

# 2024 Spring Semester

## Undergraduate Aerodynamics and Propulsion Laboratory (AerE344)

### COURSE SYLLABUS

**Course Instructors:** Dr. Hui Hu  
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Iowa State University  
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**Office Hours:** Tuesday 3:10 pm – 4:00 pm  
Thursday 3:10 pm – 4:00 pm

**Class notes:** Available at the course website of  
<https://www.aere.iastate.edu/~huhui/teaching/2024-01S/2024S-AerE344.html>

If a student has a disability that qualifies under the Americans with Disabilities Act and Section 504 of the Rehabilitation Act and requires accommodations, he/she should contact the Disability Resources (DR) office for information on appropriate policies and procedures. DR is located on the main floor of the Student Services Building, Room 1076; their phone is 515-294-6624.

**The contents of the syllabus may be altered by the instructor during the semester.**

## Course Objectives:

By completion of the course, students will:

- Understand the applications of the fundamental principles taught in aerodynamics courses.
- Know basic knowledge related to experimental aerodynamics and measurements techniques.
- Become proficient in using basic equipment representative of aerospace engineering practice.
- Know how to design and conduct experiments.
- Know how to analyze and evaluate experimental data.
- Know how to write good lab reports.
- Gain more lab experience to get “hands-on” lab training.
- Gain experiences to promote the spirit of teamwork among engineers.

## Topics Covered:

- Similitude and Dimensional Analysis.
- Pressure measurement methods and instrumentation: manometers and pressure transducers.
- Pitot-static probes, hotwire anemometry, and Particle Image Velocimetry (PIV).
- Flow visualization techniques: Schlieren and shadowgraph photography.
- Wind tunnel calibration.
- Pressure distribution around a circular cylinder.
- Determination of aerodynamic performance of airfoils by wind tunnel testing.
- Pressure distribution around a low-speed airfoil at different angles of attack.
- Flow characteristics in the wake of a low-speed airfoil at different angles of attack.
- Wind turbine aerodynamics and wake interferences in turbulence boundary layer flow.
- Aircraft icing physics and anti-/de-icing technology.
- Supersonic flows and shock waves in a de Laval nozzle

## Course Policy:

- **Required attendance for lab exercises:** In this course, you will conduct lab experiments for a range of different applications. These experiments will involve computer data acquisition systems, pressure and velocity measurement techniques, uncertainty analysis, and report writing. ***Unexcused absences from lab exercises will result in an “F” in the grade for the entire course!***
- **Enter and leave classroom:** You need to arrive at the lab room ~5 minutes before the class starts. Please do not congregate outside the classroom while waiting to enter; maintain social distance with previous and current class; quickly exit the room when your class is over (i.e. not hang around in the class room to discuss things)...
- **Lab experiments:** While conduct lab experiments, please follow the faculty member and/or TA’s guidance with respect to lab safety protocols. Please make sure adhering to the workspace markings, cleaning spaces, any rotation or structures in the lab used to maintain distancing, etc.
- **Lab Reports:** Please make sure to turn in your lab reports on time. If lab reports are turned in after 5 pm on the due date, the score will be reduced by 25%. If work is turned in 2 days after the due date, scores will be reduced by 50%. No credit will be given for reports turned in more than 2 days after the due date. To be granted an extension on a missed homework or project assignment requires a written signed memo delivered to the course instructor in advance of the due date explaining in detail the reason for the request.

- **COVID-19 Related Medical Absence:** If any students in AerE344 class have confirmed or suspected COVID-19 infections, they should follow ISU policy to fill [“COVID-19 Reporting Form for Campus”](#) as soon as possible! A notice email will be received by the course instructor about the reported COVID-19 cases. The notice email will serve as evidence to justify the excused absence of AerE344 labs or final exams for the infected students during the required quarantine period. Further information about COVID-19 Quarantine, Isolation can be found at <https://www.provost.iastate.edu/about/covid-19--fall-planning-resources/faq--quarantine--isolation--and-contact-tracing>.
- **Other Excusable Absence:** It is required for you to attend lab exercises and the final exam. Providing doctor’s note to state the sickness is an example to justify the excusable lab or exam absence. You can also provide other reasonable evidence to justify your lab or exam absence.
- **Make up the Excusable Absence:** Please contact the course instructor as soon as possible to discuss about the plan to make up the excusable absence when you have an excusable absence from lab exercise and final exam.

**Grading:**

The final grade of the course will be calculated with the following weights:

- Labs reports (including pre-lab homework for 10%) 65%
- Class/lab participation; in-class quizzes 10%
- Final exam 25%

**Other Important Statements:**

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**Free Expression**

Iowa State University supports and upholds the First Amendment protection of [freedom of speech](#) and the principle of academic freedom in order to foster a learning environment where open inquiry and the vigorous debate of a diversity of ideas are encouraged. Students will not be penalized for the content or viewpoints of their speech as long as student expression in a class context is germane to the subject matter of the class and conveyed in an appropriate manner.

