AE4071 and AE8803 Syllabus

AE4071 - Rotorcraft Aeromechanics, 3 Undergraduate Credits

AE8803 – Rotorcraft Aeromechanics, 3 Grad Credits (also known as Vertical Lift Aeromechanics)

General Information

Description

This is the basic/introductory rotorcraft course offered at Georgia Tech and it should be taken by any student that is interested in rotorcraft and wants to lay a foundation for future work in rotorcraft. The aim is to provide students with a basic understanding of rotor aerodynamics and dynamics, how rotors and rotorcraft work, review/introduce the fundamental rotor theories, calculate helicopter performance, trim, and introduce rotor dynamics and controls.

Pre- &/or Co-Requisites

AE4071: AE3030 - Steady Fluid Mechanics and/or Aerodynamics at the undergraduate level
AE8803: Graduate standing.

Both: Some of the assignments may require use of Matlab or other computational tools, and familiarity with numerical programming is assumed.

Course Goals and Learning Outcomes

Students will be able to model the rotor as an actuator disk/line/blades; develop simplified rotor inflow models; formulate and analyze rigid blade dynamics; compute rotor aerodynamic forces and moments; perform simplified rotorcraft vehicle performance analysis; formulate and solve helicopter trim equations; analyze rotor damping and controllability; understand introductory aspects of rotorcraft stability and control and vibration.

Course Requirements & Grading

Assignment	Information	Percentage Weight
Homework		50%
Midterm		20%
Final	See official GT finals schedule	30%

Extra Credit Opportunities

Extra credit assignments may be presented to the class towards the end of the semester at the discretion of the instructor.

Description of Graded Components

There will be different, though in some cases, overlapping graded components for the undergraduate AE4071 and the graduate AE8803 sections. There will be different exams, and homework assignments will have additional components.

Unless noted, all graded components will be individual assignments. Quizzes and the final will be timed and in-person (or with proctor), unless health and safety circumstances require otherwise.

Grading Scale

Your final grade will be assigned as a letter grade according to the following scale:

A	90-100%
B	80-89%
C	70-79%
D	60-69%
F	0-59%

Full credit is awarded for solutions that are correct and demonstrate an understanding of the concepts of the problem. Partial credit is given for solutions that, while incorrect, demonstrate some knowledge of the concepts.

Course Materials

Course Text

Required Text: Leishman, *Principles of Helicopter Aerodynamics,* Cambridge University Press, 978-1107013353[1] (See important footnote) Reading and homework will be assigned from this text.

Additional Materials/Resources: Professor notes and handouts.

The following textbook may also be helpful as optional references for this course:
Johnson, *Rotorcraft Aeromechanics*, Cambridge University Press, 978-1107606913 (See footnote)

Course Website and Other Classroom Management Tools

Course materials will be posted online to Canvas (https://canvas.gatech.edu/) and/or communicated directly by the Teaching Assistant. Course materials (e.g. recorded videos) will be available to both in person and distance learning sections. Important communications to the class will be sent through the Canvas system; please be alert to these messages.

Course Expectations & Guidelines

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's Academic Honor Code, please visit http://www.catalog.gatech.edu/policies/honor-code/ or http://www.catalog.gatech.edu/rules/18/.

Students are required to report any suspected violation of the Honor Code to the Instructor whether or not they were directly involved in the incident.

Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404)894-2563 or http://disabilityservices.gatech.edu/, 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 in order to set up a time to discuss your learning needs.

[1]There are no "free" internet downloads of this textbook available (I know the author and checked!) Download of a pdf book from any internet site is a copyright violation which is not only a violation of engineering ethics and the GT honor code, it is a federal criminal act. Any instances I find will be reported. Don't jeopardize your career to save a few dollars; if you are in need, please see me for help.

Attendance and/or Participation

Classroom attendance, either in person or remotely, is strongly encouraged, though not required. Active participation is essential for understanding major concepts and contributing to the learning of others.

Absences related to personal illness or emergency, or career development (e.g. presenting a paper at a conference or scheduled job interview) are considered excused. Please contact the instructor as soon as you know of a schedule conflict if this applies to you.

Collaboration & Group Work

Discussions with other students about how to solve homework problems are allowed and encouraged; however, all work turned in must be the student's own original work.

The use of outside references (e.g. textbooks) is expected and encouraged; however, students must appropriately cite (including page, figure, equation number, as appropriate) any referenced material that is used.

Use of homework solutions from prior semesters (if/when applicable) is not allowed.

The quizzes and final intended to measure the learning of individual students; therefore receiving assistance from individuals during these examinations is not allowed.

Extensions, Late Assignments, & Re-Scheduled/Missed Exams

Assignments are due at the designated time using online submission on Canvas or to Teaching Assistant (will be communicated in class). Any assignment turned in after collection is late. There are no late submissions (no partial points) or extensions, except for extraordinary circumstances. Students are granted ONE late submission (3 days late inclusive of weekend days).

