     Although the 'Textbook' covers the fundamentals of most of the technical topics of this course, additional reference material, such as books and technical papers, is essential to covering the gaps and adding more details to some topics. Examples include subsystems, configuration layout, computer-aided design (CAD), and engineering analysis software. Therefore, students are expected to use numerous other sources of online and hardcopy reference material. Although we provide an extensive list of books and references, students will most likely need to search for others depending on the nature and scope of their design project.

   a. Select Primary References

   - Raymer, D.P., *Aircraft Design*: *A Conceptual Approach*, Sixth Edition, AIAA Education Series, AIAA, Washington, D.C., 2018.
   - Gundlach, J., *Designing Unmanned Aircraft Systems: A Comprehensive Approach*. Reston, VA: AIAA Education Series, 2012.
   - Sadraey, M.H., *Aircraft Design: A Systems Engineering Approach*. West Sussex, United Kingdom: John Wiley and Sons, Ltd., 2013.
   - Kirschbaum, N. and Mason, W.H., *Aircraft Design Handbook: Aircraft Design Aid and Layout Guide*, VPI Aircraft Design Series, 1992-93.
   - Roskam, J., *Aircraft Design,* Parts 1-8, Roskam Aviation and Engineering Corp., Lawrence, KS, 1985.
   - Moir, I. and Seabridge, A., *Aircraft Systems: Mechanical, Electrical, and Avionics Subsystems Integration*, 3rd edition, AIAA Education Series, AIAA, Reston, VA, 2008.
   - Mason, W.H., Info for Aircraft Design, *http://www.dept.aoe.vt.edu/~mason/Mason_f/SD1.html*

8. **Specific Course Information**

   b. Catalog Description

   Fundamental principles of innovative air vehicle design. Qualitative and quantitative decision-making tools. Multidisciplinary design teams with emphasis on ethics and professionalism. Project risks and mitigation plans. Oral presentations for design reviews. Written engineering design report. 4065: Proven conceptual design process. Tradeoff studies. Air vehicle weight estimation. Air vehicle concepts feasibility assessment; 4066: Preliminary design tools and processes. Efficient and light-weight air vehicles. Air vehicle design validation.

c. Course Description

AOE 4066, offered in the spring semester, is the second of a two-semester capstone senior design sequence. Throughout the spring semester, each team schedules weekly meetings with the teaching staff lasting about an hour to discuss progress, plans, and problems (the 3Ps). Formal lectures are limited to the first week; guest lectures might be scheduled later if the right opportunity arises. Peer-to-peer (P2P) learning sessions take the place of formal lectures on various topics that are relevant to the design projects. Students are expected to spend considerable amount of additional time every week to perform specific technical tasks assigned to each individual team member per the team project plan and/or tasks assigned by the instructors. Any student needing assistance should feel free to meet with the instructors during office hours (send an email to schedule an appointment).

Each team conducts two formal project reviews with the 'customer': (1) iPDR (interim Preliminary Design Review); and (2) final PDR. The purpose is to demonstrate that team's preliminary design meets all requirements with acceptable risk and within the cost and schedule constraints. The reviews establish the basis for proceeding with detailed design once the preliminary design is completed. Teams need to show that the correct design options have been selected, interfaces have been identified, and verification methods have been described. Teams should present full baseline cost and schedules, as well as all risk assessment, management systems, and metrics. In addition, each team will prepare and submit a final report in proposal format at the end of the semester. Once approved by the instructors, teams will submit their reports as their response to the RFP received from the customer in fall. This course also meets the AOE curriculum's "writing intensive" requirement.

d. Prerequisites 4065 for 4066 (Pre-reqs. for 4065 are: 2104, 3054, 3114, 3124, 3134, 3164)

e. Corequisites 4106 (Experiments for Aerospace Design II)

f. Required Course Yes

g. Grading Distribution

We do not use any set grade distribution targets (such as a certain percentage of A's and B's) or cut-offs (e.g., A=90 and above, or B = 80-90) in this course. Your letter grade represents <u>*relative standing*</u>; it's <u>*not*</u> an absolute measure.

