AE 4451 Syllabus

AE 4451 Jet and Rocket Propulsion, Summer 2026

CATALOG DESCRIPTION

The theories and principles of jet and rocket propulsion. Thermodynamic cycles. The mechanics and thermodynamics of combustion. Turbine engine and rocket performance characteristics. Component and cycle analysis of jet engines and turbomachinery.

COURSE OBJECTIVES

This course is intended to have students obtain some level of mastery of the following:

Mastery Level

1. Common types of aircraft and spacecraft propulsion systems.
2. Performance characteristics and operating ranges of these aeropropulsion systems.
3. Application of thermodynamic cycle analysis.

Basic Use Level

4. Thermodynamic treatment of chemically reacting systems; application to combustors and rocket nozzles.
5. Preliminary (single-point) cycle design and performance analysis of aeropropulsion systems, for jet engines, and chemical and thermal rockets.

Exposure Level

6. Basic operation and design requirements of jet engine components, including: inlets, fans, compressors, combustors, turbines, afterburners, and nozzles.
7. Performance and analysis of electric propulsion systems for spacecraft.
8. Heat transfer analysis and cooling considerations for aeropropulsion systems.

LEARNING OUTCOMES

A student successfully completing this course will be able to:

1. Make design choices between jet and rocket propulsion systems based on performance issues.
2. Calculate energy release, e.g., adiabatic flame temperatures, and equilibrium composition of gases at known temperature and pressure.
3. Analyze the thermodynamic performance of jet engine cycles and compute relevant performance parameters.
4. Perform and report preliminary design calculations to size jet engines to meet specific performance goals.

5. Analyze the thermodynamic performance of simple chemical and electrical rocket cycles and compute relevant performance parameters.
6. Characterize the performance and operating/design constraints for inlets, compressors, combustors, turbines and nozzles.

PREREQUISITES

AE 2010 or (ME3322 and AE 2011). Specific areas/concepts include:

1. thermodynamic concepts of properties and states
2. conservation equations (mass, momentum, energy, and entropy)
3. control volume analysis
4. one- and two-dimensional compressible flows, e.g., normal and oblique shock, and supersonic flow with area change (nozzles)

REQUIRED COURSE MATERIALS

Course notes will be supplied by the instructor. There are no required textbooks; there is a recommended text: *Mechanics and Thermodynamics of Propulsion*, 2nd Edition, Philip Hill and Carl Peterson, Addison-Wesley, 1992, that is available at Georgia Tech Barnes and Noble Bookstore.

GRADING

The class will include the following learning/assessment mechanisms with the following weightings applied to the overall course grade:

Homework	:	30% of course grade
Team Project	:	25% of course grade
Midterms	:	20% of course grade
Final Exam	:	25% of course grade

Homework and projects can be turned in online until the assignment closes, but with a late penalty assessed. If unusual circumstances arise that will prevent you from finishing on time, please contact the instructor **in advance**, so that special consideration can be given.

The following rubric will be used to determine course grades.

A $\geq 90\%$

B $\geq 80\%$

C $\geq 70\%$

D $\geq 55\%$

F $< 55\%$

CLASS ATTENDANCE

While attendance during class lectures will not be mandatory, the course makes use of active learning strategies, so attendance is crucial to learn the material and successfully complete this course. Also, students who regularly attend class almost always achieve better performance on homework and exams. Since class attendance is not directly a part of your grade, it is not necessary to report your planned absence to the instructor, unless it occurs on an exam date. If there is any reason that makes your attendance impossible for a long period of time–such as an illness or injury–please contact the instructor. Please refer to the Catalog for the Institute regulations regarding attendance.

Re-Scheduled and Missed Exams

In compliance with the Institute rules regarding excused absences, students who have a planned excused absence on the scheduled exam dates must inform the instructor well in advance so accommodations can be made. Students who miss the midterm exam due to an unforeseen emergency that constitutes an excused absence according to the Office of the Vice President for Student Life and Dean of Students, should contact the Instructor as soon as possible to arrange a make-up exam or alternative grading adjustment. Students must take the Final Exam during the official period designated by the Office of the Registrar for this class, unless the meet the exceptions for excused absences or conflicts. An alternative Exam time will be provided according to the rules laid out in the Catalog.

ACADEMIC INTEGRITY

Georgia Tech and the School of Aerospace Engineering value honesty and integrity of all members of our community. Academic dishonesty is not tolerated. This includes cheating, lying about course matters, plagiarism, or helping others commit a violation of the Honor Code. Plagiarism includes reproducing the words or visual/graphical expressions of others without clear attribution and citation. Cheating includes violating rules presented in the course syllabus, or descriptions and directions for homework assignments and the project regarding allowable collaborations, and exams regarding allowable materials/resources to be used during the exam. Students are reminded of the obligations and expectations associated with the Georgia Tech Academic Honor Code.

Plagiarism and the use of Generative AI

Copying or modifying someone else's work without attribution – including prompting a generative AI tool to do the same – or other sources such as: solutions from prior offerings of this course, Course Hero, and Chegg is plagiarism, which is a violation of the Honor Code as noted above.

Collaboration and Group Work

The homeworks are an important tool in helping you learn the course material. You are encouraged to discuss the course material and homework problems with other classmates, but you should work the problems (e.g., how you write them up) on your own - no copying. Generally what this means is: 1) try the problem on your own, 2) then if necessary ask for help/suggestions, 3) then go back on your own and try to implement the suggestions. Do not work with another student on the homework step-by-step, checking each step as you go (this will not help you learn the material or prepare you for the exams).

The project will be performed in teams assigned by the instructor. The team's report should represent work done by all the team members, and only the team members.

No collaboration is permitted on exams.

STUDENT-FACULTY EXPECTATIONS AGREEMENT

At Georgia Tech we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulate some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

LEARNING ACCOMMODATIONS

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services (404-894-2563) as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible so we can arrange a time to discuss your learning needs.

CORE IMPACTS

Not applicable