COURSE OUTLINE SPRING 2009

CIV 223	Fluid Mechanics
Course Number	**Course Title**
4	**3 / 3**
Credits	**Lecture/Laboratory Hours**

COURSE DESCRIPTION

Introduction to the field of fluid mechanics. Topics include the properties of fluids, buoyancy, basic fluid power, closed pipe flow, open channel flow, forces due to fluids in motion, flow measuring devices, and the energy balances of fluid systems. Lab experiments (requiring written reports) on non-compressible fluids illustrate the theoretical concepts. Fall Offering.

Text (s): **Reference Division Booklist**

Prerequisites: **MAT115**

Co-requisites:

Course Coordinator: John Santosuosso **Latest Review: 2009**

I. COURSE OBJECTIVES

1. To introduce the basic terminology of fluid mechanics.
2. To acquire a working knowledge of fluid confinement and transport.
3. To solve basic flow problems and evaluate the flow potential of given systems.
4. To familiarize the student with the more popular methods of measuring fluid flow and predicting a flow system's capacity.
5. To plan, discuss and perform proposed experiments based on acquired knowledge and research done by investigation of facts from local library collections.

II. UNIT I - FLUID STATICS 2 weeks

General Objective**:**

To introduce the student to the more common terms and their definitions used in describing both the internal and external properties of a fluid as required for a study of flow.

Specific Objectives:

1. Be capable of defining weight, head, pressure and force as it may be used in the measurement of a fluid.
2. Recognize or calculate specific gravity, specific weight, and density of both solids and liquids.
3. Comprehend charts or graphs enumerating these items.
4. Convert pressures from absolute to gage and back.
5. Use Pascal's Law in solving problems involving force and pressure as needed in actuator cylinders of hydraulic units.
6. Understand the theory of manometers and be able to work problems involving instruments.
7. Be capable of determining a point force on a submerged body.
8. Be able to determine the center of pressure on a submerged regular area.

III. UNIT II - FLOW AND ENERGY 3 weeks

General Objective:

To survey the conditions which cause or restrict the flow of liquids in closed circular pipes and tubes, and to study these conditions mathematically in connection with power systems, pumps and turbines.

Specific Objectives:

1. Be able to work flow problems involving volume flow rates, weight flow rates, and mass flow rates.
2. Understand and use the law for conservation of energy as related to flow.
3. Be able to solve flow problems involving potential, kinetic, and pressure energies.
4. Be able to name or sketch at least five separate types of pumps and describe the method of operation of each.
5. Use the complete Bernoulli's equation to solve assigned flow problems dealing with energy and losses.
6. Solve for power requirements of pumps and turbines using flow parameters.

IV. UNIT III - FLUID ENERGY LOSSES 3 weeks

General Objective:

To familiarize the student with normal energy losses caused by the flow of fluids in pipe lines and fittings, and improve the students ability in making necessary calculations and estimates for energy requirements in maintenance of low through simple pipe lines containing standard fittings and valves.

Specific Objectives:

1. To investigate the function of viscosity and be able to predict flow results which will correspond to specific viscosity changes.
2. Be able to use both dynamic and kinematic viscosity data in solving problems.
3. Be familiar with a number of methods for determining the viscosity of a fluid.
4. To comprehend and be capable of determining whether a flow is laminar or turbulent.
5. Employ the Darcy equation to determine the friction factor for flow in pipelines.
6. Be able to determine the roughness factor of a commercially available material which could be made into a pipe.
7. Attain accuracy in reading a Moody diagram.
8. To recognize or sketch the various standard types of nozzles, outlets, and enlargement fittings used to control or conduct flow.
9. Be able to determine loss coefficients for nozzles, outlets, and change-in-size fittings.
10. Be familiar with the equivalent length technique and be capable of calculating equivalent length for values and fitting either from engineering data or nomagraphs.
11. Be able to recognize the various standard fittings and their proper symbols.

V. UNIT IV - PIPE SYSTEMS 3 weeks

General Objective:

To familiarize the student with the total conditions involved in solving piping problems and to sharpen the students' capability of assuming reasonable factors, necessary but not generally given, in order to solve many complicated industrial hydraulic engineering problems.

Specific Objectives:

1. To be capable of analyzing a piping system and indicating all the factors which will cause a loss of energy.
2. Be able to use the literature, charts, and tables to find the constants, coefficients, and factors necessary for computation.
3. Calculate flow losses predicted and solve the energy equation for values required in flow problems.
4. Solve flow problems requiring the determination of a practical flow rate through a given piping system.
5. Solve flow problems requiring the design of a flow system for a particular flow material and rate.
6. To predict the nature of flow in a parallel system of any number of branches.
7. Solve practical problems of parallel piping to determine the pressure drop caused by each branch.
8. Compute normal flow rates for parallel branch piping systems similar to public water supply systems.

VI. UNIT V - OPEN CHANNEL FLOW 2 weeks

General Objective:

To familiarize the student with conditions involved in design and operation of drainage systems, storm sewers, irrigation canals, or natural streams and to permit the student to calculate necessary parameters for many civil applications of open channel flow.