- We strongly recommend that you carefully study the **<u>Grading Procedure</u>** document posted on the course site.
- Individual grade is determined by combining the numerical scores of:

Oral Project Reviews	35%
Interim PDR (15%)	
Final PDR (20%)	
Written Final Report	60%
Peer Performance Assessment	5%
	100%

<u>Note:</u> there are no quizzes, midterm or final exams.

- *Your team must work together for the entire semester. Conflicts or concerns will not magically go away over the next 15 weeks. Each of you needs to be proactive when you see potential problems, trying to work it out within the team when possible and asking for help from your instructors sooner rather than later. You will have the opportunity to provide feedback using*

a Peer Performance Assessment process. Individual grades may be adjusted in cases of a large and clear imbalance in a team at the instructor's discretion.

9. Specific Goals for the Course

a. Learning Objectives

1. Design innovative air vehicles that meet all customer requirements.
2. Develop a project plan, assess project risks, and prepare risk mitigation plans.
3. Contribute to a multidisciplinary design team as a member with highest levels of ethics, integrity, and professionalism.
4. Deliver oral presentations for informal and formal design reviews.
5. Write an engineering project report in proposal style (response to Request for Proposal).
6. Refine the aircraft concept (from a baseline created in the first semester) to develop an integrated system with lightest weight and lowest cost to meet customer requirements.
7. Perform engineering analyses to quantitatively assess air vehicle capabilities against specific design requirements.
8. Validate the final air vehicle design through analyses to demonstrate compliance with all customer requirements.

b. ABET Outcomes Addressed by the Course

Coverage of the following seven ABET outcomes in relation to each course learning objective is assessed on the following scale: **0 (blank) = none, 1 = low, 2 = moderate, 3 = high**. The seven outcomes specified by ABET are:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply the engineering design process to produce solutions that meet specified needs with consideration for public health and safety, and global, cultural, social, environmental, economic, and other factors as appropriate to the discipline.
3. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
4. An ability to communicate effectively with a range of audiences.
5. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
6. An ability to recognize the ongoing need to acquire new knowledge, to choose appropriate learning strategies, and to apply this knowledge.
7. An ability to function effectively as a member or leader of a team that establishes goals, plans tasks, meets deadlines, and creates a collaborative and inclusive environment.

Course Learning Objective ▼ / **ABET Outcome ►**	1.	2.	3.	4.	5.	6.	7.
1. Design innovative air vehicles to meet *all* customer requirements.	1	3		2			2
2. Assess project risks, such as uncertainties in analysis results, and prepare risk mitigation plans.	2			2			
3. Contribute to a multidisciplinary design team as a member with highest levels of ethics, integrity, and professionalism.	2	2	2	3	3	2	2
4. Deliver oral presentations for informal and formal design reviews.	2	3	3	1	2	1	2
5. Write an engineering design project report in proposal style (response to Request for Proposal).	2	3	3	1	2	3	2

6. Refine the aircraft concept (from the first semester) to create an integrated system with lightest weight and lowest cost to meet customer requirements.	2	3		2		2	2
7. Perform engineering analyses to quantitatively assess air vehicle capabilities against specific design requirements.	3					2	3
8. Validate the final air vehicle design through analyses to demonstrate compliance with all customer requirements.	3					3	

10. Brief List of Topics

TOPIC **% of Course**

Analysis and Assessment of a Baseline Design…….80%

Requirements Compliance
Aircraft Layout and Sizing
Vehicle/system Performance Estimates
Weight Estimation
Airframe Propulsion Integration
Control and Stability
Cost Estimation

Communicate the design through presentations and a report…….20%

100%

11. Honor Code

The Undergraduate Honor Code pledge that each member of the university community agrees to abide by states:

"As a Hokie, I will conduct myself with honor and integrity at all times.
I will not lie, cheat, or steal, nor will I accept the actions of those who do."

Students enrolled in this course are responsible for abiding by the Honor Code. A student who has doubts about how the Honor Code applies to any assignment is responsible for obtaining specific guidance from the course instructor before submitting the assignment for evaluation. Bear in mind that honesty in your academic work is a reflection of your personal and professional integrity. Ignorance of the rules does not exclude any member of the University community from the requirements and expectations of the Honor Code.

