

AEE 427: Aircraft Performance & Dynamics

Syllabus – Fall 2026

M/W 8:00-9:20 Link 369 | F 12:45-1:40 Eggers 032

Catalog Description

Wing aerodynamics, thrust and drag. Performance analysis of aircraft: take-off, landing, climbing, gliding, turns, range and load factors. Control surfaces. Longitudinal and lateral static stability. Dynamic stability. Introduction to autopilot.

Prerequisites

MAE 341, Fluid Mechanics

Instructor

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Teaching Assistant

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Course Web Information

I will post course resources on Blackboard. The syllabus posted there is the latest for the course and will supersede any previous versions.

Course Materials

- Anderson, *Introduction to Flight* (required, any edition)
- Nelson, *Flight Stability and Automatic Control* (recommended)

Course Learning Objectives & Shared Competencies¹

This course satisfies two ABET student outcomes:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science and mathematics
9. An ability to apply knowledge of aerodynamics, structures, propulsion, flight mechanics, and orbital mechanics in the analysis of aerospace vehicles

This course also fulfills Syracuse University's Critical and Creative Thinking (CCT) shared competency, which emphasizes the exploration and synthesis of ideas to evaluate arguments and develop new insights, and the application of rigorous, innovative modes of inquiry to research and knowledge creation.

This course is divided into 5 modules. By the end of each module, you will be able to:

- apply the principles of airfoil and finite wing theory, airspeed measurement, and atmospheric modeling to predict and interpret the flight environment of an aircraft [Module 1 – ABET 9; CCT 1, 2]
- analyze and predict aircraft performance during straight-and-level flight, climbing, gliding, take-off, landing, range, endurance, and turning by formulating and solving the governing equations of motion [Module 2 – ABET 1, 9; CCT 1, 3]
- analyze the longitudinal, directional, and lateral static stability of an aircraft by deriving and applying pitching, yawing, and rolling moment equations, and evaluate the influence of design parameters (such as CG location, dihedral, and tail geometry) on stability margins [Module 3 – ABET 9; CCT 1, 3]
- derive and linearize the six-degree-of-freedom rigid-body equations of motion for an aircraft using Euler angles and small-disturbance theory, and simulate the resulting state-space system numerically using MATLAB [Module 4 – ABET 1; CCT 3]
- characterize the longitudinal (phugoid, short-period) and lateral-directional (roll, spiral, Dutch-roll) dynamic stability modes of an aircraft from eigenvalue analysis and time-domain simulation, and interpret how aircraft design parameters influence each mode [Module 5 – ABET 1, 9; CCT 3]

¹ Included descriptions of the ABET criteria and Shared Competencies to highlight why these learning objectives are what they are

- produce structured, professional engineering analyses (laboratory reports) that identify the problem, state assumptions, formulate governing equations, compare theoretical predictions to experimental data, and communicate conclusions clearly [Throughout – ABET 1; CCT 2, 3]

Course Learning Objective Measurement & Assessment

In-class exams	20% (each)
Final exam	25%
Labs	25%
In-class activities (lowest 2 dropped)	5%
Homework (lowest dropped)	5%

Numeric scores will be translated into letter grades with the following table:

		B+	87.0 – 89.9	C+	77.0 – 79.9	D	60.0 – 69.9
A	93.0 – 100	B	83.0 – 86.9	C	73.0 – 76.9	F	below 60
A-	90.0 – 92.9	B-	80.0 – 82.9	C-	70.0 – 72.9		

In-Class & Final Exams

You will have three exams in total, including two in-class exams and a final exam, with the specific timing and locations listed in the course schedule. To recognize your hard work and mastery of the material, your lowest in-class exam grade may be replaced by your final exam grade. To qualify for this grade replacement, you must demonstrate consistent engagement by submitting at least 80% of your homework assignments and participating in at least 80% of our in-class activities (including the lowest dropped).

To help you focus on applying concepts rather than memorizing formulas, you may prepare and use your own handwritten note sheet during each exam. For Exam 1 and Exam 2, your note sheet is limited to one side of an 8.5"x11" piece of paper, while the final exam allows for two sides. Your note sheet should include your name, formulas, and key concepts in your own writing, but please ensure it does not include worked-out example problems. These sheets will be collected at the end of the exam, and following these guidelines is essential to ensure your exam is graded. If these guidelines are not followed (e.g. extra pages, including example problems, not turned in etc.) you may receive a zero on the exam. If you are ever

unsure whether your note sheet violates these requirements, I encourage you to email me for confirmation at least 24 hours before the exam begins.

