

**AE 419 Aircraft Flight Mechanics**  
**Spring 2024**  
**Course Syllabus**

**Course Description:** The course begins by investigating steady and quasi-steady aircraft flight performance including a review of atmospheric and aerodynamic principles, and then in-depth discussions of the flight mechanics during take-off and landing, climbing and diving, cruise, turning flight, and energy methods. Halfway through the semester we will begin covering longitudinal, directional, and lateral static stability and control of aircraft, starting first with aircraft stability derivatives. The end of the course covers longitudinal and lateral dynamic stability and motion through use of small perturbation equations.

**Course Objectives:** To build upon the foundational aerodynamics and dynamics knowledge from previous courses and investigate the specifics of aircraft performance, stability, and control. The goal of this course is to help make the physics of flight more intuitively understood by the learner, allow them an opportunity to analyze and form conclusions about data related to aircraft flight mechanics and have exposure to practical challenges faced by engineers who study performance, stability, and control.

**Course Meeting:** MWF 12:00 pm - 12:50 pm  
112 Transportation Building  
Course Zoom (Remote Days): Meeting ID: 850 1416 9879, Password: 152784  
<https://illinois.zoom.us/j/85014169879?pwd=cGhjSnZrTkQ4UHhUbG9zWFVKQUlrZz09>

**Instructor:** Prof. Matthew Clarke, [maclarke@illinois.edu](mailto:maclarke@illinois.edu)  
Office: 321A  
Office Hours Times: Mondays and Tuesdays, 10:00 am -11:00 am  
Office Hours Location (Hybrid):  
In-person: 321A  
Office Hours Zoom: Meeting ID: 894 6124 0773, Password: 133098  
<https://illinois.zoom.us/j/89461240773?pwd=RjE5Ykt0WTdDenBMS2xDSHIHTmxJdz09>

**Teaching Assistant:** Paul Poovakulam, [pmp4@illinois.edu](mailto:pmp4@illinois.edu)  
Office Hours Times: Wednesday 3:00 pm - 5:00 pm, Thursday 1:00 pm -2:00 pm  
Office Hours Location (Hybrid):  
In-person: TBD, Talbot Laboratory  
Office Hours Zoom: Meeting ID: 839 2193 6379, Password: 735560  
<https://illinois.zoom.us/j/83921936379?pwd=c08rcHY0dHg3UHRsUUZzOFBwVm9oQT09&from=addon>

**Prerequisite:** AE 202, AE 353 or consent from the instructor

**Credit:** 3 undergraduate hours, 3 or 4 graduate hours

**Textbook:** There is no required textbook for this course. When requested, excerpts from books or articles may be made available to assist you with your homework. The following books are good references if you would like more in-depth reading (McCormick and Etkin & Reid) or a very well-organized overview of the course topics (Anderson).

John D. Anderson Jr., "Introduction to Flight," Chapters 6 & 7

Digitized version available:

[https://i-share-uiu.primo.exlibrisgroup.com/permalink/01CARLI\\_UIU/gpjosq/alma9925415712205899](https://i-share-uiu.primo.exlibrisgroup.com/permalink/01CARLI_UIU/gpjosq/alma9925415712205899)

Barnes W. McCormick, "Aerodynamics, Aeronautics, and Flight Mechanics," Chapter 7, Chapters 8-10

Digitized version available:

[https://i-share-uiu.primo.exlibrisgroup.com/permalink/01CARLI\\_UIU/gpjosq/alma99154827312205899](https://i-share-uiu.primo.exlibrisgroup.com/permalink/01CARLI_UIU/gpjosq/alma99154827312205899)

Bernard Etkin & Lloyd D. Reid, "Dynamics of flight: stability and control,"

No digitized version available through UIUC library:

[https://i-share-uiu.primo.exlibrisgroup.com/permalink/01CARLI\\_UIU/gpjosq/alma99379158212205899](https://i-share-uiu.primo.exlibrisgroup.com/permalink/01CARLI_UIU/gpjosq/alma99379158212205899)

**Assignments:** Assignments are due on the posted due date at 11:59 pm. I have set up Canvas to take late assignments, however there Late Assignment Grade Policy: 10% per day for late assignments. i.e. After 10 days, you will get a 0. No assignments are accepted after solutions have been posted. Please note: all students are always expected to turn in their own work. Submitting the work of another student as if it were your own, allowing others to submit your work as if it is theirs, and plagiarism in general are infractions of academic integrity. [See the Student Code for more information on academic integrity.](#)

