

# AERO 3312 Aerodynamics I

## Course Syllabus

### Fall 2023

#### COURSE MOTIVATION

This course builds on the students' background in Fluid Mechanics to deal primarily with flows (low-speed and high-speed) relevant to aerospace applications, with particular emphasis on components related to an airplane.

#### SCHEDULED MEETING TIMES

Section CRN	Time	Location
15310	M W 10:30 am - 11:50 am	Liberal Arts Building 318

**INSTRUCTOR:** Dr. Md Mahamudur Rahman

**E-MAIL:** [mrahman15@utep.edu](mailto:mrahman15@utep.edu)

**OFFICE HOURS:** By Appointment (via e-mail)

**OFFICE:** Engr. Bldg. A#118

**TEXTBOOK:** Fundamentals of Aerodynamics, 5th or 6th Edition by John Anderson

**BLACKBOARD:** Instructor will be using Blackboard for uploading lecture videos, updating the syllabus (if necessary), and communicating with students via "Announcements" and email.

#### COURSE OBJECTIVES:

The objectives of this course are to examine the fundamentals of flowing fluids that can be treated as incompressible and to use this foundation to analyze and predict the dynamics of fluid flow fields. To this end, we will come to understand what it means to be an incompressible fluid, analyze and develop potential flow field expressions, and make use of airfoil theory and finite-wing theory.

#### TOPICS

- Fluid Properties
- Conservation of Mass and Momentum Principles
- Flow Similarity
- Circulation and Vorticity
- Superposition of Potential Flow Elements
- Velocity Potential
- Stream Function
- Airfoil Nomenclature
- Thin Airfoil Theory
- Lifting Line Theory
- Laminar Boundary Layers

## COURSE SCHEDULE

Week	Week of	Reading	Lecture Topic	Due
1	08/28	1.1 – 1.5	<b>Introduction to Aerodynamics</b> 1. History of aerodynamics, classifications, fundamental variables 2. Aerodynamic forces and momentum	
2	09/04	1.5 – 1.8	<b>No Class on Monday 09/04 (Labor Day)</b> <b>Project assignment</b> 3. Aerodynamic forces and momentum 4. Center of pressure 5. Flow similarity	<b>Quiz-1</b> <b>HW-1</b>
3	09/11	2.11 – 2.12	<b>Chapter 2: Fundamental Principles and Conservation Equations</b> 6. Pathlines, Streamlines and Streaklines 7. Angular velocity	<b>Quiz-2</b> <b>HW-2</b>
4	09/18	2.12 – 2.13 2.4, 3.6	8. Angular velocity, vorticity, circulation of flow 9. Continuity equation 10. Conditions for incompressible flow	<b>Quiz-3</b> <b>HW-3</b>
5	09/25	15.4	11. Navier-Stokes equation	<b>Project#1</b>
6	10/02	3.1 – 3.5	<b>Chapter 3: Fundamentals of Inviscid Incompressible Flow</b> 12. Bernoulli's equation and low speed tunnel flow 13. Measurement of airspeed, pressure coefficient	<b>Quiz-4</b> <b>HW-4</b>
7	10/09	2.14 – 2.16 3.9 – 3.10	14. Stream function and velocity potential 15. Uniform and source flow	<b>Quiz-5</b> <b>HW-5</b>
8	10/16	3.11 – 3.14	16. Uniform flow with source and sink, doublet flow 17. Non-lifting flow 18. Vortex flow	<b>Quiz-6</b> <b>HW-6</b>
9	10/23	3.15 – 3.16	19. Lifting flow 20. The Kutta-Joukowski Theorem	<b>Project#2</b>
10	10/30	4.1 – 4.6	<b>Chapter 4: Incompressible Flow over Airfoils</b> 21. Introduction of airfoil 22. Low-speed flow over airfoil, Kutta condition and Kelvin's circulation theorem	<b>Exam-1</b>
11	11/06	4.7	23. Thin airfoil theory	<b>Quiz-7</b> <b>HW-7</b>
12	11/13	4.8 – 4.11	24. Cambered airfoil 25. The aerodynamic center 26. Lifting flows over arbitrary bodies, Modern low-speed airfoils	<b>Quiz-8</b> <b>HW-8</b>
13	11/20	5.1 – 5.2	<b>Chapter 5: Incompressible Flow over Finite Wings</b> 27. Downwash and induced drag 28. The vortex filament, the Biot-Savart Law, and Helmholtz's theorems	<b>Project#3</b>
14	11/27	5.3, 5.5	29. Prandtl's classical lifting-line theory 30. The lifting-surface theory	<b>Quiz-9</b> <b>HW-9</b>

15	12/04	5.4, 5.6	31. Nonlinear lifting-line method 32. The delta wing	<b>Exam-2</b>
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**GRADING:** Your grade for the course will be determined using the following formula:

Exams	10%	× 2	20%
Class Project	15%	× 3	45%
Quizzes	10%		10%
Homework	15%		15%
Class Participation	10%		10%

*A (100-90): B (89-80): C (79-70): D (69-60): F (59 and Below)*

**ABET PROGRAM OUTCOMES:** This class addresses the following ABET objectives:

<b>Outcomes 1 - 7</b>	<b>Evidence</b>
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	Homework; Exams; Design project
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	N/A
3. An ability to communicate effectively with a range of audiences	Design project report and presentation
4. An ability to recognize ethical and professional responsibilities in engineering solutions and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts	Classroom discussion of sustainability; Design project
5. An ability to function effectively on a team whose members together provide leadership, create collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	Design project
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions	Design project; classroom example and homework problems
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	Homework; Final report for the design project

**ACCOMODATIONS:** If you have a disability and need classroom accommodations, please contact the Center for Accommodations and Support Services (CASS) at 747-5148, or by email to [cass@utep.edu](mailto:cass@utep.edu), or visit their office located in UTEP Union East, Room 106. For additional information, please visit the CASS website at [www.sa.utep.edu/cass](http://www.sa.utep.edu/cass).

