ME 3340 Fluid Mechanics (Required)

Catalog Description: ME 3340 Fluid Mechanics (3-0-3)
Prerequisites: ME 2202 Dynamics of Rigid Bodies, MATH 2403 Differential Equations
Prerequisites or Corequisites: ME 3322 Thermodynamics
The fundamentals of fluid mechanics. Topics include fluid statics, control-volume analysis, the Navier-Stokes equations, similitude, viscous, inviscid and turbulent flows, boundary layers.

Textbook: Bruce R. Munson, Donald F. Young, and Theodore H. Okiishi, *Fundamentals of Fluid Mechanics*, 5th Edition, John Wiley and Sons, 2006.

Topics Covered:

1. Fluid statics - Pressure distribution in a fluid. Manometry. Force on plane and curved submerged surfaces. Buoyancy.
2. Fluid velocity and acceleration fields - Eulerian vs. Lagrangian descriptions. Velocity field. Flow lines. Acceleration in a fluid.
3. Control-volume analysis - Reynolds transport theorem. Conservation of mass. Momentum balance. Angular momentum balance. Conservation of energy. Bernoulli's equation.
4. Local analysis – 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.
5. Similitude - Dimensional analysis. Buckingham Pi theorem. Dimensionless groups. Modeling. Scaling equations of motion.
6. Boundary layers - Laminar and turbulent boundary layers. Transition.
7. Pipe flow - Entry region. Fully developed flow - laminar and turbulent. Colebrook formula. Pipe systems. Pumps.
8. Drag - Pressure drag. Friction drag. Separation.
9. Turbulent flow – Introduction to basic concepts.

Course Outcomes:

Outcome 1: To develop a student's understanding of the basic principles of fluid mechanics.

1.1 The student will demonstrate an ability to recognize the type of fluid flow that is occurring in a particular physical system.
1.2 The student will demonstrate an ability to choose the appropriate fluid mechanical principles needed to analyze fluid-flow situations.

Outcome 2: To develop a student's skills in analyzing fluid flows through the proper use of modeling and the application of the basic fluid-flow principles.

2.1 The student will demonstrate an ability to apply appropriate simplifying assumptions and basic fluid-flow principles to produce a mathematical model of a physical fluid-flow system.
2.2 The student will demonstrate an ability to solve and analyze the mathematical model associated with a physical fluid-flow system.

Outcome 3: To provide the student with some specific knowledge regarding fluid-flow phenomena observed in mechanical engineering systems, such as flow in a pipe, boundary-layer flows, drag, etc.

3.1 The student will be able to recognize the particular flow regime that is present in a typical engineering system.

3.2 The student will demonstrate knowledge of important practical results in common fluid flows and their physical implications.

Correlation between Course Outcomes and Program Educational Outcomes:

ME 3340												
	Mechanical Engineering Program Educational Outcomes											
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k	l
Course Outcome 1.1	X	X			X				X		X	X
Course Outcome 1.2	X	X			X				X		X	X
Course Outcome 2.1	X	X			X				X		X	X
Course Outcome 2.2	X	X			X				X		X	X
Course Outcome 3.1	X	X			X				X	X	X	X
Course Outcome 3.2	X	X			X				X	X	X	X

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