MENG 4150

Fluid Mechanics

Catalog Description

4150. Fluid Mechanics (3) (S) 3 lecture hours per week. P: ENGR 3012.Fluid systems including fluid statics; conservation of mass, momentum, and energy; incompressible inviscid flow; similitude; internal and external incompressible viscous flow; and fluid machinery.

Text:

1. Munson, Bruce R., Donald F. Young, and Theodore H. Okiishi. *Fundamentals of Fluid Mechanics*, 6th Edition, John Wiley and Sons, 2005, ISBN 978-0-471-67582-2
2. National Council of Examiners for Engineering and Surveying, *Fundamentals of Engineering Supplied-Reference Handbook (8th Edition)*, 2008, ISBN 978-1-932613-30-8. .

Objectives:

At the completion of this course, students will:

- Recognize the types of fluid flow that is occurring in a particular physical system
- Choose the appropriate fluid mechanical principles needed to analyze fluid-flow situations
- Apply appropriate simplifying assumptions and basic fluid mechanics principles to produce a mathematical model of a physical fluid system
- Solve and analyze the mathematical model associated with a physical fluid system
- Describe important practical results in common fluid flows and their physical implications
- Apply modern engineering tools to solve practical fluid mechanics problems

Course Content:

Fluid statics (3 classes)
- Pressure distribution in a fluid.
- Manometry
- Force on plane and curved submerged surfaces
- Buoyancy

Fluid velocity and acceleration fields (4 classes)
- Eulerian vs. Lagrangian descriptions
- Velocity field and flow lines
- Acceleration in a fluid

Control-volume analysis (6 classes)
- Reynolds transport theorem
- Conservation of mass
- Momentum balance
- Angular momentum balance
- Conservation of energy
- Bernoulli's equation.

Local analysis (6 classes)
- Derivation of continuity and Navier-Stokes equations
- Kinematics

Stream function and velocity potential
Simple viscous-flow solutions in Cartesian and polar coordinates
Reduction to Euler equations

Similitude (3 classes)
Dimensional analysis
Buckingham Pi theorem
Dimensionless groups
Modeling
Scaling equations of motion

Boundary layers (5 classes)
Laminar and turbulent boundary layers
Transition

Pipe flow (8 classes)
Entry region
Fully developed flow - laminar and turbulent
Colebrook formula
Pipe systems
Pumps and turbines

Drag - Pressure drag (5 classes)
Friction drag
Separation

Exams (2 classes)

Grading:

Grading			**Assessment**	
A	90% or better		Homework/Assignments	10%
B	80% or better		Project	20%
C	70% or better		Tests (2)	40%
D	60% or better		Final Exam	30%
F	Less than 60%		Total	100%