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SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title:	MECHANICS OF FLUIDS
Code No.J	MCH 203
Program:	MECHANICAL TECHNOLOGY
Semester:	FOUR
Date:	JUNE 1987
Author:	W. JENKINS

New: Revision:

APPROVED:

Chairperson Date

MECHANICS OF FLUIDS — MCH 203

Course Name — Course Number

PHILOSOPHY/GOALS:

This is the basic course in fluid statics and dynamics. It gives the student the tools necessary for the understanding and design of fluid flow systems.

METHOD OF ASSESSMENT (GRADING METHOD):

SEE ATTACHED SHEET

TEXTBOOK(S):

Fluid Mechanics - Daugherty and Franzini

Flow of Fluids - Crane - Tech Paper #410-C

REFERENCES;

Fluid Mechanics - Binder - (Prentice-Hall)

Fluid Mechanics - Streeter

MTY 4 - MCH 203

The course will cover chapters 1, 2, 3, 4, 6, 8, 11, 12 in Fluid Mechanics by Daugherty and Franzini.

You will be tested on chapters 1, 2, 3, two weeks after completion of these chapters -

You will be tested on chapters 4, 6, 12, two weeks after completion of these chapters.

You will be tested on chapters 8, 11 at the end of the course.

The marking system will be A, B, C and I and test will be graded on logical solutions, layout, sketches and tidiness.

It is expected that the student will be a regular, diligent, and punctual attender in class.

TOPIC NUMBER

TOPIC INFORMATION

Introduction - Static Mechanical

Pressure - guage and absolute specific weight, volume, density. Surface tension, capilliarity Equation of state for grass.

Fluid Statics

- pressure
- Hydrostatic equation for incompressible fluids $dp = -dz$
- Pressure vs depth (incompressible)
- Maomentry pressure gauging
- Location and magnitude of pressure forces on submerged bodies, plane and curved surfaces
- Buoyant forces and static stability of submerged bodies
- Static stability of floating bodies metacentric height, restoring couples
- Pressure vs height for compressible fluids
  - isothermal
  - adiabatic
  - polytropic
- The atmosphere - topo, strato, ionosphere convective stability, lapse rates, weather

Fluids Kinematics

- Pathlines and streamlines
  One, two, three dimensional flow
  Velocity fields - steady and uniform flow
  General Equation of Continuity
- steady flow
- incompressible flow
- two dimensional velocity profiles
- laminar flow
- turbulent flow

Fluid Dynamics

- The energy equation
- Bernoulli's Equation for incompressible flow
  Grade lines

MECHANICS OF FLUID MCH 203-5

Course Textbook: ~- FLUID MECHANICS - Binder

UNIT #1 - FLUID PROPERTIES

General Objectives: - The student will be able to solve varied problems dealing with Fluid Properties.

Specific Objectives:

1. To be able to define the term fluid.
2. To be able to define the term pressure.
3. To be able to define the term absolute pressure,
4. To be able to define the term gauge pressure.
5. To be able to recall the term force.
6. To be able to recall the term vector.
7. To be able to recall the term speed.
8. To be able to recall the term velocity.
9. To be able to recall the term acceleration.
10. To be able to recall the term equation force = mass X acceleration.
11. To be able to define the term density.
12. To be able to define the term specific weight.
13. To be able to define the term specific volume.
14. To be able to state the characteristic gas equation.
15. To be able to define the term viscosity.
16. To be able to define the term dynamic viscosity.
17. To be able to define the term kinematic viscosity.
18. Using the above specific objectives the student will solve correctly the following problems from the textbook:
    1-1 to 1-21 inclusive.

UNIT #2 - FLUID STATICS

General Objectives: The student will be able to solve a number of varied problems dealing with fluid statics.

Specific Objectives:

1. To be able to recall the term pressure.
2. To be able to explain an equation.
3. To be able to define the term manometer.
4. To be able to recall the term specific gravity.
5. To be able to derive an expression for the pressure change measure by any manometer.
6. To be able to define the term barometer.
7. To be able to read a barometer.
8. To be able to explain the operation of a Bourdon Tube.
9. To be able to obtain the force on a plane submerged surface.

