



MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF BUILDING & CIVIL ENGINEERING
SECOND YEAR FIRST SEMESTER EXAMINATION FOR
BACHELOR OF SCIENCE (CIVIL ENGINEERING)
ECV 202: FLUID MECHANICS I

DATE: 14/12/2021

TIME: 8:30 – 10:30 AM

INSTRUCTIONS

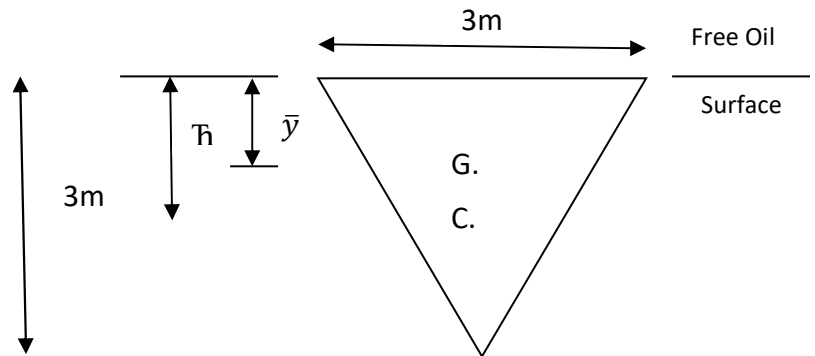
- This paper comprises of FIVE questions. Answer **THREE** questions
- Question one is **compulsory** and carry 30 marks
- Answer any other **TWO** questions

QUESTION ONE (30MKS)

- 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 if mercury level if the pressure difference in the two pipes is 80kNm^{-2} . (15 marks)

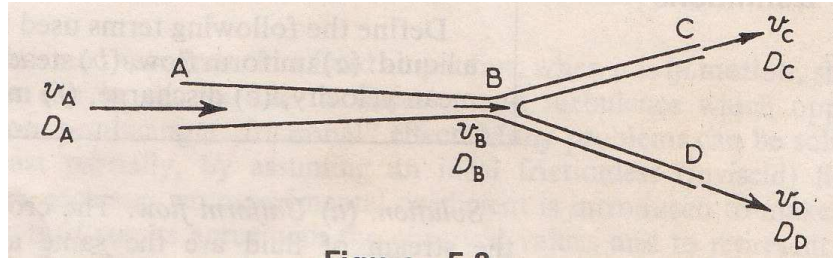
QUESTION TWO (20 MARKS)

- a) Define the following terms. (8 marks)
- i) Pressure Intensity
 - ii) Total Pressure
 - iii) Centre of pressure ($\bar{h}$)
 - 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 $\frac{bh^3}{36}$. (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)

- State three forms of energy that a liquid in motion possesses. (3 marks)
- State Bernoulli's equation defining each term. (3 marks)
- From first principles derive the expression for the actual discharge of water flowing through a horizontal venturi-meter. (10 marks)
- A venture meter has an area ratio of 9 to 1, the larger diameter being 30 cm. During flow, the discharge recorded pressure head in the larger section is 6.5 m, and that at the throat is 4.25 m. If the meter coefficient is $C_d = 0.99$. Compute the discharge through the meter in m^3/s . (4 marks)

QUESTION FIVE (20 MARKS)

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