AE 416 Applied Aerodynamics
Fall 2024
Course Syllabus

Course Meeting: MWF 11:00 - 11:50 am,
Location: 106B8 Engineering Hall
Course Zoom (Remote Days): Meeting ID: 829 2473 5361, Passcode: 805467
https://illinois.zoom.us/j/82924735361?pwd=RffM2PpxN57VqHHBP8kisDith4khzh.1

Instructor: Prof. Matthew Clarke, maclarke@illinois.edu
Office: 321A, Talbot Laboratory
Office Hours Times: Mondays and Tuesdays, 3:00 – 4:00 pm
Office Hours Location (Hybrid): 321A, Talbot Laboratory
Office Hours Zoom: Meeting ID: 837 1717 2883, Passcode: 717559
https://illinois.zoom.us/j/83717172883?pwd=cUfvqx2FazxFo1wRqRsmGcpLgQqLkX.1

Teaching Assistant: Niranjan Nanjappa, nn18@illinois.edu
Office Hours Times: Mondays 1:00 – 2:30 pm
Office Hours Location (Hybrid): Room TBD, Talbot Laboratory
Office Hours Zoom: Meeting ID: 906 123 5478 , Passcode: 283004
https://illinois.zoom.us/j/86483697030?pwd=KLsjKgqJ7ODSoavqD5zwxqmdvpb7TF.1

Prerequisite: AE 311 (Incompressible Flow) or consent from the instructor

Credit: 3 undergraduate hours, 3 or 4 graduate hours

Textbook:
- Bertin, John J., and Russell M. Cummings. *Aerodynamics for engineers*. Cambridge University Press, 2021. *(Recommended)*
- Katz, Joseph, and Allen Plotkin. *Low-speed aerodynamics*. Vol. 13. Cambridge University Press, 2001. *(Recommended)*

Assignments: Assignments are due via online submission at the beginning of class.
Late Assignment Grade Policy: 20% per day for late assignments.
No assignments are accepted after solutions have been posted.

Tentative Assignment Dates:

	Posted	Due
Assignment 1	Sep 11	Sep 25
Assignment 2	Sep 27	Oct 14
Assignment 3	Oct 16	Oct 30
Assignment 4	Nov 1	Nov 13
Assignment 5	Nov 15	Nov 29
Assignment 6	Dec 02	Dec 11

Exams: Two hourly exams and one final exam will be given:
Midterm 1: Monday, October 7, 11:00-11:50 am
Midterm 2: Wednesday, November 20, 11:00-11:50 am
Final: Wednesday, December 18, 8:00 am – 11:00 am (Per Registrar)

Grading:

	3 hours	4 hours
Assignments (5):	40%	35%
Midterms (2):	30%	25%
Final:	30%	30%
Project:	--	10%

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%

Project: A term project is required for graduate students enrolled in 4 credit hours. A one-page written project proposal is due Monday, September 30th at the beginning of class. Final paper submissions are due Wednesday, December 6th at the beginning of class.

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.

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.

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. Other information about resources and reporting is available here: 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 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 ; 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 416
Applied Aerodynamics
Fall 2024

Tentative Topic Schedule

Chapter	Topic	Week	Date
Introduction	What is applied aerodynamics?	Week 1	26-Aug
	Origin of Forces and Dimensionless Quantities	Week 1	28-Aug
	Fundamentals of Aerodynamics	Week 1	30-Aug
	LABOR DAY	Week 2	2-Sep
	Classifications of Aerodynamic Drag	Week 2	4-Sep
	Aerodynamic Performance Coefficients	Week 2	6-Sep
	Conservation Equations	Week 3	9-Sep
	Common Approximations of Fluid Equations	Week 3	11-Sep
	The Standard Atmosphere	Week 3	13-Sep
Boundary Layers	Introduction to Boundary Layers and Skin Friction	Week 4	16-Sep
	Similarities Analysis and Boundary Layers	Week 4	18-Sep
	Solutions to Laminar Boundary Layer Equations	Week 4	20-Sep
	Integral Boundary Layer Equations	Week 5	23-Sep
	Solving Integral Boundary Layer Equations Part 1	Week 5	25-Sep
	Solving Integral Boundary Layer Equations Part 2	Week 5	27-Sep
	Boundary Layer Transition	Week 6	30-Sep
	Turbulent Boundary Layers and Separation Criteria	Week 6	2-Oct
	Boundary Layer Practical Examples	Week 6	4-Oct
	Exam 1	**Week 7**	**7-Oct**
Potential Flow	2-D Potential Flows	Week 7	9-Oct
	Kutta-Joukowski Theorem	Week 7	11-Oct

Chapter	Topic	Week	Date
Airfoil Aerodynamics	Airfoils: History and Development	Week 8	14-Oct
	Airfoil Design Methods	Week 8	16-Oct
	Airfoil Analysis - Thin Airfoil Theory Part 1	Week 8	18-Oct
	Airfoil Analysis - Thin Airfoil Theory Part 2	Week 9	21-Oct
	Airfoil Analysis - Thin Airfoil Theory Part 3 & Numerical Implementation of Thin Airfoil Theory	Week 9	23-Oct
	Airfoil Analysis –Panel Methods Part 1	Week 9	25-Oct
	Airfoil Analysis –Panel Methods Part 2	Week 10	28-Oct
	Numerical Implementation of a Panel Method	Week 10	30-Oct
	Compressibility Effects	Week 10	1-Nov
	High-Lift Airfoil Aerodynamics Part 1	Week 11	4-Nov
	High-Lift Airfoil Aerodynamics Part 2	Week 11	6-Nov
Wing Aerodynamics	3D Aerodynamics and Finite Wings	Week 11	8-Nov
	Lifting Line Theory & Vortex Lattice Methods Part 1	Week 12	11-Nov
	Lifting Line Theory & Vortex Lattice Methods Part 2/ Far Field Drag Computation and Influence of Wake Modeling Part 1	Week 12	13-Nov
	Far Field Drag Computation and Influence of Wake Modeling Part 2	Week 12	15-Nov
	Wing Design and Configuration Aerodynamics	Week 13	18-Nov
	Exam 2	**Week 13**	**20-Nov**
Rotor Aerodynamics	Principles of Helicopter Aerodynamics	Week 13	22-Nov
	THANKSGIVING BREAK	Week 14	25-Nov
	THANKSGIVING BREAK	Week 14	27-Nov
	THANKSGIVING BREAK	Week 14	29-Nov
	Momentum (Actuator Disc) Theory in Hover	Week 15	2-Dec
	Momentum (Actuator Disc) Theory in Axial Flight	Week 15	4-Dec
	Momentum (Actuator Disc) Theory in Forward Flight	Week 15	6-Dec
	Blade Element Theory	Week 16	8-Dec
	Blade Element Theory in Forward Flight	Week 16	11-Dec
	FINAL (8 am, Location TBD)	**Week 17**	**18-Dec**