10. To be able to obtain the location of the force on plane submerged surface.
11. To be able to recall the term resultant.
12. To be able to obtain the location of the force on a submerged irregular surface.
13. To be able to obtain the location on a submerged irregular surface.
14. To be able to define the term buoyancy.
15. To be able to define the term stable equilibrum.
16. To be able to define the term neutral equilibrum.
17. To be able to define the term metacentre.
18. To be able to obtain the expression for the isothermal pressure-height relationship for compressible fluids.
19. To be able to obtain the expression for th adiabatic pressure-height relationship for compressible fluids.
20. To be able to obtain the expression for the polytropic pressure-height relationship for compressible fluids.
21. With the aid of the above specific objectives, the student will be able to solve correctly the following problems from the textbook *

    2-1, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 21, 23, 24, 26, 28, 32, 42, 44, 46, 48, 49, 60, 62, 69

UNIT #3 - KINETICS OF FLUID FLOW

General Objectives; The student will be able to solve varied problems dealing with the Kinematics of Fluid Flow.

Specific Objectives:

1. To be able to describe the Langrangian Method of Fluid Motion.
2. To be able to describe the Euler method of Fluid Motion.
3. To be able to define the term pathline.
4. To be able to define the term streamline.
5. To be ale to recall the term normal acceleration.
6. To be able to state the equation of continuity of steady flow.
7. To be able to state the equation of continuity for unsteady flow.
8. With the aid of the above specific objectives, the student will be able to solve correctly the following problems from the textbook: 3-1 to 3-9 inclusive.

UNIT #4 - MOMENTUM EQUATION

General Objectives: The student will be able to solve varied problems dealing with the Dynamic or Momentum Equation.

Specific Obejectives:

1. To be able to recall the Newton' three equations of motion.
2. To be able to state the Momentum Equation.
3. To be able to state the Euler's Equation of Motion.

4. To be able to state the Bernouli's Equation of Flow.
5. To be able to'state the D'Alembert's Principle.
6. To be able to recall the equation for normal acceleration.
7. To be able to derive the equation for a free vortex,
8. To be able to derive the equation for a forced vortex.
9. With the aid of the slide rule and the above specific objectives, the student will be able to solve correctly the following problems from the textbook: 6-4 to 17 and 23-33 inclusive.

UNIT #5 - ENERGY EQUATION FOR STEADY FLOW

General Objectives - The student will be able to solve varied problems dealing with the Energy Equation for steady flow.

Specific Objectives:

1. To be able to recall the term Work,
2. To be able to recall the term Energy.
3. To be able to recall the term Internal Energy.
4. To be able to define the term heat.
5. To be able to state the Energy Equation for steady flow.
6. To be able to recall the term Horse power.
7. To be able to recall the term Adiabatic Process.
8. To be able to recall the term enthalpy.
9. With the aid of the above specific objectives, the student will be able to solve correctly the following problems from the textbook: 4-1 to 4-9,

UNIT #6 - FLOW MEASUREMENT

General Objectives: The student will be able to solve varied problems dealing with Flow Measurement.

Specific Objectives:

1. To be able to recall the Bernoulli's equation.
2. To be able to describe a Pitot tube.
3. To be able to convert velocity head to pressure head.
4. To be able to describe a Venturi meter.
5. To be able to obtain the formula for flow through a Venturi meter.
6. To be able to describe the flow nozzle.
7. To be able to obtain the formula for flow through a flow nozzle.

8. To be able to obtain the formula for flow through a flow orifice under a constant head.
9. To be able to obtain the formula for flow through a flow orifice under a varying head.
10. With the above specific objectives, the student will be able to solve correctly the following problems from the textbook: 12-39 to 56 inclusive.

Unit #7 - STEADY FLOW IN PRESSURE PIPES - FRICTION

GENERAL OBJECTIVES

The student be able to solve problems dealing with pipe friction and losses in fluid handling systems.

SPECIFIC OBJECTIVES

1. To be able to recall the formula for Reynold's Number.
2. To be able to distinguish between laminar and turbulent flow.
3. To be able to state the formula for hydraulic radius.
4. To be able to state the formula for the DARSY-WEISBACH equation for pipe friction loss.
5. To be able to interpret the friction factor charts for flow involving relative roughness.
6. To be able to state the formulae for loss of head at entrance to pipes.
7. To be able to state the formula for loss of heat at exit from pipes.
8. To be able to interpret the head loss at a sudden contraction.
9. To be able to interpret the head loss for pipe fittings from industrial charts.
10. To be able to derive the formulae for flow in branching pipes, series pipes and parallel pipes.
11. To be able to state the condition required for maximum power to be developed in a hydraulic installation.
12. Using the above specific objectives will correctly solve the following problems: 8-73 to 8-87 and 8-107 to 8-117.