

# AE4532 Syllabus

Spacecraft Flight Dynamics, 3 Undergraduate Credits

Summer 2026, CRN 56571

Lectures: Monday, Tuesday, Wednesday, and Thursday, 10:00-11:50 am

## Instructor Information

Instructor  
E.Glenn Lightsey

Email  
[glenn.lightsey@gatech.edu](mailto:glenn.lightsey@gatech.edu)

Office Hours & Location  
MW 12:00-12:45 pm,  
Location TBD

## General Information

### Description

This course covers fundamental material in orbit and attitude dynamics. Investigate orbits, rendezvous / intercept maneuvers, interplanetary transfers, attitude coordinates, attitude stability, attitude control, and attitude estimation.

### Pre-Requisites

AE 3330 Introduction to Aerospace Vehicle Performance  
AE 3530 System Dynamics and Vibrations  
MATH 2403 Differential Equations

### Course Goals and Learning Outcomes

Upon completion of this course, the student should be able to:

- Perform applications of space orbits to solve mission design problems
- Analyze and design interplanetary trajectories
- Describe the attitude orientation and dynamics of a rigid body
- Apply rotational dynamics to spacecraft problems

### Course Requirements & Grading

Assignment	Date	Weight
Homework	4 total	20%
Midterm Exam - during class	July 8	40%
Final Exam - during class	July 23	40%

### Description of Graded Components

Homework: Homework assignments are due at the designated time using online submission. This will normally be due at 11:59 pm Ireland time on Thursday (you are welcome to turn it in sooner). Late homework assignments are deducted 25% per day late.

Some of the assignments require Matlab to solve. In this case, you are expected to write functions to solve various problems. Include any Matlab scripts or session logs you use with your name and date printed on them, indicating that it is your own work. If you use AI tools like ChatGPT or Gemini to help you find the answer or write code to any problem, include your AI chat session with your prompts and its responses in your submitted homework. Homework that is generated by AI tools and submitted without attribution will be treated as cheating.

Exams: A midterm exam will be given during class time on Wednesday July 8 and final exam will be given during class time on Thursday July 23. The exam will be administered over Canvas and is expected to be taken remotely (e.g. from your dorm room). Communication with others about the exam by any means is prohibited during the exam and until everyone in the class has completed the exam. The exam will be open book and notes, although you probably won't have much time to look things up during the exam, so be prepared to treat it like a closed book exam.

## Grading Scale

Letter grades are based on a straight average plus statistical curve. Letter grades will be assigned according to the following scale:

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

If the class average is below 85, a statistical curve will be used to determine grades. Grades that are higher than one half standard deviation above the mean will receive an A. Grades that are higher than one half standard deviation below the mean will receive a B.

## Excused Absences

Class attendance is strongly recommended but not required. Single absences are not a factor in the grading, but repeated unexcused absences may result in a downward adjustment of the grade.

Excused absences may be provided for significant personal or professional schedule conflicts. Examples of personal excused absences are personal illness or death in the family. Examples of professional schedule conflicts are job interviews or presenting a paper at a conference. Excused absences should be requested and approved at least 24 hours in advance if possible. Depending on the reason, it may be possible to reschedule an assignment deadline to the earliest opportunity. **Due to the tight schedule in Limerick, exam delays will generally not be allowed.** In the event that an exam is missed, the student must not communicate with anyone other than the instructor about the exam until everyone has taken the exam.

## Course Materials

### Course Text

Required text: Wiesel, Spaceflight Dynamics, 3rd edition, McGraw Hill, 2010. This book is out of print, but electronic copies may be available for download.

Additional class notes and provided materials.

Supplemental texts for additional reading (helpful but not required):

Bate, Mueller, White, Fundamentals of Astrodynamics, Dover, 1971.

Curtis, Orbital Mechanics for Engineering Students, 2<sup>nd</sup> edition, Elsevier, 2010.

## Course Website

Course materials will be posted online to Canvas (<https://canvas.gatech.edu/>). Important communications to the class will be sent through the Canvas system; please be alert to these messages. Students will be held responsible for any message or announcement that has been posted to the class for more than 24 hours.

## 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.

### Attendance and/or Participation

Classroom attendance is strongly encouraged but not required. Active participation is essential for understanding major concepts and contributing to the learning of others.

Absences related to personal illness, emergency, or career development (e.g. presenting a paper at a conference or scheduled job interview) may be excused. Please contact the instructor as soon as you know of a schedule conflict if this applies to you. Please see the Institute Absence Policy - <https://catalog.gatech.edu/rules/4/> for more information.

### Use of Mobile Devices in the Classroom

Mobile devices (laptop computers and tablets) may be used during lectures 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. Viewing materials unrelated to the class and doing homework in class is not permitted. 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.