# Department's Policies

## ACADEMIC HONESTY

During exams and quizzes, you are not allowed to use any form of wifi enabled electronic device, including cell phones or other electronic communication devices or methods (wrist watches, earbuds, etc.). No wrist watch or other electronic device may be worn. Calculators and watches may be subject to inspection. You may be asked to temporarily remove glasses to allow for their inspection.

You may not bring backpacks, hats, bulky coats or hoodies into the exam room. Lockers are not available at the exam site so plan and leave your belongings in a secure location. You may NOT sit them in a corner of the exam room.

You must show your work for all problems. You must use the paper provided by the instructor. If no work is shown you may not receive credit. After the exam, the instructor may require you to explain how you solved a problem on the exam. If you refuse to or cannot explain your work you may be subject to disciplinary action.

No electronic version of the book, loose paper print-outs of the book or extra sheets of paper of any kind are allowed unless explicitly mentioned in writing by the instructor. As a part of the zero-tolerance policy, if you have a cellphone or other electronic device capable of communication on your person; or if any proctor sees or hears any electronic device during the exam or if you share your work with someone else, you will be reported to the proper authorities and you may receive a zero on the exam or an F in the class. Other actions including suspension may also be pursued.

No one will be allowed to leave the room during an exam. This includes restroom breaks.

University approved recording devices may be located at various locations in the room and may be out of sight of the students. These recordings will be managed according to the UTEP approved regulations for such media. The instructor may create a record of your activity during the exam and may take photographs of your work during the exam.

If you are suspected of scholastic dishonesty you may or may not be directly confronted about your conduct by the instructor or proctor. You will however, be reported to the Office of Student Conduct and Conflict Resolution (OSCCR) and your exam may not be admissible. Your grade in the class may not be available until OSCCR makes a final ruling, this may adversely impact your ability to enroll in other classes.

If you arrive more than 15 minutes late to an exam, you will not be allowed to take the examination. There will be no makeup exams administered. If you have a university approved excuse, your instructor will have a process for determining how to handle the missing grade outlined in the syllabus. However, no makeup exams will be given.

If you miss more than one exam, the instructor may choose to administratively drop you from the class. This may adversely impact a visa and financial aid.

No food or drink may be brought into the examination room.

Departmental policy allows for the use of assigned seats. All students must present their UTEP issued ID prior to and during every exam and may be required to sign in. Not having a UTEP issued ID when asked will result in forfeiture of the exam. No other IDs will be accepted.

Scholastic dishonesty on homework, lab assignments and all other class assignments will be held to the same standards and requirements of academic honesty as quizzes and exams.

### **CLASS ATTENDANCE POLICY**

Attendance is mandatory. Anyone with 5 or more absences will be dropped from the class. A drop for not attending will count toward the State Allowed Six Drop Limit. If you are failing the class at the time of the drop you may also be given a WF designation. Be advised that a drop could adversely impact visa status, financial aid and other programs.

As per UTEP rules, you may be asked to show a UTEP ID at any time during class. Anyone who is present and not registered in the class will be subject to disciplinary action unless the instructor gives prior approval.

### **EXCUSED ABSENCE FOR EXAMS**

The UTEP catalog allows Exam Absence to be excused **ONLY** for University-Recognized Activities and very specific other situations. Medical absence is **NOT** allowed in the UTEP catalog. For consistency with the catalog, students will **NOT** be excused from exams due to illness.

### **HARASSMENT POLICY**

The University (see Handbook of Operating Procedures 1.2.2.4) has a zero-tolerance policy for harassment. Engagement in any behavior considered harassment will be reported to the proper authorities. In addition to generally understood forms of harassment, the department also treats the following behavior as harassment:

- Repeated emails and/or calls regarding subjects that have already been addressed. Once a decision has been made or a question answered, a student who continues to ask the same question will be given a warning by the recipient of the email/call. If the student continues, the behavior will be reported. Questions that seek understanding of course material are not harassment; but repeated questions about a grade or an administrative decision are.
- Grades are **NOT** negotiable, ever. If you believe a grading mistake has been made, you must follow the process described in the UTEP catalog. Any request for a grade elevation that is **NOT** based on a mistake is considered harassment and will be reported immediately.
- Remaining in an office after the occupant requests you leave is considered harassment and potentially threatening. You will be reported immediately without warning and depending on the severity, may be reported to law enforcement.

Similar behavior towards department staff, and student advisors will also be treated as harassment, including persistent phone calls, emails, and badgering. Department staff and student advisors are there to help students, and should be treated with due respect.

**Best of Luck!**

**I am always with you to help!**

**Stay Safe and Take Care!**

**Relax and Smile!**