MAE 104
Aerodynamics (4 units)

Class/Laboratory Schedule: four lecture hours per week, three lab, and five hours outside preparation. 12 hours/week total

Course Coordinator(s): Kal Seshadri, Juan Carlos del Alamo

Textbooks/Materials: Anderson, J.D. Fundamentals of Aerodynamics. McGraw-Hill Series in Aeronautical and Aerospace Engineering.

Catalog Description: Basic relations describing flow field around wings and bodies at subsonic and supersonic speeds. Thin-wing theory. Slender-body theory. Formulation of theories for the evaluation of forces and moments on airplane geometries. Application to the design of high-speed airplanes.

Prerequisites: Admission to the engineering major and grade C- or better in MAE 101A-B.

- ■ Required Course
- □ Technical Elective Course
- □ Other: _____

Performance Criteria

Objective 1
1.1 Students will demonstrate understanding of the basic principles of classical aerodynamics

Objective 2
2.1 Student will demonstrate ability to apply principles of analysis to formulate and solve engineering problems in aerodynamics

Objective 3
3.1 Student will demonstrate good problem solving skills and written analysis

Objective 4
4.1 Student will demonstrate familiarity and understanding of the basic principles of the design of airplane components
4.2 Students will demonstrate the ability to apply principles and perform analysis of complex systems

Objective 5
5.1 Student will demonstrate the ability to integrate theory and experimentation in the design of airplanes

Objective 6
6.1 Students will demonstrate understanding of the basic principles of aerodynamics

Course Objectives:
(Numbers in parentheses refer to the MAE Program Outcomes)

Objective 1: To teach students the basic principles of classical aerodynamics. (1a,AE12)

Objective 2: To train students to apply principles of analysis to formulate and solve engineering problems in aerodynamics (1a,5e,AE12)

Objective 3: To encourage good problem solving skills and written analysis (5e,7g)

Objective 4: To introduce students to the design and performance evaluation of wings and other lifting surfaces. (1a,2b,3c,AE12)

Objective 5: To teach integration of theory and experimentation in the design of airplanes (1a,2b,3c,AE12)

Objective 6: To provide students with sound basis for subsequent courses in flight mechanics (1a,AE12,AE14).

Course Topics:

1. Fundamental principles: aerodynamic variables, aerodynamic forces and, flow similarities, conservation of mass, momentum and energy in fluid flow, vorticity and circulation. Kelvin circulation theorem.
2. Fundamental of inviscid incompressible flow: stream function and velocity potential. Governing equation for irrotational, incompressible flows. The Kutta-Joukowski theorem and the generation of lift.
3. Incompressible flows over airfoils: classical thin airfoil theory, symmetric airfoil, cambered airfoil. Lifting flow over arbitrary shape bodies, the vortex panel method.
4. Incompressible flows over finite span wings: downwash and induced drag, Prandtl's classical lifting-line theory. Lifting-surface theory.
5. High speed aerodynamics: compressible flows, generation of shock waves and expansion waves. Supersonic flows over wedges and cones.
6. Supersonic flows through nozzles and diffusers
7. Subsonic compressible flows over airfoils: Linear theory
8. Linearized supersonic flows.
9. Numerical techniques for supersonic flows: methods of characteristics.

Prepared By: K. Vecchio, March 2000
Revised: Prab bandaru & Joanna McKittrick, April 2008, via Teaching Work Group Meeting
Reviewed and Revised: TWG, June 2010; June 2011, August 2012