Labs

Our lab sessions are designed to bring the theoretical concepts of aircraft performance to life through hands-on experience and flight simulation. Lab lectures and lab sessions will generally alternate each week, beginning with lab lecture during the second week of class (Lab 1a). Lab sign-ups are due along with HW1 (second Wednesday of the semester). If you have not signed up for a lab by this time, the TA or I will assign a lab to you.

To ensure everyone has a consistent and fair schedule, any reoccurring conflicts with your assigned time must be finalized with me before the start of Lab 1b. If a new time is not finalized by this deadline, you will be required to attend your originally assigned lab session for the remainder of the semester. If you have a one-time conflict, please contact the TA at least one week in advance to discuss making up that specific lab.

Preparation is key to a successful flight; therefore, each lab (except Lab 4) includes a pre-lab and a post-lab report. Pre-labs are due on Wednesday at the start of class during lab weeks. To ensure everyone's safety and maximize our time in the flight simulator, completing the pre-lab is a prerequisite for participating in the flight session. Post-lab reports² are due one week after your specific lab session ends and are only accepted if you attended lab.

In addition to pre- and post-lab reports, you must submit one analyst report during the semester, which will be assigned by the TA at the end of your lab. Members of the same lab group may not select the same lab for this report, and analyst reports will not be accepted if you did not attend your assigned lab session. If you need additional time, please reach out before your report is due and we can arrange an alternate deadline.³ Late submissions without prior approval will not be accepted.

All reports must be your own original work. You may use AI models (like ChatGPT) to assist with brainstorming, clarification, or to support your own learning. You may not use it as a

² While not explicit in the syllabus, post-lab reports now include reflections related to the learning outcomes as well as conceptual questions related to design concepts

³ Relaxed late policy (used to be 1% deduction per hour late). Now students simply suggest a new due date, which reduces the time I spend calculating late penalties

shortcut to produce written reports. Use of AI-generated materials must be cited properly, listing the tool you used as the author and indicating how it was used. Improper use and failure to cite AI models will be reported to the Academic Integrity Office.

To maintain academic integrity, you are required to work in a platform like Google Docs or OneDrive that tracks document history. If you are suspected of using AI to write your reports and cannot provide this document history upon request, you will receive a zero for the entire lab and associated assignments. Furthermore, to avoid future issues, any student unable to provide document history will be required to handwrite all future reports. Please note that copy-pasting an assignment from another source into your document also results in a zero.

This class will use the plagiarism detection and prevention system Turnitin. You will have the option to submit your papers to Turnitin to check that all sources have been properly acknowledged and cited before submitting reports. Turnitin compares submitted documents against documents on the Internet and against student papers submitted to Turnitin at Syracuse University and at other colleges and universities. Keep in mind that all reports submitted for this class will become part of the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers.

Pre-labs will be handed in during Friday lecture. Lab reports will be submitted on Blackboard.

In-Class Activities

In-class activities will occur in class approximately once a week. These sessions are designed to help you apply new concepts and practice problem-solving in a collaborative environment.⁴ These exercises are graded based on completion and a good-faith effort rather than correctness; if you are unable to reach a final answer, you will still receive full credit by explaining your reasoning or identifying what prevented you from solving the problem.

While you are encouraged to use your notes and textbooks and discuss the problems with your classmates, the use of the internet or other external sources is strongly discouraged. These activities must be turned in during the class period and cannot be made up. However, to provide flexibility for unexpected conflicts or illnesses, your lowest two in-class activity

⁴ Explicitly made in-class activities collaborative

grades will be dropped at the end of the semester. If you have an officially excused absence, you will be excused from that day's activity with no penalty to your grade.

In-class activities will be submitted in class.

Homework

Homework is assigned every week to provide consistent practice with the principles of aircraft performance. These assignments are submitted in class on Wednesday and often include recommended textbook readings to support your understanding. When a problem requires figures, you should generate them using MATLAB and attach both the plots and the corresponding code. To demonstrate your underlying technical proficiency, any problem solved with MATLAB must also include a hand-calculated process for at least one representative data point (which I typically provided in the prompt). Please ensure your work is organized and clearly explained, as disorganized submissions may not receive full credit.

Homework is submitted on a rolling two-week cycle. Each week on Wednesday, you will submit your current assignment alongside corrections from the previous week's assignment. Corrections are completed using the solutions provided by me, which are posted every Friday at 8:00 AM to give you time to review your work and reflect on your mistakes⁵. To get the most out of the correction process, corrections must be completed in your own handwriting. If you need additional time, please reach out before the deadline and we can arrange an alternate submission date. Note that extensions for the initial submission cannot be granted past Friday at 8am, as solutions are posted at that time. To provide flexibility for unexpected personal circumstances, your lowest homework grade will be dropped at the end of the semester.

