AE 6343 Syllabus

Aircraft Design I A/Q01/Q03 – 3 Credits

Fall 2026

Instructor Information

Instructors: Prof. Dimitri N. Mavris & Dr. Evan D. Harrison

Email: dimitri.mavris@aerospace.gatech.edu ; evan.harrison@asdl.gatech.edu

General Course Information

Description

This document provides basic information regarding the Aircraft Design I class for the Fall 2026 academic term. The course is listed as AE6343 for 3 credit hours in the course catalog of the Georgia Institute of Technology. Section A is for students on the US main campus; Section Q is for distance-learning students; and Section Q3 is for students on the European campus.

The focus of AE 6343 is the study of early-stage aerospace vehicle design, particularly for fixed-wing aircraft, from a broad systems perspective that integrates technical disciplines. Rather than focusing solely on one part of the airplane, the course examines how requirements, mission needs, and engineering trade-offs converge during synthesis and sizing. The lectures will cover the design process itself, systems engineering as a design framework, requirements analysis, energy-based and mission-dependent constraint analysis, mission analysis for fixed-wing vehicles, alternative-energy concepts, aerodynamics, aircraft performance, structures, and air-breathing propulsion.

The official AE6343 class website is on Canvas at https://canvas.gatech.edu/ . This website is intended to provide all official lecture material, handouts, presentations, notices, and relevant information. Note that the website will be updated regularly and must be checked frequently. All announcements are automatically emailed to your GT student account. It is the student's responsibility to maintain access to this account and address email filtering issues. To log in, use your GT account username (usually your first name initial followed by your last name and a number, e.g., *gburdell3* and your GT account user password. Once on Canvas, select the AE6343 course.

Pre- & Co-Requisites

Students taking AE6343 Aircraft Design I in sections A and Q should register concurrently for AE6383 Applied Design Laboratory, **except for students taking AE6343 for the Ph.D. qualifying exam**. Students planning to take AE6344 Aircraft Design II in the Spring term must take AE6383 concurrently.

Required Course Materials

The following textbooks are suggested references for the course. Most of the material discussed in the lectures will be drawn from the following works and are not required for purchase:

1. Raymer, D. P., *Aircraft Design: A Conceptual Approach*, 6th Ed., Reston, Va.: AIAA, 2018.
2. Mattingly, J. D., Heiser, W. H., Pratt, D. T., *Aircraft Engine Design*, 2nd Ed., Reston, Va.: AIAA, 2002.

Specific reading assignments from the two sources listed above will be provided throughout the semester to complement the material covered in class.

At the end of major sections of the course, a 10-15-minute online quiz will be made available on Canvas to help students assess their understanding of basic concepts. These quizzes will consist of multiple-choice and true-or-false questions, may be taken any number of times, and will not be graded.

Students seeking additional background on topics covered in the course may find the following supplemental references useful:

1. Anderson, J. D., *Fundamentals of Aerodynamics*, 6th Ed., Boston: McGraw-Hill Higher Education, 2016.
2. Anderson, J. D., *Aircraft Performance and Design*, Boston: McGraw-Hill, 1999.
3. Nicolai, L., Carichner, G., *Fundamentals of Aircraft and Airship Design, Volume 1: Aircraft Design*, AIAA, 2010.
4. Nicolai, L., Carichner, G., *Fundamentals of Aircraft and Airship Design, Volume 2: Airship Design and Case Studies*, AIAA, 2013.
5. Torenbeek, E., *Synthesis of Subsonic Airplane Design*, Delft University Press, 1982.
6. Torenbeek, E., *Advanced Aircraft Design: Conceptual Design, Technology and Optimization of Subsonic Civil Airplanes*, John Wiley \& Sons, 2013.
7. Gere, J. M., Goodno, B., *Mechanics of Materials*, 8th Ed., Cengage Learning, 2012.
8. Hill, P. G., Peterson, C. R., *Mechanics and Thermodynamics of Propulsion*, 2nd Ed., Reading, Mass.: Addison-Wesley, 1991.
9. Nelson, R. C., *Flight Stability and Automatic Controls*, 2nd Ed., Boston, Mass.: McGraw-Hill, 1998.

