MECHANICAL ENGINEERING PROGRAM

ABET COURSE SYLLABUS

ME 380: Fluid Dynamics for Mechanical Engineers (3 credits): Required Course

Course Description (2008-2010 Catalog):

Introduction to fluid properties, statics, and fluid dynamics. Development of the Navier-Stokes equations for the study of flow in closed conduits, external flows, boundary layers, compressible flows, potential flows, and turbomachinery.

Prerequisite Course: ME 242, MATH 283, PHYS 182-182L

Prerequisite by Topic:

- Dynamics
- Calculus III
- Physics for Scientists and Engineers III
- Physics for Scientists and Engineers Lab III

Textbook: Robert W. Fox, Philip J. Pritchard, Alan T. McDonald, "Introduction to Fluid Mechanics," 7th Ed., John Wiley & Sons, Inc. 2009

Other Reference Material: N/A

Course Coordinator: Yi-Tung Chen, Professor

Course learning outcomes:

(a) Lead students toward a clear understanding and firm grasp of the basic principles of fluid mechanics.
(b) Apply the governing equations in integral form for a control volume and differential analysis to a variety of fluid problems, including those they have not encountered previously.
(c) Model the variety of phenomena that occur in real fluid situations.
(d) Encourage creative thinking and development of a deeper understanding and intuitive feel for fluid mechanics.
(e) Understand motion of a fluid particle (kinematics) such as translation, rotation, angular deformation, and linear deformation.
(f) Understand incompressible inviscid flow and Euler's equations in streamline coordinates and apply the Bernoulli equation between any two points on a streamline.
(g) Apply dimensional analysis in determining the relevant scales in a given problem, correlating experimental data and extrapolating measurements on small-scale models to large-scale objects.
(h) Calculate the entrance length for laminar pipe flow and understand fully developed laminar flow between infinite parallel plates, in a pipe, shear stress distribution, turbulent velocity profiles in fully developed pipe flow, and velocity potential.
(i) Calculate the total head loss as the sum of major losses and minor losses and apply the Moody diagram to find friction factor based Reynolds number and relative roughness.

(j) Understand flow measurement from different flow meter types such orifice, flow nozzle, and Venturi.
(k) Understand the concept of boundary layer and calculate the disturbance thickness, displacement thickness, and momentum thickness.
(l) Understand the drag and lift coefficients and use it to calculate drag and lift forces on a body.
(m) Understand propagation of sound waves.
(n) Understand basic machines that add energy to a fluid by performing work on it.

Relationship of Course to Mechanical Engineering Program Educational Outcomes:

Goal1: Provide mechanical engineering graduates with technical capabilities.					Goal 2: Prepare the mechanical engineering graduates to have effective workplace skills.				Goal 3: Instilling a sense of responsibility as a professional member of society.			
1.a	**1.b**	**1.c**	**1.d**	**1.e**	**2.a**	**2.b**	**2.c**	**2.d**	**3.a**	**3.b**	**3.c**	**3.d**
H		**M**	**H**	**H**	**L**			**M**			**L**	**H**

(L)ow (M)edium (H)igh

Topics Covered:

1. Velocity and stress fields, viscosity, surface tension, fluid motions
2. Newtonian and non-Newtonian fluids
3. Manometer, hydrostatic forces on a plan or curved submerged surface
4. Basic equations in integral form for a control volume (conservation of mass and momentum)
5. Introduction to differential analysis of fluid motion (stream function and fluid kinematics)
6. Continuity and Navier-Stokes equations
7. Incompressible inviscid flow (Euler and Bernoulli equations; energy and hydraulic grade lines)
8. Dimensional analysis and similitude (Buckingham PI theorem)
9. Internal incompressible viscous flow (fully developed laminar flow; flow in pipes and ducts; flow measurement)
10. External incompressible viscous flow (Boundary-layer, drag and lift)
11. Basic introduction of compressible flow
12. Basic introduction of turbomachinery

Laboratory Projects: None

Class/Laboratory Schedule: 75 minutes lecture two sessions per week

Assessment of Student Progress toward Course Objectives

Homework assignment on each week, two written midterm exams, and final exam

Class/Laboratory Schedule: TTh 8:30-9:45 AM (Fall Semester)

Contribution of Course for meeting Professional Component:

(a) Mathematics and basic sciences: 0 credit
(b) Engineering Topics (Design/Science): 3 credit
(c) General Education: 0 credit
(d) Others: 0 credits

Prepared By:
Yi-Tung Chen

Date:
September 24, 2009