MACHAKOS UNIVERSITY

University Examinations for 2020/2021 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

SECOND YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 202: FLUID MECHANICS I

DATE: 12/8/2021 **TIME: 2.00-4.00 PM**

INSTRUCTIONS

- *This paper comprises of five questions. Answer **three** questions*
- *Question one is **compulsory** and carry 30 marks*
- *Answer any other **two** questions*

QUESTION ONE (COMPULSORY) (30 MARKS)

a) Explain what is meant by the following terms as applied to fluid mechanics giving SI units where necessary: (15 marks)

i. Mass density

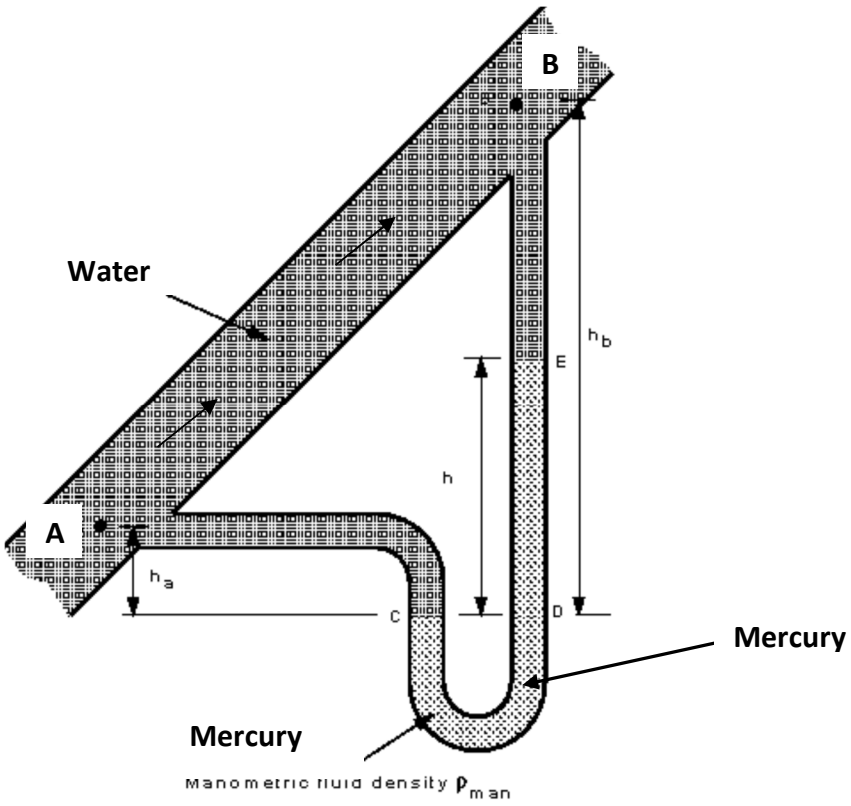
ii. Specific weight

iii. Specific gravity

iv. The coefficient of dynamic viscosity

v. Kinematic viscosity

b) The figure below shows a U-tube differential manometer arranged as shown below to measure the pressure difference between two points A and B in a pipeline conveying water. Find the pressure difference between points A and B if point B is 0.3 m higher than point A and h is 0.7 m. (15 marks)



QUESTION TWO (20 MARKS)

a) Define the following terms. (8 marks)

i. Pressure Intensity

ii. Total Pressure

iii. Centre of pressure (Ħ)

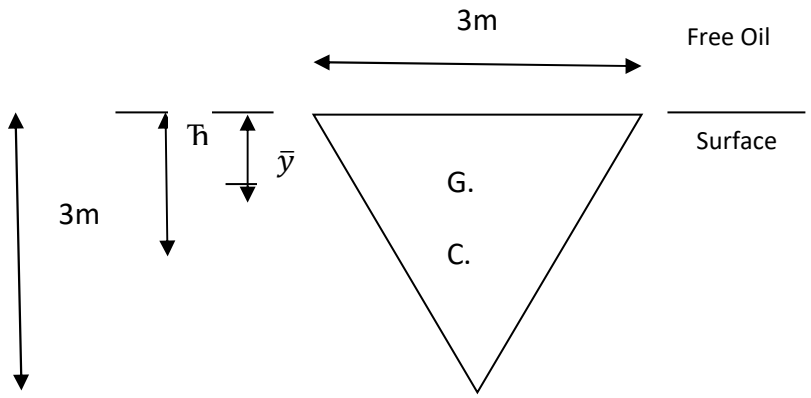
iv. BuoyancyBuoyant force (or Upthrust)