Course Goals & Instructional Approach

Course Learning Outcomes

Upon successful completion of this course, you should be able to:

1. Explain the role of systems thinking in fixed-wing vehicle design.
2. Interpret mission requirements and translate them into engineering design drivers and constraints.
3. Perform preliminary sizing and synthesis of fixed-wing vehicles using conceptual design methods.
4. Apply energy-based and mission-dependent constraint analysis to evaluate design feasibility and performance
5. Assess the influence of aerodynamics, propulsion, structures, and performance on overall vehicle design
6. Compare alternative design approaches and technologies in the context of fixed-wing vehicle development
7. Analyze and communicate design tradeoffs in a clear and technically sound manner
8. Apply course concepts in team-based projects focused on the design of fixed-wing vehicles

Rationale for Teaching Techniques

These are graduate-level courses designed with the expectation that learning will take place both inside and outside the classroom. Lectures are intended to organize the material, highlight key ideas, model ways of thinking, and create opportunities for discussion, but they are not meant to deliver every detail needed for mastery. Students are therefore expected to prepare before class, engage actively during lecture, and revisit the material afterward through review, practice, and reflection. This approach is consistent with learning science findings showing that durable learning is strengthened by effortful engagement, retrieval practice, spacing, and working through ideas rather than only rereading or listening passively [1, 2, 3].

For that reason, students are expected to be active and proactive in their own learning. Office hours, Piazza, and other course support structures are provided not as substitutes for independent effort, but as places to ask questions, test your understanding, and get help when you are stuck. Students are strongly encouraged to form study groups, compare approaches, and discuss concepts with one another, since structured cooperative learning has been shown to support achievement and engagement. At the same time, each student must still do their own intellectual work: struggling with a problem, attempting a solution, identifying what is missing, and repairing errors are essential parts of the learning process. In that sense, failing to do the work yourself not only violates course expectations; it also deprives you of the very practice that helps learning stick [3, 4, 5].

This is also why complete worked solutions are not routinely released. Research in learning and memory shows that students learn more when they must retrieve information, generate a response, and diagnose their own mistakes than when they passively read an answer key. Accordingly, students are encouraged to return to lecture notes, assigned materials, and released guidance to identify what is missing in their work and correct it themselves. Teaching assistants remain available during office hours and on Piazza to help clarify concepts, confirm corrected reasoning, or assist when students cannot resolve an issue on their own. The goal is not to withhold help but to support the productive effort that leads to stronger retention, transfer, and later performance [1, 3, 5].

For similar reasons, exam questions are not released, and students will not retain access to them after the exam period. Exams are intended to assess individual understanding at a particular point in time, while preserving the integrity and long-term usefulness of the question bank. More importantly, course learning is best supported when students focus on underlying methods, concepts, and patterns of reasoning rather than on memorizing prior exam items. Students should therefore use lecture notes, practice materials, homework, discussions, and feedback as the primary basis for preparation. Evidence from the science of learning consistently favors practice testing, spaced review, and active problem solving over passive review of old solutions alone [3, 6, 7].

Course Policies & Expectations

Attendance & Participation

For students in section A, the class meets on Fridays from 2:00 PM to 4:45 PM EST. The building and classroom location are available on the class website. Students on the main Georgia Tech campus are expected to attend in person.

Distance learning students in sections Q and Q3 are encouraged to attend lectures during class time to ask questions in real time. However, the instructors understand that this may not always be possible because of time zone differences and work schedules. Class recordings will be made available to students in the Q and Q3 sections of the class website shortly after each lecture. Distance learning students are expected to keep up with the class material within the same week that it is presented. This is important because some group deliverables may depend on lecture content. Assignment due dates are the same for both on-campus and distance learning students.

Students are expected to attend lectures, participate actively in class discussions, and ask questions whenever they are uncertain about the material. Lectures are conducted in a discussion-based format, in which regular questioning of concepts is encouraged, and student engagement is essential. Students should notify the instructors in a timely manner if they are unable to attend a lecture or meet a deadline so that alternative arrangements may be considered.

Student-Faculty Expectations Agreement

At Georgia Tech, we believe it is important to foster an atmosphere of mutual respect, acknowledgment, and responsibility between faculty and students. The Student-Faculty Expectations outline the basic expectations you may have of me, as well as those I have of you. Ultimately, respect for learning, dedication to hard work, and courteous interactions help create the kind of environment we value. We encourage you to remain committed to Georgia Tech's ideals throughout this course.

