AerE545/AerE445: Experimental Fluid Mechanics and Heat Transfer

COURSE SYLLABUS

Course Instructor: Dr. Hui HU
Department of Aerospace Engineering
Iowa State University, Room 2249, Howe Hall
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and
Dr. Amrit Kumar
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Lecture time: Mondays 12:05pm – 12:55 pm
Wednesdays 12:05am – 12:55 pm

Lecture Room: 2228 Howe Hall

Lab time: Fridays 9:55am ~11:45am (Section #1)
12:05pm ~1:55pm (Section #2

Classroom for Labs: 1380 Howe Hall

Office Hours: Mondays 2:10pm – 4:00 pm
Wednesdays 2:10pm – 4:00 pm

Reference materials: 1). Stavros Tavoularies, "Measurement in Fluid Mechanics", Cambridge Univ. Press
2). Richard Goldstein, "Fluid Mechanics Measurements", 2nd Edition, Taylor&Francis.

Outline resources: Lecture Notes and Course Syllabus are available at:
http://www.aere.iastate.edu/~huhui/teaching.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.

The topics covered in the course:

Introduction of various experimental techniques widely used for fluid mechanics, aerodynamics, heat transfer, and combustion and wind tunnel testing. The measurement techniques to be covered in the course include Pressure gauge and transducers; Pitot tube; hot wire anemometry; shadowgraph and Schlieren Photography; laser Doppler velocimetry; particle image velocimetry (PIV); advanced PIV techniques (stereo PIV, 3-D PIV, Holograph PIV, microscopic PIV); laser-induced fluorescence; pressure sensitive painting, temperature-sensitive painting; molecular tagging velocimetry; molecular tagging thermometry. Extensive applications and laboratory experiments will be included in the course.

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 the 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., do not hang around in the classroom to discuss things) ...
- **Lab experiments:** While conducting lab experiments, please follow the faculty member and/or TA's guidance with respect to lab safety protocols. Please make sure to adhere to the workspace markings, cleaning spaces, any rotation or structures in the lab used to maintain distancing, etc.
- **Lab Reports:** Please make sure to submit your lab reports on time. The score will be reduced by 25% for late submissions on the due date, reduced by 50% within 2 days after the deadline, and no credit for the late submission > 2 days after the deadline. Requesting an extension on the submission deadline requires a signed memo to the course instructor in advance to explain the reasons in detail.
- **COVID-19 Related Medical Absence:** *If any students in the 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. Please send a notification email to the course instructor about the reported COVID-19 case, which can be used as evidence to justify the excused absence of the required labs or final exam during the required quarantine period.*
- **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:** Pease contacts the course instructor as soon as possible to discuss the plan to make up the excusable absence when you have an excusable absent from lab exercise and the final exam.

Grading:

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

- Labs reports (including pre-lab homework) 60%
- Final exam 40%

Other Important Statements:

Public Health:

- If you are not feeling well, you should stay home and focus on your health. Should you miss class due to illness, it is your responsibility to work with your instructor to arrange accommodation and to make up coursework, as consistent with the instructor's attendance policy.
- You may choose to wear a face mask and/or receive the COVID-19 vaccine and boosters, as well as other vaccines such as influenza, but those options are not required. Thielen Student Health Center will continue to provide COVID-19 vaccinations free of charge to students. The university will continue to offer free masks and COVID-19 test kits during the fall 2022 semester. Other well-being resources for students are available at: https://www.cyclonehealth.iastate.edu/wellbeing-resources/
- Public health information for the campus community continues to be available on Iowa State's public health website. All public health questions should be directed to publichealthteam@iastate.edu.

