MAE 104

Aerodynamics (4 units)

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

Course Coordinator(s): Zahra Sadeghizadeh, Antonio L. Sánchez, Oliver T. Schmidt

Textbooks/Materials:

1. John D. Anderson, Fundamentals of Aerodynamics. (6th Edition), McGraw-Hill Series in Aeronautical and Aerospace Engineering, 2016

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

Prerequisites: 101A and 101B, or consent of instructor. Enrollment restricted to MC 25, MC 27, MC 29, MC 30–34, MC 35–37, and SE 27 majors only.

Course Type: Required

Course Objectives:

1. To teach students the basic principles of classical aerodynamics.
2. To train students to apply principles of analysis to formulate and solve engineering problems in aerodynamics.
3. To encourage good problem-solving skills and written analysis.
4. To introduce students to the design and performance evaluations of wings and other lifting surfaces.
5. To teach integration of theory and experimentation in the design of airplanes.

Course Topics:

1. Fundamental principles: aerodynamic variables, aerodynamic forces and moments, aerodynamic coefficients, and steady flight analysis.
2. Conservation of mass, momentum, and energy in fluid flow, compressibility and the

Mach number. Incompressible aerodynamics: Bernoulli equation, irrotational flow, vorticity, and circulation.

3. Fundamental of inviscid incompressible flow: vorticity and divergence, Laplace's equation for the stream function and velocity potential, classical potential solutions, D'Alembert's paradox and the generation of drag, circulation, and the Kutta-Joukowski theorem.
4. Incompressible flows over airfoils: the Kutta condition, Kelvin's circulation theorem, and the generation of lift. Classical thin airfoil theory, the vortex panel method, and design considerations.
5. Incompressible flows over finite span wings: downwash and induced drag, Prandtl's classical lifting-line theory. The lifting-surface theory and the vortex lattice numerical method.
6. High speed aerodynamics: subsonic compressibility corrections, linearized theory for supersonic flow around a slender body, and shock-expansion theory for supersonic airfoils.

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