Collaboration, Group Work & Use of Generative AI

a) Collaboration:

Collaboration is encouraged when it supports learning, professional growth, and thoughtful engagement with course material. Students are welcome to discuss concepts, compare approaches at a high level, and help one another think through difficult ideas. However, collaboration must never cross the line into submitting work that is not genuinely your own. Unless explicitly stated otherwise, each student is expected to produce their own individual assignments, write their own solutions, and be able to explain and defend their work independently. Productive collaboration should clarify understanding, not replace the intellectual effort required of each student. When in doubt, students should ask the instructional team for clarification before proceeding.

b) Group Work:

Group work is a central part of these courses and is intended to reflect the realities of professional engineering practice. Teams are expected to function in a coordinated, responsible, and equitable manner. No team member should carry a disproportionate share of the workload, and no student should disengage and rely on others to complete the work on their behalf. Responsibilities should be clearly divided, progress should be communicated regularly, and each member should remain accountable for both their own contributions and the project's overall direction. Effective teams do not wait for problems to escalate, they raise concerns early, adjust workloads when necessary, and seek guidance from the instructional team when issues cannot be resolved internally. Peer and self-assessments may be used to reflect the quality and consistency of each student's contribution.

c) Use of Past Student Work:

For individual assignments, students may not use materials created by students who took the course in previous years or by their current classmates. Doing so undermines the purpose of an individual assignment and will be treated as a violation of the Honor Code.

d) Use of Generative AI:

Students may not use generative machine learning models or services (i.e., AI tools) to create text, technical figures, or code for any assignment submitted for a grade. The use of such tools is permitted for research purposes; however, students are reminded that these models are trained on imperfect data and may produce inaccurate or misleading results. Tools such as ChatGPT are not acceptable scholarly sources. If students use such tools during their research, any resulting statements must be supported by published sources that can be properly cited.

AI tools may be helpful when beginning a literature review in an unfamiliar area, as they can sometimes provide a broad overview of a field. However, students are expected to continue their literature review by reading survey papers as well as papers directly related to the methods and processes relevant to their specific research needs.

Students may use AI tools to help overcome writer's block or to explore possible starting points for coding assignments. However, all work submitted for grading must be the student's own. Model-generated text must not be copied into any submitted document, even if it is later edited. Likewise, AI-generated code may not appear in any submitted assignment. Students may use such tools to support learning, but not to complete the work on their behalf. Any AI-generated code used during the learning process must be discarded and independently recreated by the student so that the instructors can properly assess the student's understanding.

If AI-generated text, figures, or code are detected, the student-or the entire team, if applicable-will receive a zero for that portion of the assignment. Repeated use of auto-generated text or code may result in additional penalties in accordance with Institute policies established by the Office of Student Integrity.

Students with questions about the appropriate use of AI tools should contact the instructors for clarification and obtain permission if they believe a particular use is justified. Office hours and post-lecture discussions are the best opportunities to resolve such questions. Students should also keep in mind that AI use policies may differ across courses; permission granted in one course does not automatically apply in another.

Experience has shown that work produced by generative models is often unsatisfactory and of poor quality, frequently resulting in grade penalties and weak academic performance. Students are here to develop new skills and methods, and they are expected to focus on building those abilities rather than relying on shortcuts that are easily recognized and reflect poorly on their work ethic.

Assessment & Grading

Assignments

Please note that the assignment description handout, available on the class website, will include detailed assignment descriptions, team information (if applicable), instructions, deliverables, and helpful resources. Students should direct any questions to the teaching assistants through Piazza under the appropriate assignment tab.

a) Homework:

A total of four individual homework assignments will be given throughout the semester. Each assignment will focus on a specific topic, including sizing & synthesis, aerodynamics, performance, and propulsion. In most cases, students will have approximately two weeks to complete an assignment; however, the first assignment will allow roughly one month. Assignments will be released when a topic is introduced and will generally be due when the next major topic begins.

Most problems can be solved using the material provided in class, although some may require additional independent research. These assignments are intended to assess students' ongoing understanding of the course material and to help prepare them for the exams.

b) Projects:

A two-part, semester-long group project is intended to provide practical application of the design methodologies and tools introduced in lecture.