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

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 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 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

AerE 545 2023 Fall Lectures: Mondays & Wednesdays (12:05 pm-12:55pm) Room 2228, Howe

Class Schedules

Date	Lecture #		Lecture Topics	Homework/Report Due
Week 1				
21 Aug.	1	M	Syllabus, policies, and course introduction	
23 Aug.	2	W	Measurement properties and measurement uncertainties	
25 Aug.		F	Special Topics – Visit AerE wind tunnel laboratory (both AerE445/AerE545)	
Week 2				
28 Aug.	3	M	Fluid mechanical apparatus: wind tunnel and water tunnels	
30 Aug.	4	W	Classic pressure-measuring instrumentation	
01 Sep.		F	AerE445- Lab#01: Pressure measurements & hotwire anemometer lab	
Week 3				
04 Sep.		M	University Holiday	
06 Sep.	5	W	Pitot probe and Hot wire anemometry	
08 Sep.		F	AerE545- Lab#01: Pressure measurements & hotwire anemometer lab	
Week 4				
11 Sep.	6	M	Hot wire anemometry -2	
13 Sep.	7	W	Technical basis for optical/laser-based flow diagnostics	
15 Sep.		F	AerE445-Lab#02: Shadowgraph & Schlieren lab (AerE445-Lab#01 report due)	
Week 5				
18 Sep.	8	M	Shadowgraph and Schlieren photography -01	
20 Sep.	9	W	Shadowgraph and Schlieren photography -02	
22 Sep.		F	AerE545-Lab#02: Shadowgraph & Schlieren lab (AerE545-Lab#01 report due)	
Week 6				
25 Sep.	10	M	PSP and TSP techniques -01	
27 Sep.	11	W	PSP and TSP techniques -02	
29 Sep.		F	AerE445-Lab#03: PSP Laboratory	(AerE445-Lab #02 report due)
Week 7				
02 Oct.	12	M	LDV / PDA - 01	
04 Sep.	13	W	LDV / PDA - 20	
06 Oct.		F	AerE545-Lab#03: PSP Laboratory	(AerE545-Lab #02 report due)
Week 8				
09 Oct.	14	M	2-D PIV technique - 1	
11 Oct.	15	W	2-D PIV technique - 2	
13 Oct.		F	AerE445-Lab #04: 2D PIV Laboratory	(AerE445-Lab #03 report due)
Week 9				
16 Oct.	16	M	2-D PIV technique - 3	
18 Oct.	17	W	Stereoscopic PIV technique- 01	
20 Oct.		F	AerE545-Lab #04: 2D PIV Laboratory	(AerE545-Lab #03 report due)

Week 10	.....		
23 Oct.	18	M	**Stereoscopic PIV technique- 02**
25 Oct.	19	W	**Advanced 3D PIV techniques**
27 Oct.		F	**AerE445-Lab #05: Stereo PIV Laboratory (AerE445-Lab #04 report due)**
Week 11	.....		
30 Oct.	20	M	**Micro-PIV technique - 1**
01 Nov.	21	W	**Micro-PIV technique - 2**
03 Nov.		F	**AerE545-Lab #05: Stereo PIV Laboratory (AerE545-Lab #04 report due)**
Week 12	.....		
06 Nov.	22	M	**LIF technique - 1**
08 Nov.	23	W	**LIF technique - 2**
10 Nov.		F	**AerE445-Lab #06: ISU Icing Tunnel Lab (AerE445-Lab #05 report due)**
Week 13	.....		
13 Nov.	24	M	**Molecular Tagging Techniques - 1**
15 Nov.	25	W	**Molecular Tagging Techniques - 2**
17 Nov.		F	**AerE545-Lab #06: ISU Icing Tunnel Lab (AerE545-Lab #05 report due)**
Week 14	.....		
20 Nov.		M	**Thanksgiving break**
22 Nov.		W	**Thanksgiving break**
24 Nov.		F	**Thanksgiving break**
Week 15	.....		
27 Nov.	26	M	**Application examples - 1**
29 Nov.	27	W	**Application examples - 2**
01 Dec.		F	**AerE445-Lab #07: Wind Turbine Laboratory (AerE445-Lab #06 report due)**
Week 16	.....		
04 Dec.	28	M	**Application examples - 3**
06 Dec.	29	W	**Application examples - 4**
08 Dec.		F	**AerE545-Lab #07: Wind Turbine Laboratory (AerE545-Lab #06 report due)**
Week 17	.....		

- Final exam schedule can be found at https://www.registrar.iastate.edu/students/exams/fallexams.

End of 2023 Fall Semester