Recognizing that DL students are mostly working professionals, students in a distance learning or GTL section will receive a standard 1-week delay on all assignments. The quizzes and finals can be taken during the week delay at a time convenient to you and your proctor (if needed).

Excused absences (see above) may be a justification to receive an extension on an assignment or to re-schedule an exam. Please contact the instructor as soon as you know of a schedule conflict if this applies to you.

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. See http://www.catalog.gatech.edu/rules/22/ for an articulation of some basic expectation 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.

Student Use of Mobile Devices in the Classroom

Mobile Devices (laptop computers and tablets) may be used in class to enhance your learning experience, provided they are used in support of the class and are not a distraction to you or your classmates. It is pointed out, however, that the professor's writings on the board and oral explanations for conveying the content are of utmost importance for students' understanding, and for the exams or homework.

Viewing materials unrelated to the class and doing homework in class is not allowed. Cell phones should be set to silent mode during class. If you must answer a phone call during class, please step outside so as not to disturb the class.

Additional Syllabus Components

Honesty:

The School of Aerospace Engineering values honesty and integrity of all members of our community. An important element of this value is the academic honor code.

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.

Honor Code: http://policylibrary.gatech.edu/student-affairs/academic-honor-code#Article_I:Honor_Agreement

Well Being:

The School of Aerospace Engineering values the complete well-being of all members of its community, which includes professional, physical, spiritual, emotional, and social dimensions. There are numerous resources to support the health and well-being of all members of our community: https://gatech.instructure.com/courses/108574

Mental Health Resources:

Emergencies: Can either Call 911 or call Campus Police at 404.894.2500 http://www.police.gatech.edu/
Center for Assessment, Referral, & Ed. (CARE): https://care.gatech.edu/ 404.894.3498 (Counselor On-Call)
Counseling Center: https://counseling.gatech.edu/ 404.894.2575
Stamps Health Services: https://health.gatech.edu/ 404.894.1420
Student Life and Dean of Students: https://studentlife.gatech.edu/content/get-help-now 404.894.6367
Victim-Survivor Support (VOICE): https://healthinitiatives.gatech.edu/well-being/voice 404-385-4464/(or 4451)
National Suicide Prevention Lifeline: 1.800.273.TALK (8255)
Georgia Crisis and Access Line: 1.800.715.4225

Social Justice:

The School of Aerospace Engineering values social justice for all members of the Georgia Tech community and the larger society. Social justice means that everyone's human rights are respected and protected. We stand committed in the fight against racism, discrimination, racial bias, and racial injustice. Our shared vision is one of social justice, opportunity, community, and equity. We believe that the diversity and contributions from all of our members are essential and make us who we are. We believe that our impact must reach beyond the classroom, research labs, our campus, and the technology we create, but must also improve the human condition where injustice lives. We will continue to work to understand, value, and celebrate all people and create an inclusive educational and work environment that welcomes all.

As a matter of policy, Georgia Tech is committed to equal opportunity, a culture of inclusion, and an environment free from discrimination and harassment in its educational programs and employment. Georgia Tech prohibits discrimination, including discriminatory harassment, on the basis of race, ethnicity, ancestry, color, religion, sex (including pregnancy), sexual orientation, gender identity, national origin, age, disability, genetics, or veteran status in its programs, activities, employment, and admissions.

http://policylibrary.gatech.edu/equal-opportunity-nondiscrimination-and-anti-harassment-policy

Course Schedule

The following outline lists the topics to be covered in the course. Due to travel commitments and other unanticipated events, the instructor reserves the right to modify the dates, length, or sequence of course topics taught, assignments associated with topics, and project dates. These will be communicated in class or via email/Canvas.

Topic	Approx. Class Hours
1. Introduction • Course introduction • A brief history of rotorcraft • Terminology, classes and types of rotorcraft • Importance of aeromechanics	**4**
2. Aerodynamics of rotors in hover, axial, and forward flight • Momentum theory in hover and forward flight • Blade element theory (BET) • Combined momentum and blade element theory (BEMT)	**14**
3. Simplified performance analysis • Hover performance • Climb and descent performance • Performance in forward flight • Autorotation	**9**
4. Physical Concepts of blade motion and control • Flapping, lead-lag, and feathering • Collective and cyclic controls • Steady-state flapping motion to control inputs • Steady-state flapping motion to body angular rates	**8**
5. Simplified trim analysis • Rotor forces and moments • force and moment balance • Trim solutions	**4**
6. Introduction to stability, control, and vibration (optional, because also taught in more depth in the class Helicopter Stability and Control by Prof. Prasad) • Pitch, roll, and yaw damping • Control power and control sensitivity • Static stability • Dynamic modes in hover • Vibration and methods for vibration control	**4**
Quiz/Exam	**2**
Total	**45**