ME 3340 Fluid Mechanics (Required)

Catalog Description: ME 3340 Fluid Mechanics (3-0-3)

Prerequisites: ME 2202 Dynamics of Rigid Bodies, MATH 2401 Calculus III (C or better), and MATH 2403 Differential Equations (C or better)

Corequisites: ME 3322 Thermodynamics

The fundamentals of fluid mechanics. Topics include fluid statics, control-volume analysis, the Navier-Stokes equations, similitude, inviscid, viscous, and turbulent flows, pipe flow, boundary layers, and external flows.

Textbook: Bruce R. Munson, Theodore H. Okiishi, Wade W. Huebsch, and Alric P. Rothmayer, *Fundamentals of Fluid Mechanics*, 7th Edition, John Wiley and Sons, 2013.

Topics Covered:

1. Fluid statics: Pressure distribution in a fluid. Manometry. Force on plane and curved submerged surfaces. Buoyancy.
2. Fluid flow fields: Eulerian vs. Lagrangian descriptions. Velocity fields. Flow lines. Acceleration fields.
3. Control-volume analysis: Reynolds transport theorem. Mass balance. Momentum balance. Energy balance. Bernoulli's equation.
4. Local analysis: Kinematics. The stream function. Derivation of continuity and Navier-Stokes equations. Simple viscous-flow solutions.
5. Similitude: Dimensional analysis. Buckingham Pi theorem. Dimensionless groups. Modeling.
6. Pipe flow: Entry region. Fully developed flow. Laminar and turbulent flow. Colebrook formula. Minor losses.
7. External flows: Laminar and turbulent boundary layers. Flow transition. Separation. Drag.

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 basic fluid-flow principles.

2.1 The student will demonstrate an ability to apply appropriate simplifying assumptions and basic fluid-flow principles to formulate a mathematical description of a simple fluid-flow system.

2.2 The student will demonstrate an ability to solve and analyze the mathematical equations for a simple 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 basic flow phenomena that are 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 Student Outcomes:

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

GWW School of Mechanical Engineering Student Outcomes:

(a) an ability to apply knowledge of mathematics, science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Prepared by: Marc K. Smith