Specific Objectives:

1. To recognize and suggest proper places and conditions where open channel flow may or should be employed.
2. Be able to calculate the hydraulic radius of any given flow channel.
3. Recognize and distinguish channels that are in uniform steady state of flow.
4. Use the Manning equation to calculate factors such as flow rate, slope, and roughness.
5. Through the specific energy equation, determine whether the flow is above, at, or below its critical velocity.
6. Be capable of calculating when and how high a hydraulic jump may occur.
7. Calculate flow channel dimensions needed for field drainage problems, including culverts, canals, flumes, and catch basins.
8. Be aware of methods and be capable of making field measurements of accrual flows.

VII. UNIT VI - FLOW MEASURING DEVICES 2 weeks

General Objective:

To acquaint the student with available devices used commercially to measure flow and investigate how each functions. Applications of the more common devices will be studied in detail and their limitations and advantages outlined.

Specific Objectives:

1. Be able to compute or measure the range and accuracy of any specific meter.
2. Understand and use the flow rate equation.
3. Be able to choose a flow coefficient with reasonable accuracy from appropriate tables for any given flow device.
4. Be capable of recognizing and naming the various meters and describing the method by which they operate.
5. Be able to list advantages and disadvantages of at least six common metering devices.
6. Solve problems involving metering devices in a complex piping system.
7. Analyze complex problems involving piping systems, meters, fittings, and power units, and solve these problems to a satisfactory mathematical conclusion.

VIII. METHOD OF INSTRUCTION

Lecture will be used as the primary motivating power. Extensive chalkboard work explaining theories and working examples will form the base from which numerous homework problems will yield proficiency. The lecture, problems, and laboratory work will emphasize the practical application of theories and formula.

The laboratory work will follow the lecture as close as practicable. Experiments will emphasize and reinforce the theories discussed in the classroom and will yield much practical experience in using flow measuring devices and constructing proper circuits to obtain correct measurements with these devices.

The equipment available for use in the laboratory is extensive and includes such items as:

a. a variety of types of pumps
b. a wide assortment of valves
c. a fluid power bench
d. a pneumatic test console
e. a pipe friction loss apparatus
f. a flow demonstrator
g. an open channel chamber
h. variable slope open trough
i. a weir box with several weirs
j. assorted pressure-sensing devices

Homework will be assigned each week and it will be collected, marked, and returned to the student. Practice doing these problems will be essential to obtaining proper understanding of the theories expounded and in acquiring a good grade. The homework will appear as an integral part of the final grade.

A report will be required for each of the twelve experiments that will be assigned during the semester. Of these twelve, at least four will be formal reports and will be expected to follow the directions given by the paper "General Outline of a Laboratory Report."

IX. DISTRIBUTION OF VALUE FOR FINAL GRADING

20% Homework

30% Five one-hour tests, scheduled normally at the conclusion of each unit and encompassing all work covered in the course prior to the test date.

30% Laboratory reports will be graded on their comprehensive content, correctness, neatness, and general approach to the problem.

20% Final comprehensive exam shall be made up of from 6 to 12 problems to be solved by methods covered during the semester.

X. REFERENCE MATERIAL

1. Pippenger and Hicks, Industrial Hydraulics, McGraw Hill
2. King and Others, Hydraulics, John Wiley and Sons
3. Robinson, Basic Fluid Mechanics, McGraw Hill
4. Daily and Harleman, Fluid Dynamics, Addison Wesley,
5. Hydraulic Handbook, Colt Inc.,
6. Flow Meter Engineering Handbook, Brown Instrument Company
7. Stenert, H.L., Fluid Power, Howard W. Sams & Co.
8. Pease, D.A., Basic Fluid Power
9. Oster, Jon, Applied Fluid Power,
10. Flow-through Pipes and Fittings, Crane Company
11. Hughes and Brighton, Fluid Dynamics, Schaum Publishing Company
12. Stephen Witaker, Introduction to Fluid Mechanics, Prentice Hall
13. R. Sabersky and Others, Fluid Flow, MacMillan, 2nd Edition, 1971
14. Munson/Young/Oklishi, Fundamentals of Fluid Mechanics, Wiley, 1990

Academic Integrity Statement: Students are expected to comply with the college-wide requirements for academic integrity. Mercer County Community College is committed to Academic Integrity—the honest, fair, and continuing pursuit of knowledge, free from fraud or deception. This implies that students are expected to be responsible for their own work. Presenting another individual's work as one's own and receiving excessive help from another individual will qualify as a violation of Academic Integrity. The entire policy on Academic Integrity is located in the Student handbook and is found on the college website (http://www.mccc.edu/admissions_policies_integrity.shtml).

Students with Disabilities

Any student in this class who has special needs because of a disability is entitled to receive accommodations. Eligible students at Mercer County Community College are assured services under the Americans with Disabilities Act and Section 504 of the Rehabilitation Act of 1973.

If you believe you are eligible for services, please contact Arlene Stinson, the Director of Academic Support Services. Ms. Stinson's office is LB216, and she can be reached at (609) 570-3525.