ME 3300 Fluid Mechanics

Term: Fall 2005
12:45- 3:00 pm, T. Th., 1500 Engineering,

Instructor: Dr. Joon Lee, 2146 Engineering
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Office Hours: 3 - 4 pm T. R. or by appointment
GTA: TBA
Office: TBA

Pre-requisites: MAT 2040, co-req ME 2210

Text: Fundamentals of Fluid Mechanics, Munson, Young, and Okiishi

Specific Learning Objectives: Letters in brackets refer to BSME Program Outcomes A-K. Numbers in brackets refer to the methods of evaluation, with 1 = Homework, 2 = Quizzes & Exams, 3 = Projects & Competitions, 4=Presentations, 5 = Lab Reports):

Students who successfully complete ME 3300 will be able to

1. Give Operation definition of continuum, property at a point, scalar field, vector field, streamline, pathline, body force, surface force, normal stress, shear stress, Newton's law of viscosity and calculate shear stress and shear force for one-D flow. [A, B, F, G, 1, 2]

2. Use the equations of fluid statics, and be able to calculate the pressure differences indicated by various manometers, the resultant force due to fluid acting on a plane submerged surface and on a submerged surface with curvature, be able to calculate the external force (s) required to maintain the surface in equilibrium. [A, B, C, H, 1, 2, 5]

3. Write the control volume formulation for the conservation of mass and momentum for an inertial control volume, state meaning of each term, and apply the formulation to the solution of flow problems. [A, B, G, 1, 2]

4. Write Euler's equation in (a) vector form (b) rectangular coordinates (c) integrate equation along a streamline to obtain Bernoulli equation, understand difference between static pressure, dynamic pressure and stagnation pressure and use these concepts to solve fluid mechanics problems. [A, B, C, H, 1, 2, 5]

5. Define commonly used non-dimensional numbers such as Reynold number, Mach number, Froude number etc., be able to state the Buckingham Pi theory, be able to determine a set of independent dimensionless ratios for a given physical problem in which the dependant parameter is a function of specified independent parameters, predict results for a prototype from model test data. [A, B, D, F, 1, 2]

6. Define internal flow, entrance length, fully developed flow etc. associated with internal flow, be able to use Newton's second law for calculating velocity distribution, shear stress distribution, volume rate, wall shear stress, pressure gradient in a fully developed flow in a pipe, use Moody diagram to determine head losses due to friction. [A, E, G, H, 1, 2, 5]

7. Define various terms associated with external incompressible flows over flat plate, such as boundary layer thickness, momentum thickness, drag, skin friction and how to estimate their values by using approx. methods. [A, B, G, H, 1, 2, 5]

8. Apply above concepts and principles for identifying, formulating and solving engineering problems and preliminary design of simple systems like tanks, pump, compressor, pipes by solving computer aided open-ended problems etc. [A, B, D, F, H, 1, 2, 5]

9. Learn the basic principles of measurement, data analysis, through "hands –on" laboratory experience and design of simple experiments. [A, B, E, F, J, 5]

Relationship of Course to Program Educational Outcomes:

Strongly contributes to the BSME Program Educational outcomes that successful students will:

A. be able to understand scientific principles and apply them to the practice of engineering;
B. be able to communicate effectively;
C. posses the problem-solving skills, background, and confidence necessary to educate themselves continually throughout their careers;

Contributes to the following BSME program outcomes that successful students will:

D. be able to apply computers as tools for engineering
E. be able to apply the basic principles of measurement, data analysis, and design of experiments learned through "hands-on" laboratory
F. be able to practice engineering with ethical standards and a responsibility to the society
H. be able to work as part of a team;
I. be able to apply design process to engineering problems, including the consideration of different technical alternatives while bearing in mind cost, and other constraints;

Grade: PRE Test 5%, Mid-term 25%, Final 25%, Quizzes and HWs 30%, Lab Report 15% Grade: **A**: 90% and above **B**: 80-89%, **C**: 70-79%, **D**: 60-69%. +/- Grades will be allocated for marginal cases.

MATERIALS COVERED

Dimensions, units, properties	CH1
Fluid statics, pressure Buoyancy, Archimedes' Principle	CH2
Stability, Bernoulli equation Bernoulli equation	CH3 CH3
Bernoulli Eqn. Examples Static, total, dynamic pressure. Transport Theorem	CH3 CH4
Conservation Laws: Mass Linear Momentum Energy. First Law	CH5

Energy Eqn, Applications Frictional Losses	CH5	
Second Law	CH5	
Mid-term Dimensional Analysis Pi Terms, Modeling, Similitude		CH7
Pipe flow Pipe flow: laminar Pipe flow: turbulent	CH8	
Turbulent flow Pipe flow problems Moody Chart	CH8	
Minor losses Energy eqn problems/applications	CH8	
Velocity fields, streamlines Acceleration fields	CH4	
Strain and Vorticity	CH6	
Mass Conservation, Streamlines Differential conservation laws, Euler eqns	CH6	
Velocity potential Potential Flow Basic plane potential flows	CH6 CH9	
Boundary Layers: Laminar Boundary Layers: Turbulent External Flow, Drag, Lift	CH9	

Lab problems: Each student *must* perform 2 lab problems (Room 1325 Engineering Building). Lab portion of the course starts in October. Everyone must attend the lecture in October (TBA) where the lab problems will be discussed, and the teams will be formed. The lab assignments require a formal report, word-processor generated and of professional quality.

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Each quiz will consist of one problem (30 minutes).
Quizzes will be **open book** (text book only) and **open notes.**
Tests will be **open book** (text book only) and **closed notes**.
Design Projects/Computer Aided problem reports must be typed.

No make up exam/quiz will be given. The minimum penalty for academic dishonesty is failure in the course.

College of Engineering does not allow withdrawal from courses after the fifth week of class except under exceptional circumstances. This requires the permission of the Associate Dean of the College of Engineering. Failing a class is not an acceptable excuse for withdrawal after 5th week.