The University Undergraduate Honor Code applies to all work for this course. Bear in mind that honesty in your academic work is a reflection of your personal and professional integrity. All work you submit must be your own (for individual assignments) or the team's (for team assignments). For team assignments, the work must reflect uniform participation across all team members; team members should be prepared to provide feedback about their own and their team members' involvement. Note that differential grades are likely on team assignments. We will report suspected violations of the Honor Code to the Office of Undergraduate Academic Integrity.

The Honor Code expressly forbids the following academic violations:

A. CHEATING
Cheating includes the intentional use of unauthorized materials, information, notes, study aids or other devices or materials in any academic exercise, or attempts thereof.
B. PLAGIARISM
Plagiarism includes the copying of the language, structure, programming, computer code, ideas, and/or thoughts of another and passing off the same as one's own original work, or attempts thereof.

C. FALSIFICATION
Falsification includes the statement of any untruth, either verbally or in writing, with respect to any element of one's academic work, or attempts thereof.
D. FABRICATION
Fabrication includes making up data and results, and recording or reporting them, or submitting fabricated documents, or attempts thereof.
E. MULTIPLE SUBMISSION
Multiple submission involves the submission for credit—without authorization of the instructor receiving the work—of substantial portions of any work (including oral reports) previously submitted for credit at any academic institution, or attempts thereof.
F. COMPLICITY
Complicity includes intentionally helping another to engage in an act of academic misconduct, or attempts thereof.
G. VIOLATION OF UNIVERSITY, COLLEGE, DEPARTMENTAL, PROGRAM, COURSE, OR FACULTY RULES
The violation of any University, College, Departmental, Program, Course, or Faculty Rules relating to academic matters that may lead to an unfair academic advantage by the student violating the rule(s).

12. Attendance and Classroom Behavior

Virginia Tech has a class attendance policy. Class meetings are an integral part of this course. Students and faculty are expected to attend class at all regularly scheduled times, except for cancellations announced on a university wide basis by the appropriate authority. When students cannot attend a class, it is their responsibility, as soon as possible, to consult with the course instructor about missed work. Students are expected to respect one another, and the instructors, in and outside the classroom. Computers may be used in the classroom *only for viewing material for this course or for taking notes*. Accessing audio, images, or videos during class may be distracting to other students and is strictly prohibited. *Mobile phone use is prohibited*, except as a student response system.

13. AOE Studio for Design Innovation (ASDI@VT)

Because of the emphasis on teamwork, the ASDI@VT in Surge 118 has been dedicated to senior design activity. Seniors use it on a priority basis. There are three collaboration rooms; a conference room; one presentation theater; and a flexible "white-board" room. The collaboration room and presentation theater are equipped with a hockey-puck system which allows multiple portable computers to be connected via HDMI and selected by tapping one of the pucks.

In addition, there is an ASDI Library with two-cabinet full of relevant reference material. *This material is for your use while you are in ASDI*. ***The material should not be taken out of the Studio unless expressly authorized by one of the instructors.*** It is your personal responsibility to maintain the room in good condition. *Leave it in a better condition than you found it.* After all, it is your facility!

Note that you can have remote access to the eight engineering workstations in the studio. Please email your request to (aoe-it-support-g@vt.edu) for setting up a computer account, and for any other information about the workstations that you need.

14. Accommodations

Virginia Tech welcomes students with disabilities into the University's educational programs. The University promotes efforts to provide equal access and a culture of inclusion without altering the essential elements of coursework. If you anticipate or experience academic barriers that may be due to disability, including but not limited to ADHD, chronic or temporary medical conditions, deaf or hard of hearing, learning disability, mental health, or vision impairment, please contact the Services for

Students with Disabilities (SSD) office at 540-231-3788 or **ssd@vt.edu**, or visit **www.ssd.vt.edu**. If you have an SSD accommodation letter, please meet with me privately during office hours as early in the semester as possible to deliver your letter and discuss your accommodations. You must give the instructor reasonable notice to implement your accommodations, which is generally 5 business days, and 10 business days for final exams.

15. Emergency Preparedness

Recognizing that emergency preparedness is every Hokie's responsibility, please familiarize yourself with the resources on the VT Emergency Management website: https://emergency.vt.edu/ready.html

16. Principles of Community Statement

The Virginia Tech Principles of Community are intended to increase access and inclusion and to create a community that nurtures learning and growth for all of its members. They are defined at http://inclusive.vt.edu/