

## ME 439: Applied Aerodynamics

<i>Course description:</i>	Aerodynamic lift and drag; circulation; boundary layers; application to subsonic aircraft wing design.
<i>Number of credits:</i>	3
<i>Course Coordinator:</i>	K. Matveev
<i>Prerequisites by course:</i>	ME 303
<i>Prerequisites by topic:</i>	<ol style="list-style-type: none"><li>1. Differentiation and integration</li><li>2. Vector operations.</li><li>3. Basic fluid mechanics.</li></ol>
<i>Postrequisites:</i>	None
<i>Textbooks/other required materials:</i>	John D. Anderson, Jr., <i>Introduction to Flight</i> , 7th edition, McGraw-Hill, 2011.
<i>Course objectives:</i>	<ol style="list-style-type: none"><li>1. To provide the students an understanding of fluid properties in the atmosphere, dimensional analysis, main aircraft components.</li><li>2. To introduce the students to methods for describing airflow around airfoils and wings and calculating lift, drag and moments.</li><li>3. To introduce students to analysis of aerodynamics effects on aircraft performance, dynamics, stability and control.</li></ol>
<i>Topics covered:</i>	<ol style="list-style-type: none"><li>1. Governing equations of fluid mechanics.</li><li>2. Elements of compressible flow.</li><li>3. Boundary layers, flow separation and computation of friction and pressure drag.</li><li>4. Elements of the potential flow analysis.</li><li>5. Airfoil theory.</li><li>6. Air properties in the atmosphere.</li><li>7. Aerodynamic characteristics of wings.</li><li>8. Airplane performance, dynamics, stability and control.</li><li>9. Propulsion systems of airplanes.</li></ol>
<i>Expected learning outcomes:</i>	<ol style="list-style-type: none"><li>1. Ability to use dimensions and units consistently.</li><li>2. Ability to apply governing equations of fluid mechanics to calculate flow rates and forces in simple flows.</li><li>3. Ability to calculate flow patterns, pressure distribution and forces in irrotational flows of simple geometry, using superposition principles.</li><li>4. Ability to evaluate aerodynamic drag.</li><li>5. Understanding of airflow around airfoils and wings in different</li></ol>

flow regimes and conditions.

6. Ability to calculate aerodynamic forces and moments of wings.

7. Familiarity with the variation of air properties in the atmosphere with altitude.

8. Ability to use existing analytical and approximate methods to model airplane performance, dynamics, stability and control.

*Class schedule:* Three 50-minute lecture sessions per week or two 75-minute lecture sessions per week for one semester.

*Laboratory schedule:* None

*Contribution to meeting the professional component:* Engineering Topics

*Relationship of course to student outcomes:* Meets:  
1. School of MME ME educational objectives: 1, 2  
2. School of MME ME program outcomes: 1, 7  
3. ABET EC2019, Criterion 3 program outcomes: 1, 7

*Prepared by:* Amy Johnson and K. Matveev

*Date:* August 1, 2022

## POLICIES

- A. **Reasonable Accommodation** (the nature of the particular course determines which one applies):
- **Pullman Campus.** Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please either visit or call the Access Center (Washington Building 217; 509-335-3417) to schedule an appointment with an Access Advisor. All accommodations MUST be approved through the Access Center.
  - **WSU Online Course.** Reasonable accommodations are available in online classes for students with a documented disability. All accommodations must be approved through your WSU Disability Services office. If you have a disability and need accommodations, we recommend you begin the process as soon as possible. For more information contact a Disability Specialist on your home campus: Pullman or WSU Online (<http://accesscenter.wsu.edu>), Spokane (<http://spokane.wsu.edu/students/current/studentaffairs/disability/>), Tri- Cities (<http://www.tricity.wsu.edu/disability>), Vancouver (<http://studentaffairs.vancouver.wsu.edu/student-resource-center/disability-services>).
- B. **Academic Integrity** WSU expects all students to behave in a manner consistent with its high standards of scholarship and conduct. Students are expected to uphold these standards both on and off campus and acknowledge the university's authority to take disciplinary action. The Standards of Conduct for Students can be found at <http://conduct.wsu.edu>.
- C. **WSU Safety** WSU is committed to maintaining a safe environment for its faculty, staff, and students. Safety is the responsibility of every member of the campus community and individuals should know the appropriate actions to take when an emergency arises. In support of our commitment to the safety of the campus community the University has developed a Campus Safety Plan, <http://safetyplan.wsu.edu>. It is highly recommended that you visit this web site as well as the University emergency management web site at <http://oem.wsu.edu/> to become familiar with the information provided.