

DEPARTMENT OF AERONAUTICS AND ASTRONAUTICS

AA 302 INCOMPRESSIBLE AERODYNAMICS

SPRING QUARTER

CREDITS AND

CONTACT HOURS: 4 credits, Four 50-minute lectures per week.

COORDINATOR: M. Kurosaka, Professor of Aeronautics and Astronautics

TEXTBOOK: Fundamentals of Aerodynamics, Anderson, John M., 5th Ed., McGraw Hill 2010

**SUPPLEMENTAL
MATERIALS:**

None

CATALOG DATA: INCOMPRESSIBLE AERODYNAMICS, Required

Aerodynamics as applied to the problems of performance of flight vehicles in the atmosphere. Kinematics and dynamics of flow fields; incompressible flow about bodies. Thin airfoil theory; finite wing theory. Prerequisite: minimum grade of 1.7 in AA 301; PHYS 123; either AMATH 351, MATH 136, or MATH 307; MATH 324. Offered: Sp.

PREREQUISITES BY TOPIC:

- 1) Vector analysis
- 2) Physics (mechanics)

OUTCOMES:

- 1) Students will understand basic properties of fluids.
- 2) Be able to develop the mass and momentum conservation laws.
- 3) Be able to calculate velocity fields, streamlines, vorticity and circulation.
- 4) Have the ability to solve airfoil problems using superposition.
- 5) Be able to calculate the lift and induced drag of a 3D wing.

RELATIONSHIP TO STUDENT OUTCOMES:

- a) An ability to apply knowledge of mathematics, science, and engineering.
- e) An ability to identify, formulate, and solve engineering problems.
- k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

TOPICS:

- 1) Forces and Moments, Coefficients & its eqns + center of pressure; Buckingham PI thm, Flow similarity; Line, surface, volume integrals; continuity eqn; (3 lectures)
- 2) Conservation laws in 3-D, substantial derivatives (3 lectures)
- 3) Flow visualization, vorticity, streamlines, strain rates (2 lectures)
- 4) Circulation; stream function; Velocity potential (1 lecture)
- 5) Bernoulli Eqn; venturi & pitot tube, Pressure coefficient; Laplace eqn. (1 lecture)
- 6) Potential flow (6 lectures)
- 7) 2D airfoil theory (5 lectures)
- 8) finite wing (5 lectures)

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| 9) Axisymmetric 3D flow | (1 lecture) |
| 10) Horizontal stability | (1 lecture) |
| 11) How to use VLAERO by AMI | (one 2 hr lecture) |
| 12) project lecture by Boeing Employee | (two 2 hr lectures) |
| 13) lecture from one of last year's projects | (one 2 hr lecture) |
| 14) performing project | (7 lectures) |
| 15) mid-project review | (1 lecture) |