MACHAKOS UNIVERSITY

University Examinations for 2022/2023

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 1

DATE: **TIME:**

INSTRUCTIONS: Attempt questions **ONE** and any other **TWO** questions

1. (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) A differential manometer is connected to two pipes. The pipe on the right-hand side contains water and the one on the Left-hand side contains oil of specific gravity 0.8. If the different in levels of the two pipes is 3.5m, find the pressure difference in mercury level if the pressure difference in the two pipes is 80kNm^{-2}. (15 marks)

2. (a) Define the following terms. (8 marks)

i. Pressure Intensity

ii. Total Pressure

iii. Centre of pressure (Ħ)

iv. Buoyancy

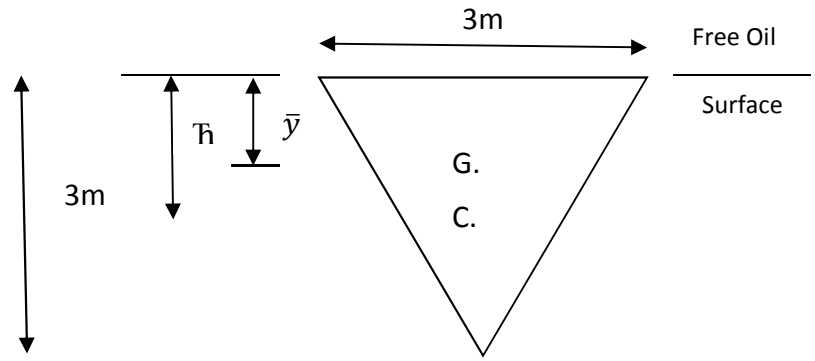
v. Buoyant force (or Upthrust)

vi. Centre of buoyancy

vii. Metacentre

viii. 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)



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

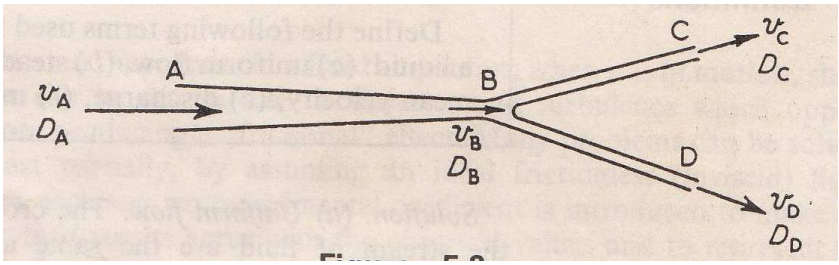
i. Lamina and turbulent flow

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)



4. (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)

5. (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)