**Academic Dishonesty**

The class will follow Iowa State University’s policy on academic dishonesty. Anyone suspected of academic dishonesty will be reported to the [Dean of Students Office](#).

**Discrimination and Harassment**

Iowa State University does not discriminate on the basis of race, color, age, ethnicity, religion, national origin, pregnancy, sexual orientation, gender identity, genetic information, sex, marital status, disability, or status as a U.S. Veteran. Inquiries regarding non-discrimination policies may be directed to Office of Equal Opportunity, 3410 Beardshear Hall, 515 Morrill Road, Ames, Iowa 50011, Tel. 515-294-7612, Hotline 515-294-1222, email [eooffice@iastate.edu](mailto:eooffice@iastate.edu)

## **Prep Week**

This class follows the Iowa State University Prep Week policy as noted in section 10.6.4 of the [Faculty Handbook](#).

## **Religious Accommodation**

Iowa State University welcomes diversity of religious beliefs and practices, recognizing the contributions differing experiences and viewpoints can bring to the community. There may be times when an academic requirement conflicts with religious observances and practices. If that happens, students may request the reasonable accommodation for religious practices. In all cases, you must put your request in writing. The instructor will review the situation in an effort to provide a reasonable accommodation when possible to do so without fundamentally altering a course. For students, you should first discuss the conflict and your requested accommodation with your professor at the earliest possible time. You or your instructor may also seek assistance from the Dean of Students Office at 515-294-1020 or the Office of Equal Opportunity at 515-294-7612.

## **Contact Information for Academic Issues**

If you are experiencing, or have experienced, a problem with any of the above statements, email [academicissues@iastate.edu](mailto:academicissues@iastate.edu)

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## COURSE SYLLABUS

<b>Week No.</b>	<b>Date</b>	<b>Lecture Topics (Tue: 9:30-10:20am; Room 0114, Student Innovation CTR)</b>	<b>Lab Activities (Room 1380, Howe Hall)</b>	<b>Reports due on Fridays</b>
1	01/16	Course introduction and policy	No lab	
2	01/23	Similitude and measurement uncertainty analysis	Lab #1: Flow visualization by using smoke wind tunnel	
3	01/30	Fluid mechanical apparatus: wind tunnel and water tunnels	Lab #2: Wind tunnel calibration	<i>Lab report #1 due on Friday</i>
4	02/06	Pressure measurement techniques and instrumentations	Lab #3: Pressure sensor calibration and measurement uncertainty analysis	<i>Lab report #2 due on Friday</i>
5	02/13	Introduction of velocimetry techniques and instrumentation	Lab #4: Pressure distributions around a circular cylinder	<i>Lab report #3 due on Friday</i>
6	02/20	Hotwire anemometry: Fundamentals and instrumentation	Lab #5: Airfoil aerodynamic characterization based on pressure measurements	<i>Lab report #4 due on Friday</i>
7	02/27	Laminar and turbulence flows	Lab #6: Airfoil wake measurements and hotwire anemometer calibration	<i>Lab report #5 due on Friday</i>
8	03/05	Technical basis for optical instrumentation	Lab #7: Measuring turbulent wake characteristics behind an airfoil by using a hotwire anemometry probe.	<i>Lab report #6 due on Friday</i>
9	03/12	<b>Spring Break</b>		
10	03/19	Shadowgraph and Schlieren techniques and instrumentation	Lab #8: Characterizing the development of boundary layer flows over a flat plate	<i>Lab report #7 due on Friday</i>
11	03/26	Shock waves and De Laval nozzle	Lab #9: Set up of Shadowgraph and Schlieren systems	<i>Lab report #8 due on Friday</i>
12	04/02	Particle Image Velocimetry (PIV): fundamentals and instrumentation	Lab #10: Shockwave visualization and pressure measurements in a de Laval nozzle	<i>Lab report #9 due on Friday</i>
13	04/09	Bio-Inspired Aerodynamics and Applications for Micro-Air-Vehicle (MAV) applications	Lab#11: PIV measurements of unsteady vortices in the wake of an airfoil model	<i>Lab report #10 due on Friday</i>
14	04/16	Aircraft icing physics and anti-/de-icing technology	Lab#12: Characterizing of ice accreting process over an airfoil surface.	<i>Lab report #11 due on Friday</i>
15	04/23	Wind turbine aeromechanics & wind farm aerodynamics	Lab#13: Wind tunnel testing of wind turbine wake interference in ABL winds	<i>Lab report #12 due on Friday</i>
16	04/30	Review for the final exam	No lab	<i>Lab report #13 due on Friday</i>
17	05/07	<b>AerE344 final exam is scheduled from 9:45 am to 11:45 am on Tuesday, May 07, 2024</b>		