As with all engineering work, your submissions must be your own original effort. You are welcome to use AI models for brainstorming or clarifying difficult concepts, but any AI-generated material must be cited properly, listing the tool as the author and describing how it was utilized. Failure to cite AI use or any other form of improper use will be reported to the Academic Integrity Office and will result in a grade of zero for the assignment.

⁵ Corrections were previously done in class. Students now do it on their own time and only if they need to (i.e. only if they did a problem wrong)

Homework will be submitted in class.

Participation & Professional Conduct

Active participation is essential for a successful learning experience in this course, which includes arriving prepared, listening respectfully to others, sharing ideas, and remaining attentive throughout our sessions. You are encouraged to ask questions and support your peers as you work through the course material together. Because consistent engagement is a core component of mastering aircraft dynamics, attendance is mandatory, and your grade will be affected by any unexcused absences.

If you encounter circumstances that make participation difficult, please reach out to me early so that we can work together to find a reasonable solution. For absences due to illness or other personal reasons, you should obtain an official excuse from the Student Records office. If you must miss a class or lab for a sanctioned event, such as a sporting event or field trip, you must submit an absence request signed by your coach or advisor before the absence occurs. In these instances, homework is expected to be submitted early, with the only exceptions made for documented medical emergencies.

Late Policy, Make-Up Work, & Grade Disputes

To provide flexibility for unexpected personal circumstances while maintaining a steady pace through the material, you may submit pre-labs, lab reports, and homework after the deadline. If you need additional time on an assignment, please reach out before the deadline and we can arrange an alternate submission date. Note that extensions for initial homework submissions cannot be granted past Friday at 8:00 AM, as solutions are posted at that time. Also note that while late pre-labs are accepted for credit, they must be completed before your assigned lab session; if they are not, you will not be permitted to operate the flight simulator. In-class activities are designed for real-time engagement and cannot be made up. However, your two lowest activity grades are dropped to allow for unexpected absences or conflicts. Exceptions to these late policies are only granted in the case of a documented medical emergency.

All grade disputes must be initiated within one week after the graded items have been returned or posted. This does not mean that the dispute must be resolved in one week, but the process must start. Grade disputes raised after one week will not be considered.

Attendance Policy

- The University policy on classroom attendance states that “Attendance is expected in all courses at Syracuse University.” It is essential that you attend all classes and recitations.
- If you miss classes for illness or other personal reasons, see the Student Records office for an official excused absence.
- The expectation is that you submit an excused absence ahead of the absence. Homework will be expected to be handed in early. The only exception will be made in the case of a medical emergency.
- If you must miss a class or lab for a sporting event, field trip, etc., you must submit an absence request that is signed by your coach, advisor, etc. before you miss the class.

Academic Integrity

As a pre-eminent and inclusive student-focused research institution, Syracuse University considers academic integrity at the forefront of learning, serving as a core value and guiding pillar of education. Syracuse University’s Academic Integrity Policy provides students with the necessary guidelines to complete academic work with integrity throughout their studies. Students are required to uphold both course-specific and university-wide academic integrity expectations such as crediting your sources, doing your own work, communicating honestly, and supporting academic integrity. The full Syracuse University Academic Integrity Policy can be found by visiting class.syr.edu, selecting, “Academic Integrity,” and “Expectations and Policy.”

Upholding Academic Integrity includes the protection of faculty’s intellectual property. Students should not upload, distribute, or share instructors’ course materials, including presentations, assignments, exams, or other evaluative materials without permission. Using websites that charge fees or require uploading of course material (e.g., Chegg, Course Hero) to obtain exam solutions or assignments completed by others, which are then presented as your own violates academic integrity expectations in this course and may be classified as a Level 3 violation. All academic integrity expectations that apply to in-person assignments, quizzes, and exams also apply online.

Students found in violation of the policy are subject to grade sanctions determined by the course instructor and non-grade sanctions determined by the School or College where the

course is offered. Students may not drop or withdraw from courses in which they face a suspected violation. Any established violation in this course may result in course failure regardless of violation level.