v. Centre of buoyancy

vi. Metacentre

vii. Metacentric height

b) An isosceles triangular plate of base 3 m and altitude 3 m is immersed vertically in an oil of specific gravity 0.8. The base of the plate coincides with the free oil surface. Determine the total pressure and centre of pressure of the plate. Take I_G for a triangle as $bh^3/36$. (12 marks)



QUESTION THREE (20 MARKS)

a) Differentiate the following terms used in connection with the flow of a liquid. (6 marks)

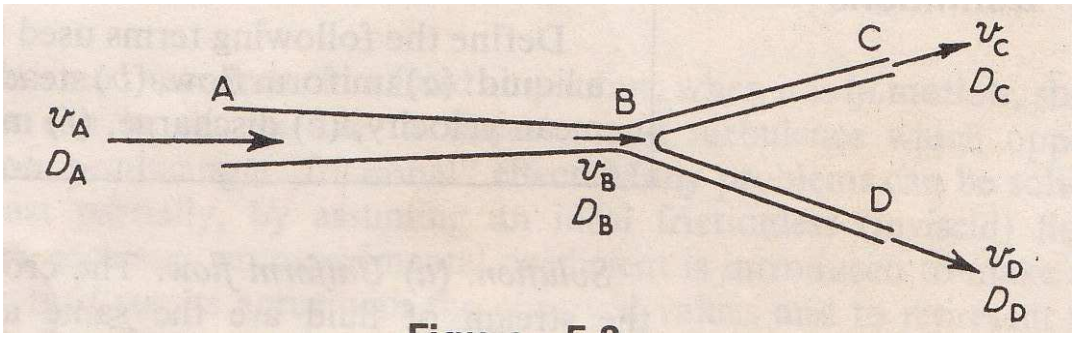
i. Lamina and turbulent flow

ii. Steady and Unsteady flow

iii. Uniform and Non-uniform flow

b) What is continuity of flow as applied to fluid mechanics? (2 marks)

c) Oil flows through a pipeline which contracts from 450 mm diameter at A to 300 mm diameter at B and then forks such that one branch is 150 mm diameter discharging at C and the other branch is 225 mm diameter discharging at D as shown in the figure below. If the velocity at A is 1.8 m/s and the velocity at D is 3.6 m/s, what will be the discharges at C and D, and the velocities at B and C? (12 marks)



QUESTION FOUR (20 MARKS)

a) State three forms of energy that a liquid in motion possesses. (3 marks)

b) State Bernoulli's equation defining each term. (3 marks)

c) From first principles derive the expression for the actual discharge of water flowing through a horizontal venturi-meter. (10 marks)

d) A venture meter has an area ratio of 9 to 1, the larger diameter being 30 cm. During flow, the recorded pressure head in the larger section is 6.5 m, and that at the throat is 4.25 m. If the meter coefficient, $C_d = 0.99$. Compute the discharge through the meter in m^3/s. (4 marks)

QUESTION FIVE (20 MARKS)

a) Define vortex flow as applied to rotational flow in liquids, and state types of vortex flow. (6 marks)

b) An open cylindrical tank 2 m high and 1 m in diameter is placed with its axis vertical, and is filled with water up to a height of 1.5 m. If the cylinder rotates about its geometric axis, find the constant angular velocity that can be attained without spilling any water. (4 marks)

c) The velocity of water at the outer edge of a whirlpool where the water level is horizontal and in the same plane as the bulk of the liquid is 2 m/s and the diameter 50 cm. Calculate the depth of the free water surface at a radius of 5 cm from the eye of the whirlpool. (10 marks)