**Exams:** Two hourly exams and one final exam will be given. The midterm exams will take place during class time and the final exam will take place during the time prescribed by the Office of the Registrar. The planned dates and times for the midterms are subject to change, but currently, the exam dates are as follows:  
Midterm 1: Wednesday, February 28, 12:00-12:50 pm  
Midterm 2: Wednesday, April 10, 12:00-12:50 pm  
Final: Friday, May 3, 1:30-4:30 p.m. Location TBD (Per Registrar)

4 Credit Hr. Project: A term project is required for graduate students enrolled in 4 credit hours. This will take the form of a self-guided research presentation. The goal here is to provide students with an opportunity to explore material and concepts beyond what can be covered in class. Deliverables include a project proposal, due February 19<sup>th</sup>, and a final deliverable comprising an 8-12 min recorded presentation as well as a 1–2-page executive summary of your study, both due April 29<sup>th</sup>. More information will be provided on Canvas.

Grading: At this time, it is unlikely there will be any sort of curve implemented into the course grading policies. However, this may change, and will only ever be done to improve your letter grade, not to lower it. Expect grades back within 2-3 weeks of an assignment or an exam.

The grading breakdown is as follows:

	<b>3 hours</b>	<b>4 hours</b>
Assignments:	25%	20%
Midterm 1:	20%	17.5%
Midterm 2:	20%	17.5%
Final:	35%	30%
Projects:	--	15%
A+ 100%-97%	A 96.9%-93%	A- 92.9%-90%
B+ 89.9%-87%	B 86.9%-83%	B- 82.9%-80%
C+ 79.9%-77%	C 76.9%-73%	C- 72.9%-70%
D+ 69.9%-67%	D 66.9%-63%	D- 62.9%-60%

### Course Logistics and Policy Changes:

The instructor reserves the right to make any changes he considers academically advisable. Such changes, if any, will be announced in class. Please note that it is your responsibility to attend the class and keep track of the proceedings.

### Academic Integrity:

The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: <http://studentcode.illinois.edu/>.

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy: <https://studentcode.illinois.edu/article1/part4/1-401/>. Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

### COVID-19 Policies

The University of Illinois System will no longer require the COVID-19 primary vaccine series for students and employees. We do, however, strongly recommend that you stay up to date with the most recent vaccine or booster available as a barrier to serious illness. Testing also continues to be a valuable tool for COVID containment and, while the University of Illinois System will no longer require regular testing of those who are unvaccinated, if you do have symptoms or have been exposed to the virus, we encourage you to take advantage of the free testing that will continue to be available. **If you do feel ill or have symptoms of COVID-19, we also strongly urge you to stay home from school and work to protect your classmates and colleagues.** Masks remain effective in limiting COVID-19 transmission, and we encourage everyone to use them, particularly in indoor spaces. Due to the different circumstances within our three universities, masking requirements may vary and could change as deemed necessary. Please refer to each university's updated guidance on masking.

#### **Anti-Racism and Inclusivity Statement:**

The Grainger College of Engineering is committed to the creation of an anti-racist, inclusive community that welcomes diversity along a number of dimensions, including, but not limited to, race, ethnicity and national origins, gender and gender identity, sexuality, disability status, class, age, or religious beliefs. The College recognizes that we are learning together in the midst of the Black Lives Matter movement, that Black, Hispanic, and Indigenous voices and contributions have largely either been excluded from, or not recognized in, science and engineering, and that both overt racism and micro-aggressions threaten the well-being of our students and our university community.

The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can also report these behaviors to the Bias Assessment and Response Team (BART) (<https://bart.illinois.edu/>). Based on your report, BART members will follow up and reach out to students to make sure they have the support they need to be healthy and safe. If the reported behavior also violates university policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action.

#### **Sexual Misconduct Reporting Obligation:**

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX Office. In turn, an individual with the Title IX Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options. A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here: [wecare.illinois.edu/resources/students/#confidential](https://wecare.illinois.edu/resources/students/#confidential). Other information about resources and reporting is available here: [wecare.illinois.edu](https://wecare.illinois.edu).

**Religious Observances:**

Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. You should examine this syllabus at the beginning of the semester for potential conflicts between course deadlines and any of your religious observances. If a conflict exists, you should notify your instructor of the conflict and follow the procedure at <https://odos.illinois.edu/community-of-care/resources/students/religious-observances/> to request appropriate accommodations. This should be done in the first two weeks of classes.

**Disability-Related Accommodations:**

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 217-333-4603, e-mail [disability@illinois.edu](mailto:disability@illinois.edu) or go to <https://www.disability.illinois.edu>. If you are concerned you have a disability-related condition that is impacting your academic progress, there are academic screening appointments available that can help diagnosis a previously undiagnosed disability. You may access these by visiting the DRES website and selecting “Request an Academic Screening” at the bottom of the page.

