MECHANICAL ENGINEERING PROGRAM

ABET COURSE SYLLABUS

ME 347: Fluid Mechanics II (4 Units) Required

Course Description: (2019-20 Catalog)	Conservation equations of fluid dynamics. Viscous flow, boundary layer concepts, lift and drag, compressible flow, turbomachinery. Laboratory measurement of turbomachine performance, velocity profiles, boundary layers on surfaces. 3 lectures, 1 laboratory
Prerequisite Courses:	ME 236, ME 341, ME 302
Prerequisites by Topic:	Principles of experimental data analysis and basic engineering courses in fluid mechanics and thermodynamics
Textbook: (and/or other required material)	Fox and McDonald's Introduction to Fluid Mechanics, by Pritchard and Mitchell, 9th Edition, John Wiley, 2015. ME 347 Fluid Mechanics Experiments, 7th ed., El Corral, 2010.
References:	Fundamentals of Engineering Thermodynamics, by Moran, Shapiro, Boettner, and Bailey, 8th Edition, 2014.
Course Coordinator/Instructor:	Kim A. Shollenberger, Professor of Mechanical Engineering
Course Learning Outcomes:	Be able to formulate and solve fluid system models based on application of basic conservation laws of physics. Be able to use experimentation to validate the range of application for a fluid system model. By sub-discipline the outcomes are as follows: 1. Differential analysis of fluid motion: Apply basic laws of physics to a differential control to obtain conservation of mass and momentum equations. Understand physical significance of each term and how to reduce the momentum equation to the Navier-Stokes equations. Derive and apply the following special cases: one and two-dimensional, incompressible, and steady flow. Calculate the motion of a fluid particle (kinematics). 2. External incompressible viscous flow: Understand the derivation of Blasius exact solution and momentum integral equation and use to calculate boundary layer thicknesses and shear stresses. Explain the difference between friction drag and pressure drag and know how to reduce them. Explain the nature of the flow over a sphere and cylinder as a function of flowrate. Calculate lift for asymmetric flows and spinning bodies. Calculate drag and lift coefficients.

	3. Compressible flow: Calculate the speed of sound, Mach angle, local isentropic stagnation and critical properties of an ideal gas. Reduce the basic compressible flow equations for 1-D, internal, steady state flow of an ideal gas and use to solve problems with variable area, normal shocks, friction, and heat transfer. 4. Turbomachinery: Determine velocity triangles, torque, power output, and head of an ideal turbomachine. Use data to predict actual performance and scaling laws to predict performance at different operating conditions. Determine if a pump will cavitate. Know who to use a pump curve and system curve to calculate the operating point and select a pump.
Relationship of Course to Mechanical Engineering Student Outcomes:	SO 1: Developing (D) SO 2: Developing (D) SO 3: Developing (D) SO 4: SO 5: Developing (D) SO 6: Developing (D) SO 7: Developing (D)
Topics Covered:	1. Differential analysis of fluid motion (2 weeks) 2. External incompressible viscous flow: laminar and turbulent boundary layers, drag, and lift (3 weeks) 3. Compressible flow: sound waves and internal flow with variable area, normal shocks, friction, and heat transfer (3 weeks) 4. Turbomachinery: basic analysis, actual radial and axial pump performance, cavitation, and scaling laws (2 weeks)
Laboratory Projects:	A typical quarter will cover seven experiments that include the following: measurement techniques, basic flow investigation, flow applications, uncertainty analysis, and report writing.
Class/Lab Schedule:	Three 50-minute lectures per week. One 170-minute lab per week.

Contribution of Course to Meeting the Professional Component:	(a) College-level mathematics and basic sciences:	0 credits
	(b) Engineering Topics:	4 credits (100%)
	(c) General Education:	0 credits
	(d) Other:	0 credits

Prepared by:
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Date:
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