Specifically for this course:

- There is to be no collaboration on exams. Students who either give or get help will receive a grade of zero for the exam and will be reported to the Academic Integrity Office.
- The homework assignments and lab reports are to be done separately by each student. While it is permissible to “discuss” problems with other students, copying solutions, MATLAB code, calculations, or write-ups will result in a grade of zero for all copied solutions and will be reported to the Academic Integrity Office.
- In written work, text that has been copied from another source must appear in quotes and must include a citation at the end of the sentence. This includes any use of AI models. Failure to do so will result in a grade of zero on the assignment and will be reported to the Academic Integrity Office.

Artificial Intelligence

Based on the specific learning outcomes and assignments in this course, artificial intelligence is permitted on the following: homework and pre-lab reports, and analyst reports. See each assignment, quiz, or exam instructions for more information about what artificial intelligence tools are permitted and to what extent, as well as citation requirements. If no instructions are provided for a specific assignment, then no use of any artificial intelligence tool is permitted. Any AI use beyond that which is detailed in course assignments is explicitly prohibited except when documented permission is granted.

Labs (Alternative if reduced TA support)⁶

Our lab sessions are designed to bring the theoretical concepts of aircraft performance to life through hands-on experience and flight simulation. Lab group sign-ups are due along with HW1 (second Wednesday of the semester). If you have not signed up for a lab by this time, the TA or I will assign a lab to you. Each group is assigned a unique modified Cessna 172 for the entire semester, allowing you to develop genuine familiarity with your aircraft's characteristics over the course of the semester.

Group Roles

Each lab report is a collaborative group document, but every member is individually responsible for a specific section. Roles rotate with each lab so that all students contribute to each part of the report over the course of the semester. The four roles are:

- **Theory Lead** – Responsible for the introduction and theory sections, including all relevant equations and their physical interpretation.
- **Procedure Lead** – Responsible for documenting the data collection procedure, including a clear description of how the TA collected data in the simulator and what parameters were recorded.
- **Figures Lead** – Responsible for all figures and results. This student must email a .fig file of each plot to the TA by midnight on Thursday so that figures are available for the Friday discussion.
- **Integration Lead** – Responsible for the conclusion and for assembling the final report into a single cohesive document. This student submits the final report on behalf of the group.

Each student must sign their section of the report before submission, confirming that the work is their own original writing. Sections without a signature will not receive credit. For groups of three, the Procedure Lead and Integration Lead roles are combined into a single Procedure & Integration Lead, who is responsible for the procedure section, the conclusion, and final assembly of the report.

Draft & Report Submission

⁶ In the event that I have reduced TA support, the lab will have to be removed and students will submit reports in groups. This section will replace the existing lab section. I have tried to keep students accountable without giving myself too much workload.

Lab reports are submitted in two stages. First, each student posts a draft of their assigned section to the group's shared OneDrive folder by 8:00 am on Wednesdays. This draft does not need to be polished, but it must demonstrate a genuine attempt at the section's content. The purpose of the draft deadline is to give groupmates visibility into the state of the report with enough time to address any gaps before the final submission.

If a student's draft is missing by the deadline, the remaining group members are officially authorized to write that section themselves for the final submission. In this case, the student who did not submit a draft will receive a zero for the lab report, regardless of whether another group member covered it. The rest of the group's grade is not affected.

The complete lab report is due one week after the TA distributes the dataset for that lab. Final reports are submitted on Blackboard by the Integration Lead. Late submissions without prior approval will not be accepted; if you need additional time, please reach out before the deadline and we can arrange an alternate submission date.

Friday Discussion⁷

On Fridays following a lab data release, the TA will lead a structured class discussion comparing results across the five aircraft variants. Each group's Figures Lead is responsible for submitting a .fig file of their key plot to the TA by midnight Thursday. The Friday session is not optional – it is the primary opportunity to develop physical intuition about how design parameters affect aircraft behavior, and the discussion directly supports your ability to complete the lab report and the final project.

Accountability and Reporting Concerns

After each lab report is submitted, every student must complete a short confidential peer evaluation form, submitted individually on Blackboard. This form asks you to briefly describe each group member's contribution, including your own. Peer evaluations are not shared with your group and will not directly determine grades, but they inform my understanding of group dynamics and may be used to adjust individual grades in cases of significant and documented imbalance.

If you have a concern about a groupmate's participation that you do not feel comfortable raising within the group, please contact me directly by email – not the TA. I will treat these

⁷ Since students will not be conducting labs, there will be additional discussion time that focuses on design principles.

communications confidentially. Please reach out early; concerns raised after a report has been submitted are much harder to address fairly.

If a student repeatedly fails to submit drafts on time, their role in the group will be reviewed and I reserve the right to require that student to complete subsequent lab reports independently.

Lab reports will be submitted on Blackboard.