### Collaboration & Group Work

Discussions with other students on homework assignments and lecture content are allowed and encouraged; however, all work turned in must be each student's own original work. Students are encouraged to post questions about assignments and lectures on the appropriate Discussion thread on Canvas. The course instructor will reply as soon as possible, usually within 24 hours of the posted topic. Other students are encouraged to reply and help each other.

The use of outside source references (e.g. textbooks and web sites) is allowed; when this occurs cite any reference material that is used on assignments.

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

Exams must be taken individually. Communication by any means with others about the exam is prohibited during the exam and until everyone in the class has completed the exam. Communicating, copying work, or receiving advance notification about the exam problems is a violation of the Georgia Tech Honor Code.

### **On the use of AI tools to Solve Problems in this Class**

AI tools like ChatGPT and Gemini are rapidly becoming capable of solving sophisticated engineering problems like those taught in this class. Like any other resource that is available to you (e.g. Matlab), these tools can be used to improve your understanding and to help you catch mistakes. These tools are allowed in this class to assist you with completing your homework and learning. The recommended approach is to solve the problem first by hand without AI assistance and then use the AI tool if you wish to check your solution and to provide additional insight.

If you use an AI tool to obtain your solution to a problem in this class, you are required to give attribution and to include a printout of your prompt and the response you received in your submitted assignment with your name and date on it. Using external sources-including AI tools-without giving proper attribution is a violation of the Georgia Tech Honor Code.

Students are fully responsible for the accuracy of any answers submitted on assignments. If an AI tool provides an incorrect answer which is used by the student as their solution, partial credit will not be awarded on any part of that problem.

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

Assignments are due at the designated time using online submission on Canvas. Any assignment turned in after collection is late. Assignments that are turned in late will have a portion of the grade deducted (25% per day late).

Excused absences (see above) may be a justification to receive an extension on an assignment. Please contact the instructor as soon as you know if this applies to you. Extensions are not normally granted after the assignment due date has passed.

### **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) are allowed 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. Viewing materials unrelated to the class and doing homework during 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](http://policylibrary.gatech.edu/student-affairs/academic-honor-code#Article%20I:Honor%20Agreement)

### 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://wellnesscenter.gatech.edu/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 and tentative dates for exams. Changes to the outline will be discussed in class, and updated versions will be uploaded as necessary to Canvas.

Lecture		Topic	Book	Homework
1	June 22	Introduction, Rotations	1.4	H1 Out
2	June 22	Euler Angles, Direction Cosine Matrices	1.4	
3	June 23	Angular Velocity, Euler rates	4.7	
4	June 23	DCM rates, Euler singularity	4.7	
5	June 24	Vector differentiation	Notes	
6	June 24	Motion of a system of particles	4.7	
7	June 25	Rigid bodies and Inertia Tensor	1.3	
8	June 25	Inertia transformations	4.1	
9	June 29	Principal axes	4.2	
10	June 29	Rotational Kinetic Energy	4.3	H1 Due
11	June 30	Euler's Equations	4.6	H2 Out
12	June 30	Axisymmetric Torque Free Motion	5.2	
13	July 1	Energy and momentum ellipsoids	5.3	
14	July 1	Stability of motion with distinct inertias		
15	July 2	Gravity gradient dynamics	Notes	
16	July 2	Gravity gradient stability		
17	July 6	Attitude Sensors	Notes	
18	July 6	Attitude Determination and Control	5.10	H2 Due
19	July 7	Review Session		
20	July 7	Work Problems		
21	July 8	Midterm Exam		
22	July 8	Midterm Exam		
23	July 9	Orbit Equation	2.1-2.4	H3 Out
24	July 9	Elliptical Orbits, Energy Equation	2.5-2.6	
25	July 13	Hyperbolic Orbits, Hohmann Transfer	3.1-3.2	
26	July 13	Gravitational Sphere of Influence	11.1-11.2	
27	July 14	Patched Conic Method	11.3-11.4	
28	July 14	Worked Example Problem	Notes	
29	July 15	Planetary Flyby, Gravity Assist	11.5-11.6	
30	July 15	Restricted Three Body Problem	10.1-10.2	H3 Due
31	July 16	Lagrange Points, Zero Velocity Curves	10.3-10.6	H4 Out
32	July 16	Modern Three Body Solution Methods	10.7	
33	July 20	Chief-Deputy Reference Frame	3.5	
34	July 20	Energy Matching Condition	Notes	
35	July 21	Clohessy Wiltshire Equations and Solutions	3.5	
36	July 21	Relative Orbital Elements	Notes	H4 Due
37	July 22	Review Session		
38	July 22	Work Problems		
39	July 23	Final Exam		
40	July 23	Final Exam		