MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

…….YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMM 204: FLUID MECHANICS 1

DATE: **TIME:**

INSTRUCTIONS:

Answer Question One and Any Other Two Questions

QUESTIONS ONE (30 MARKS)

a) Define a Fluid (2 marks)

b) Name the fundamental principles of mechanics that are applied to liquids and gasses (3 marks)

c) Describe at least four properties of fluids (8 marks)

d) Prove that the intensity of pressure at a point in a fluid at rest is the same in all directions (6 marks)

e) Define surface tension (2 marks)

f) Describe the difference between the following types of flows:

i. Laminar and Turbulent flow (2 marks)

ii. Steady and Non-steady flow (2 marks)

g) Calculate the Reynolds number for a fluid of density 900 kg/m^3 and dynamic viscosity $1x$ 10^{-3} kg/m.s flowing in a 4 mm diameter pipe at 3 m/s (3 marks)

h) Differentiate between absolute and gauge pressure (2 marks)

QUESTIONS TWO (20 MARKS)

a) A liquid flows in a horizontal pipeline and gradually converges from diameter of 200mm at a position A to a diameter of 150mm at position B. if the velocity is 2m/s and the pressure head at A is 15m, calculate the velocity and pressure head at B (8 marks)

b) Consider a plane surface, immersed in a liquid whose free surface is indicated as OO as shown in Figure Q2b. Derive formulae for determination of the intensity of pressure (Total pressure) and the position of centre of pressure for the figure (12 marks)

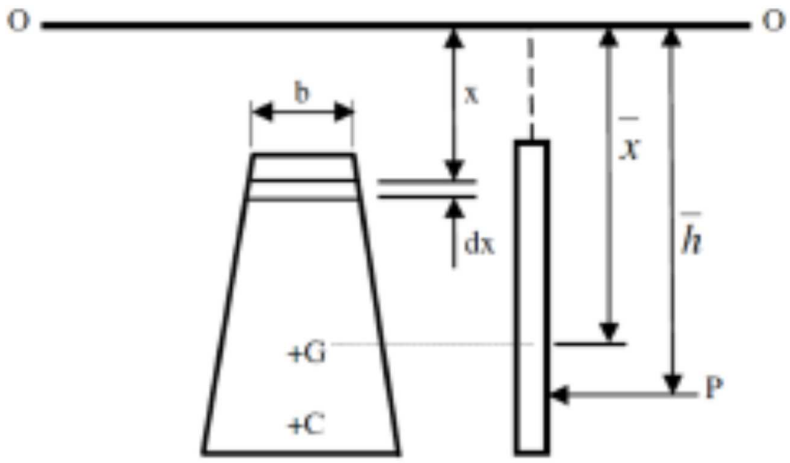

Figure Q2b

QUESTIONS THREE (20 MARKS)

a) Define the term Metacentre and show how the stability of a floating body depends upon the position of the Metacentre and the centre of gravity. (10 marks)

b) Figure 3Qb shows an inverted U-tube manometer connected to two pipes A and B which convey water. The fluid in the manometer is oil of specific gravity 0.8. Determine the pressure difference between pipes A and B. (5 marks)

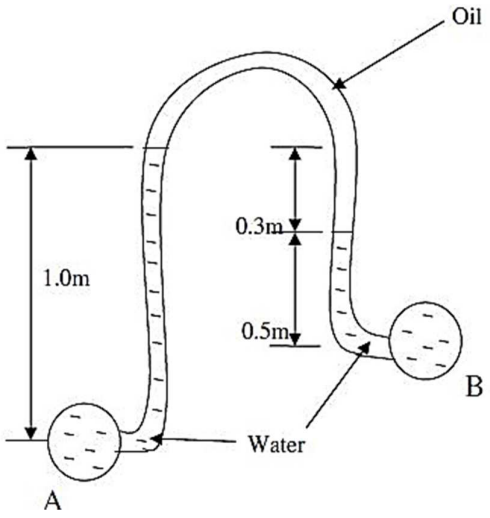

Figure Q3b

c) A stone weighs 400N in air and when immersed in water, it weighs 222N. Compute the volume of the stone and its specific gravity (5 marks)

QUESTIONS FOUR (20 MARKS)

a) A rectangular pontoon has a width of 6.0 m, a length of 12.0 m, and depth of 1.0 in fresh water of density 1000 kg/m3. Calculate:

i. Weight of the pontoon (4 marks)

ii. Its depth in sea water of density 1020 kg/m^3 (4 marks)

iii. The load that can be supported by the pontoon in fresh water if the maximum depth permissible is 1.5 m (5 marks)

b) Two plates are placed at a distance of 0.15mm apart. The lower plate is fixed while the upper plate having surface area 1.0m^2 is pulled at 0.3m/s. Find the force and power required to maintain this speed if the fluid separating them is of viscosity 0.15 NS/m^2 (7 marks)

QUESTION FIVE (20 MARKS)

a) i Derive an expression for the flow measurement in an open channel using rectangular notch and show that the total discharge, Q can be given by

$$Q = \frac{2}{3} C_d B \sqrt{2g} H^{\frac{3}{2}}$$

Where, C_d is the coefficient of discharge and g is the force of gravity. Consider Figure Q5a (8 marks)

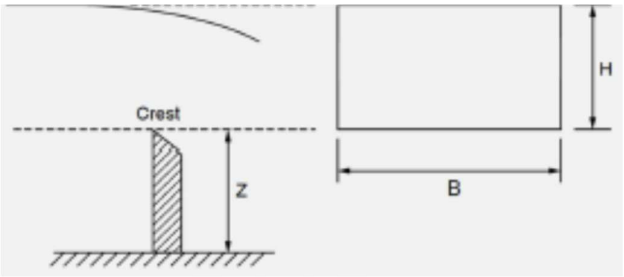

Figure Q5a

(ii) A rectangular notch is used to measure the flow rate of water in an open channel. The width of the rectangular notch is 3m and the head of water causing the flow is 0.5m. Calculate the discharge assuming the coefficient of discharge of the notch as 0.6 (3 marks)

(iii) What should be the width of a rectangular notch that should be used to measure the water flow rate of 0.5m3/s in an open channel. The head causing the flow should not exceed half the notch width. Assume the coefficient of discharge of the rectangular notch as 0.6 (4 marks)

b) A block of wood 4m long × 2m wide ×1m deep is floating horizontally in water. If the density of wood is 700 kg/m3, determine the volume of water displaced and the position of centre of buoyancy. (5 marks)