(1) Project 1

This project provides an application of the sizing and synthesis methods introduced during the lecture. Students will use the approaches taught in class to perform an initial mission-sizing and constraint analysis in the context of conceptual design. The exercise is intended to strengthen understanding of how the mathematical models used in aerospace vehicle design are connected to underlying physical principles and relationships. To complete the project, students must study the energy-based constraint analysis method presented in class, together with the weight-fraction approach to mission sizing. An analysis tool capable of implementing the full sizing and synthesis process will be developed and verified against the known performance of a provided reference aircraft. The tool will then be used to generate a conceptual design that satisfies the requirements set forth in the accompanying Request for Proposal (RFP).

(2) Project 2

Project 2 builds on the work completed in Project 1. In the first project, students applied a traditional sizing and synthesis approach based on energy-based constraint analysis, a first-order mission analysis process, and an iterative design loop to size an aircraft. While this traditional method provides a useful “back-of-the-envelope” estimate of aircraft characteristics, it also requires assumptions about the drag polar, engine performance, and empty weight.

This project is divided into three phases. In the first phase, students will configure their local computing environment and use it to run a baseline evaluation of a provided vehicle model. During this stage, they will become familiar with the Aviary and OpenMDAO interfaces and learn how to execute the vehicle model and extract relevant output data from their analyses.

In the second phase, students will modify the baseline vehicle model to investigate how different problem configurations affect the resulting vehicle solution, ultimately developing a model that converges to an optimized vehicle size and mission trajectory.

In the final phase, the resulting on-design vehicle will be evaluated under a range of off-design conditions, culminating in the generation of a payload-range diagram for the vehicle under consideration.

(3) Peer & Self Assessments

There will be a small number of logistical assignments related to the operation of the class and its projects. Students should pay attention to these assignments, as they typically require little effort but may contribute to those final points needed to earn a higher letter grade.

Team members will evaluate both their own contributions and those of their teammates relative to the level of effort and engagement expected by the group. Each assessment will include a self-reflection on areas for individual improvement and an opportunity to identify team practices or behaviors that could be improved to support more effective collaboration. These assessments are private between the students and the instructors and will not be shared with other students. A standardized form will be provided for collecting feedback.

If serious disagreements arise within a team, office hours may serve as a neutral setting to discuss concerns and resolve issues before they escalate into larger problems.

c) Exams:

(1) Midterm

The midterm will cover a subset of the course topics, to be announced later based on the pace of the semester. A tentative exam date will be posted on the class website. The exam will be closed-book and closed-notes.

Students must bring a pencil and a non-programmable calculator. Examples of acceptable calculators include:

1. Texas Instruments TI-30XIIS
2. Casio fx-300ESPLUS2
3. Sharp EL-W535TGBBL
4. HP 300s+

(2) Final

The final exam for this course will be administered in accordance with the Georgia Tech Registrar's official final exam schedule. The Office of the Registrar maintains the official Georgia Tech academic calendar and is available on the Registrar's website. Students should consult the academic calendar and the Final Exam Matrix for official final exam dates and times. The final exam will be comprehensive, with coverage drawn from the full scope of course material.

Grading Policy

Overall, 70% of the course grades are based on individual work, including homework, the midterm, the final exam, and attendance, while 30% is based on group project deliverables.

Attendance points will be awarded to students who attend at least 90% of class meetings.

An additional 2% bonus may be earned through the CIOS survey if at least 80% of students complete the CIOS survey.

Table 1 shows the grade breakdown for this class.

Table 1 Grade Breakdown

Course Component	Percentage of Final Grade
Homework	18%
Project 1	15%
Project 2	15%
Midterm	20%
Final	30%
Attendance	2%
CIOS survey	+2%

The points sum to 100%, and final letter grades will be assigned according to the overall course percentage, as shown in Equation 1.