**Mental Health**

Significant stress, mood changes, excessive worry, substance/alcohol misuse or interferences in eating or sleep can have an impact on academic performance, social development, and emotional well-being. The University of Illinois offers a variety of confidential services including individual and group counseling, crisis intervention, psychiatric services, and specialized screenings which are covered through the Student Health Fee. If you or someone you know experiences any of the above mental health concerns, it is strongly encouraged to contact or visit any of the University’s resources provided below. Getting help is a smart and courageous thing to do for yourself and for those who care about you.

- Counseling Center (217) 333-3704
- McKinley Health Center (217) 333-2700
- National Suicide Prevention Lifeline (800) 273-8255
- Rosecrance Crisis Line (217) 359-4141 (available 24/7, 365 days a year)

If you are in immediate danger, call 911.

**Disruptive Behavior**

Behavior that persistently or grossly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. Such behavior inhibits other students’ ability to learn and an instructor’s ability to teach. A student responsible for disruptive behavior may be required to leave class pending discussion and resolution of the problem and may be reported to the Office for Student Conflict Resolution (<https://conflictresolution.illinois.edu> ; [conflictresolution@illinois.edu](mailto:conflictresolution@illinois.edu) ; 333-3680) for disciplinary action.

**Family Educational Rights and Privacy Act (FERPA):**

Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See <https://registrar.illinois.edu/academic-records/ferpa/> for more information on FERPA.

**AE 419  
Aircraft Flight Mechanics  
Spring 2024**

**Tentative Topic Schedule**

Chapter	Topic	Week	Date	Homework Posted	Homework Due
Introduction	MLK DAY	1	1/15/24		
	Course Overview	1	1/17/24		
	Standard Atmosphere	1	1/19/24		
	Airspeed Measurement & Mach Number	2	1/22/24		
	Aerodynamics Review	2	1/24/24	Homework 1	
Aircraft Performance	Governing Equations	2	1/26/24		
	Thrust and Power Required/Available	3	1/29/24		
	Thrust and Power Required/Available	3	1/31/24	Homework 2	Homework 1
	Level Flight	3	2/2/24		
	Climb and Descent	4	2/5/24		
	Range and Endurance	4	2/7/24	Homework 3	Homework 2
	Take-Off and Landing	4	2/9/24		
	Maneuvering and V-n Diagrams	5	2/12/24		
	Energy Methods	5	2/14/24	Homework 4	Homework 3
Static Stability and Control	Introduction, Governing Equations	5	2/16/24		
	Introduction, Governing Equations	6	2/19/24		
	Stability Derivatives	6	2/21/24	Homework 5	Homework 4
	Stability Derivatives	6	2/23/24		
	Recap	7	2/26/24		
	Midterm 1	7	2/28/24		
	Longitudinal Static Stability	7	3/1/24	Homework 6	Homework 5
	Longitudinal Static Stability	8	3/4/24		
	Review of Midterm 1	8	3/6/24		
	No Class	8	3/8/24		

Chapter	Topic	Week	Date	Homework Posted	Homework Due
Static Stability and Control	Spring Break	9	3/11/24		
	Spring Break	9	3/13/24		
	Spring Break	9	3/15/24		
	Longitudinal Static Control	10	3/18/24		
	Longitudinal Static Control	10	3/20/24	Homework 7	Homework 6
	Lateral Static Stability	10	3/22/24		
	Lateral Static Stability	11	3/25/24		
	Lateral Static Control	11	3/27/24	Homework 8	Homework 7
	Lateral Static Control	11	3/29/24		
	Summary of Static Stability	12	4/1/24		
Dynamic Stability and Control	Introduction	12	4/3/24		Homework 8
	Governing Equations	12	4/5/24		
	Recap	13	4/8/24		
	Midterm 2	13	4/10/24		
	Small Perturbation Equations	13	4/12/24		
	Small Perturbation Equations	14	4/15/24		
	Longitudinal Dynamic Stability: Free Response & Modes	14	4/17/24	Homework 9	
	Longitudinal Dynamic Stability: Free Response & Modes	14	4/19/24		
	Review of Midterm 2	15	4/22/24		
	Lateral Dynamic Stability: Free Response & Modes	15	4/24/24		Homework 9
	Lateral Dynamic Stability: Free Response & Modes	15	4/26/24		
	Special Topics	16	4/29/24		
	Final Review	16	5/1/24		
FINAL	FINAL EXAM	16	5/3/24		