THE DEPARTMENT OF AERONAUTICS AND ASTRONATUICS

AA 402 FLUID MECHANICS

SPRING QUARTER

**CREDITS AND
CONTACT HOURS:** 3 Credits, Three 50-minute lectures per week.

COORDINATOR: Antonino Ferrante, Assistant Professor, April 2013
Website: https://catalyst.uw.edu/workspace/aferrant/15718/

TEXTBOOK: Basic Fluid Mechanics, D. C. Wilcox, Fourth Edition, DCW Industries, 2010.

**SUPPLEMENTAL
MATERIALS:** Viscous Fluid Flow, F. M. White, McGraw-Hill, 1991.
Boundary-Layer Theory, H. Schlicting, McGraw-Hill, 1979.
An Introduction to Fluid Dynamics, G. K. Batchelor, Cambridge University Press, 1967.
Fluid Mechanics P. .K. Kundu & I. M. Cohen, Fourth Edition, Academic Press, 2008.
Fluid Mechanics, F. M. White, Seventh Edition, McGrawHill, 2008.

CATALOG DATA: FLUID MECHANICS, Selective Elective
Introduction to fluid mechanics, dimensional analysis, effects of gravity on pressure, kinematics, conservation of mass & momentum, control-volume method, conservation of energy, vorticity and viscosity, viscous effects, Navier-Stokes solutions, boundary layers. Prerequisite: MATH 324; A A 302 or equivalent. Offered: A

PREREQUISITES BY TOPIC:
1) Thermodynamics
2) Introductory incompressible and compressible aerodynamics (AA301 and 302)
3) Differential equations and Advanced calculus (MATH 307 and MATH324)

OUTCOMES: The students completing this course in good standing will be able to:
1. Apply dimensional analysis.
2. Explain and calculate the effects of gravity on pressure.
3. Calculate vorticity, circulation, streamlines, streaklines and pathlines.
4. Apply conservation of mass, momentum and energy.
5. Derive and apply Navier-Stokes solutions.
6. Derive and apply boundary layer equations.

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.
i) A recognition of the need for, and an ability to engage in life-long learning.
k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

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TOPICS

1. Introduction to fluid mechanics, Fluids properties and flow classification, Dimensional analysis (3 lectures).
2. Effects of gravity on pressure, Buoyancy and Hydrostatic Forces on Plane Surf., Buoyancy and Hydrostatic Forces on Plane Surf. (3 lectures).
3. Kinematics, Reynolds Transport Theorem (3 lectures).
4. Conservation of mass & momentum, Navier-Stokes, Euler and Bernoulli's Eq. (3 lectures).
5. Control-volume method (3 lectures).
6. Conservation of energy (1 lecture).
7. Vorticity and viscosity, viscous effects (3 lectures).
8. Lift and drag (1 lecture).
9. Navier-Stokes solutions (2 lectures).
10. Boundary layers, turbulence (4 lectures).