Equation 1 Letter Grade Based on the Overall Course Percentage

$$\text{Final Grade} = \begin{cases} \text{A if } 90\% \leq \text{Course Percentage} \leq 100\% \\ \text{B if } 80\% \leq \text{Course Percentage} < 90\% \\ \text{C if } 70\% \leq \text{Course Percentage} < 80\% \\ \text{D if } 60\% \leq \text{Course Percentage} < 70\% \\ \text{F if Course Percentag} < 60\% \end{cases} \quad (1)$$

Extensions, Late Assignments & Rescheduled/ Missed Exams

a) Extensions:

Extensions may also be granted in cases of Institute-approved absences; see Institute Approved Absences. Students are expected to provide advance notice and to complete the extension request form posted on the class website so that alternate due dates can be arranged.

b) Late Assignments:

Assignments submitted up to seven days late will incur a flat 20% penalty. Assignments not received within seven days of the deadline will receive zero. For example, an assignment that earns a grade of 95/100 but is submitted late will receive a final grade of 75/100. If an assignment is marked late on Canvas, it will be treated as late.

c) Rescheduled or Missed Exams:

Students in section A who do not take exams in class will receive a zero unless prior arrangements have been made with the teaching staff. Students must notify the instructional team well in advance and complete the required extension request form Institute Approved Absences.

Resubmission & Regrading

a) Resubmission:

No resubmissions are allowed.

b) Regrading:

For the midterm, regrade requests will be accepted only within 48 hours of the graded exam being returned and only in cases where a student believes a grading error has occurred. Each request must include a brief explanation of the suspected error and the reason the grading is believed to be incorrect. Requests without a clear justification will be closed. Students who do not believe there is a grading error but would still like clarification should attend office hours instead. Students should also be aware that a regrade request may result in the entire exam being reviewed and, if necessary, regraded.

No regrade requests will be accepted for the final exam, as the timeline for grading and submission of final course grades does not allow for regrade processing.

Institutional & Administrative Policies

Academic Honesty & Integrity Statement

a) Honesty and Academic Integrity:

Georgia Tech is committed to fostering a community grounded in trust, academic integrity, and honor. Students are expected to uphold the highest ethical standards and to abide by Georgia Tech's Academic Honor Code.

b) Georgia Tech Honor Challenge Statement:

I commit to uphold the ideals of honor and integrity by refusing to betray the trust bestowed upon me as a member of the Georgia Tech community.

Students are responsible for familiarizing themselves with the Honor Code and the expectations governing academic work in this course.

Students are expected to submit original work of their own. Suspected cases of cheating or plagiarism will result in serious penalties, including a deduction from the final course grade and referral to the Office of Student Integrity.

Institute Approved Absences

Students should review Georgia Tech's attendance policy regarding Institute-approved absences. According to the Georgia Tech Catalog, students who are absent due to participation in approved Institute activities, such as field trips, professional conferences, and athletic events, must be permitted to make up any missed work. Students with illness- or emergency-related absences should also consult Georgia Tech's student absence policy for the applicable expectations and documentation requirements.

Students are expected to communicate promptly regarding any planned absences. Failure to provide timely notice may result in the absence being treated as unexcused and in receiving a zero for all missed assignments.

Students must submit the required extension or leave-of-absence request form, available on the course website, to make alternative arrangements.

Accommodations for Students with Disabilities

Student experience in this course is important to us. Students who have not yet established services through the Office of Disability Services, but who have a temporary health condition or a permanent disability requiring accommodations, should contact the Office of Disability Services at *(404) 894-2563* or dsinfo@gatech.edu as soon as possible. This may include, but is not limited to, mental health, attention-related, learning, vision, hearing, physical, or other health-related impacts.

Students who have already established accommodations with the Office of Disability Services are expected to notify the instructor of their approved accommodations at their earliest convenience so that course-specific needs can be discussed. Disability Services coordinates reasonable accommodations through an interactive process involving the student, the instructor, and Disability Services. Georgia Tech is committed to creating an inclusive and accessible learning environment consistent with federal and state law.

Because there are exams in this course, it is the responsibility of students to work with the Office of Disability Services to arrange any necessary exam proctoring or testing accommodations. Special accommodations cannot be granted without approval from the Office of Disability Services.

Remote Proctoring

Students in the Q section may arrange a time with an approved proctor to complete their exams; otherwise, they will use Honorlock. A Georgia Tech representative will provide additional details regarding the proctoring process. At present, the plan is to use digital proctoring for students in the Q section and a local proctor for students in the Q3 section. Students in the Q section will be given a limited, multi-day window to complete their exams.