ME 211 – FLUID MECHANICS I

Designation as a 'Required' or 'Elective' course
TYPE OF COURSE: Required for BSME Major

Course (catalog) description
COURSE DESCRIPTION: Fluid properties, dimensional analysis, statics and kinematics, conservation equations, inviscid and incompressible flows, Bernoulli's equation, integral momentum theorems, viscous flows, turbulent flows, boundary layer theories.

Prerequisite(s)
PREREQUISITES: MATH 220, Introduction to Differential Equations; PHYS 141, General Physics I (Mechanics).

Textbook(s) and/or other required material
SAMPLE SOURCES AND RESOURCE MATERIALS: F. M. White, “Fluid Mechanics,” Fifth Edition, Mc Graw Hill, 2003. Also, C. M. Megaridis and W. J. Minkowycz, “Laboratory Manual, Fluid Mechanics I,” 1999 (posted on course web site).

Course objectives
COURSE OBJECTIVES: This is an introductory course in the mechanics of fluid motion. It is designed to establish fundamental knowledge of basic fluid mechanics and address specific topics relevant to simple applications involving fluids. Also, to familiarize students with the relevance of fluid dynamics to many engineering systems. The course includes a laboratory component featuring important applications, such as flow in pipes, flow over airfoils and flow in channels. Students successfully completing this course are expected to: be able to perform basic calculations for analysis of simple systems involving fluid motion; be familiar with standard experimentation tools in the field; be aware and appreciative of the importance of fluid processes in the well being of the society; gain experience working in groups; be able to compose clear and effective engineering reports.

Topics covered
MAJOR TOPICS:

1.	Fundamental concepts	2 hours
2.	Fluid statics (Laboratory in fluid properties and statics)	2 hours
3.	Solid body rotation (Laboratory in liquid rotation)	1 hour
4.	Control volume approach	2 hours
5.	Equations of motion (Laboratories on Bernoulli’s equation and momentum equations)	5 hours
6.	Dimensional analysis and similitude (Laboratory on drag and dimensional analysis)	3 hours
7.	Inviscid flows	3 hours
8.	Viscous flow in pipes (Laboratory on friction loss in viscous pipe flow)	3 hours
9.	Boundary layer theory	2 hours
10.	Flow over immersed bodies	3 hours

11. Open channel flows (Laboratory on overflow spillway and hydraulic jump)	2 hours
12. Laboratory	30 hours
13. Examinations	2 hours
Total	60 hours

Class/laboratory schedule, i.e., number of sessions each week and duration of each session
CREDIT HOURS: 3 Hours

TYPE OF INSTRUCTION:	Contact Hours/Week
Lecture	2
Laboratory/Discussion	2

Contribution of course to meeting the professional component
This course shows how to use vector algebra and basic concepts of ordinary and partial differential equations to formulate and solve physical problems involving the motion of fluids. Principles of statics and dynamics are used to show how to calculate forces exerted by fluids on solids, and predict flow fields inside tubes, in between plates and outside bodies of various shapes (airfoils, spheres, cylinders). Students study fluid power generation via fluid/solid interaction and scaling between prototype and models. Issues of fluid safety are also discussed.

Relationship of course to program outcomes
As shown in the BSME Course Outcomes Matrix:

a. Ability to apply knowledge of mathematics, science and engineering
b. Design and conduct experiments, as well as analyze and interpret data
d. Function on multi-disciplinary teams
e. Ability to identify, formulate and solve engineering problems
g. Communicate effectively

Person(s) who prepared this description and date of preparation
Constantine M. Megaridis, Professor of Mechanical Engineering, March 4, 2002

Comments on outcomes

a. Use of vectors, linear algebra, differential and integral calculus; principles of statics and dynamics; graphical representations of results, analytical formulations and computer software.
b. In all labs, students are asked to utilize the experimental setup to demonstrate the fundamental laws of fluid motion. In all labs, the measurements are interpreted physically.
d. All laboratory experiments are performed in mixed teams of students from different disciplines, such as Bioengineering, Mechanical Engr, and Civil and Materials Engineering.
e. Through homeworks and laboratory experiments. Many of the homework problems require detailed understanding of the fluid system before a solution is identified and pursued.
g. The students perform the laboratory experiments, thus need to communicate effectively with the laboratory instructor. Laboratory reports give students feedback concerning communication skills (format, clarity, etc.) beyond the technical content.

These outcomes are what students are expected to gain from this course.