2016 Spring Semester
Undergraduate Aerodynamics and Propulsion Laboratory (AerE 344)

COURSE SYLLABUS

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

Course webpage:  http://www.aere.iastate.edu/~huhui/teaching.html
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 the use of 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 experiences 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 wing 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 flows
- Aircraft icing physics and anti-/de-icing technology
- Supersonic flows and shock waves in a de Laval nozzle

Course Policy:
In this course, you will conduct 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.

Lab Experience: For each lab exercise, your group must designate a “lead operator.” The lead operator must make connections, set up the devices, and run the computer. Taking turns as lead operator gives everyone a chance to have hands-on experience with the equipment. Participation as a lead operator will determine your “class/lab participation” grade. Each member of a group must serve at least once as lead operator. You must identify the lead operator to the lab TA.

Unexcused absences from lab exercises will result in an “F” in the grade for that lab course!

Homework: Pre-lab homework assignments are intended to prepare you for conducting the lab exercises and writing the lab reports.
**Lab Reports:** 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 lecture in advance of the due date explaining in detail the reason for the request.

**Medical Absence:** You must be present for the labs and the final exam. Medical excuses for absences from the final exam require a signed note from a physician (including a contact address and phone number).

**Grading:**

The two courses will be graded separately. You will receive distinct grades for each course. In each course, the grading will be calculated with the following weights:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Labs reports (including pre-lab homework)</td>
<td>50%</td>
</tr>
<tr>
<td>Class/lab participation; in class quizzes</td>
<td>20%</td>
</tr>
<tr>
<td>Final exam</td>
<td>30%</td>
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</tbody>
</table>

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.
<table>
<thead>
<tr>
<th>Week No.</th>
<th>Date</th>
<th>Lecture Topics (HOOVER 1227) (Tuesdays: 10:00am-10:50am)</th>
<th>Lab Activities (1365 Howe Hall) (1380 Howe Hall)</th>
<th>Reports Due on Fridays</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>01/12</td>
<td>Course introduction and policy</td>
<td>No lab</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>01/19</td>
<td>Similitude and measurement uncertainty analysis</td>
<td>Lab #1: Flow visualization by using smoke wind tunnel</td>
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<tr>
<td>3</td>
<td>01/26</td>
<td>Fluid mechanical apparatus: wind tunnel and water tunnels</td>
<td>Lab #2: Wind tunnel calibration</td>
<td>Lab report #1 due on Friday</td>
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<tr>
<td>4</td>
<td>02/02</td>
<td>Pressure measurement techniques and instrumentations</td>
<td>Lab #3: Pressure sensor calibration and measurement uncertainty analysis</td>
<td>Lab report #2 due on Friday</td>
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<tr>
<td>5</td>
<td>02/09</td>
<td>Introduction of velocimetry techniques and instrumentation</td>
<td>Lab #4: Pressure distributions around a circular cylinder</td>
<td>Lab report #3 due on Friday</td>
</tr>
<tr>
<td>6</td>
<td>02/16</td>
<td>Hotwire anemometry: Fundamentals and instrumentation</td>
<td>Lab #5: Aerodynamic performance of a airfoil based on pressure measurements</td>
<td>Lab report #4 due on Friday</td>
</tr>
<tr>
<td>7</td>
<td>02/23</td>
<td>Laminar and turbulence flows</td>
<td>Lab #6: Airfoil wake measurements using Pitot-tube rake</td>
<td>Lab report #5 due on Friday</td>
</tr>
<tr>
<td>8</td>
<td>03/01</td>
<td>Technical basis for optical instrumentation</td>
<td>Lab #7: Hotwire anemometry and measurements in airfoil wake flows.</td>
<td>Lab report #6 due on Friday</td>
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<tr>
<td>9</td>
<td>03/08</td>
<td>Shadowgraph and Schlieren techniques and instrumentation</td>
<td>Lab #8: Visualization of shockwaves using Schlieren technique</td>
<td>Lab report #7 due on Friday</td>
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<tr>
<td>10</td>
<td>03/15</td>
<td>Spring Break – No Class/Labs</td>
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<tr>
<td>11</td>
<td>03/22</td>
<td>Shock waves and De Laval nozzle</td>
<td>Lab #9: Set up of Shadowgraph and Schlieren systems to visualize a thermal plume flow.</td>
<td>Lab report #8 due on Friday</td>
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<tr>
<td>12</td>
<td>03/29</td>
<td>Particle Image Velocimetry(PIV): fundamentals and instrumentation</td>
<td>Lab #10: Pressure measurements in a de Laval nozzle</td>
<td>Lab report #9 due on Friday</td>
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<tr>
<td>13</td>
<td>04/05</td>
<td>Bio-inspired aerodynamics and Applications for Micro-Air-Vehicle (MAV) applications</td>
<td>Lab#11: PIV measurements of unsteady vortices in the wake of an airfoil</td>
<td>Lab report #10 due on Friday</td>
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<tr>
<td>14</td>
<td>04/12</td>
<td>Wind turbine aeromechanics &amp; wind farm aerodynamics</td>
<td>Lab#12: Wind tunnel testing of wind turbine aeromechanics and wake interference in ABL winds</td>
<td>Lab report #11 due on Friday</td>
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<tr>
<td>15</td>
<td>04/19</td>
<td>Aircraft icing physics &amp; anti-/de-icing technology</td>
<td>Lab#13: Wind tunnel testing of dynamic ice accreting process over an airfoil.</td>
<td>Lab report #12 due on Friday</td>
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<tr>
<td>16</td>
<td>04/26</td>
<td>Course review</td>
<td>Prepare for final exam</td>
<td>Lab report #13 due on Friday</td>
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<tr>
<td>17</td>
<td>05/03</td>
<td>Final Exam</td>
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