MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

SECOND YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMM 204: FLUID MECHANICS I

DATE: 26/7/2019 **TIME: 8.30-10.30 AM**

INSTRUCTIONS:

Answer Question One and Any Other Two Questions

QUESTION ONE (COMPULSORY QUESTION) [30 MARKS]

a) Define the following terms

i) Surface tension (2 marks)

ii) Fluidity (2 marks)

iii) Bulk modulus (2 marks)

iv) Absolute pressure (2 marks)

v) Metacenter (2 marks)

b) i) State Pascals law (2 marks)

ii) Describe the construction and mode of operation of a hydraulic jack (3 marks)

iii) A hydraulic jack is required to lift a load of 25kN. The jack has a ram of 200mm and a plunge of 20mm in diameter respectively. The plunger has a strike of 0.3m and makes 30 strikes per minute. calculate the power required at the plunger (5 marks)

c) A vessel filled with water and moving horizontally with a constant linear acceleration has its liquid surface inclined at 600 to the horizontal. Calculate its acceleration (4 marks)

d) With the aid of clearly labelled diagrams, explain the modes of operation of;

i) Manometers used for measuring fluid pressure (3 marks)

ii) Manometers used for measuring pressure difference between two fluid (3 marks)

QUESTION TWO [20 MARKS]

a) What do you understand by the term energy head?

b) Derive expression for energy heads for the three forms of energy a fluid flow has in terms of pressure, velocity, elevation and acceleration due to gravity g.

A horizontal pipe tapers gradually from 150mm to 300mm diameter in the direction of flow. At the narrow section pressure gauge reads 140kN/m^2. At the other section, the pressure is 260kN/m2. Neglecting the losses, calculate the flow rate of water in;

i) m3/sec

ii) Litres/sec

iii) Tonnes/hr

Assume mass density of water = 103kg/m3

QUESTION THREE [20 MARKS]

a) Using usual notations, explaining the meaning of all the symbols used, derive an expression for the discharge through ab inclined venture meter.

b) The measured discharge of water through a venture meter is 78mg/hr. the inlet pressure drops between the inlet and the outlet is 42kN/m^2 Calculate the discharge coefficient for the meter.

QUESTION FOUR [20 MARKS]

a) Define the following terms with respect to a small orifice;

i) Coefficient of contraction Cc (1 mark)

ii) Coefficient of velocity Cv (1 mark)

iii) Coefficient of discharge Cd (1 mark)

iv) Vena contracta (1 mark)

b) Show that Cd = Cv x Cc (2 marks)

c) Concisely describe experimental verification of orifice coefficients (5 marks)

d) A tank of oil discharges through an orifice of 10mm dimeter. The measured discharge was 13.6kg/min when the head of oil in the tank was 1.8m measured from the center line of the

orifice. The jet issued horizontally, falling a distance of 330mm in orifice of 1.5m. the relative density of oil was 0.7

Calculate the coefficient of;

i) Discharge (3 marks)

ii) Velocity (3 marks)

iii) Contraction (3 marks)

QUESTION FIVE [20 MARKS]

a) i) Using usual notations and explaining the meaning of all the symbols used, derive an expression for thermal discharge through a large orifice (3 marks)

ii) A rectangular opening 0.10m deep and 1.00m wide is fitted in the side of a large tank. If the depth of the flow in the tank is 0.3m and depth over the top edge of the orifice is 0.15m. Calculate the discharge assume Cd=0.63

b) i) show that the dischaerge over a v-notch Q with an inclined of θ and water head H is given by

$$Q = \frac{8}{15} C_d \sqrt{2g} tan\theta H^{\frac{5}{2}}$$

$$5mks$$

Where Cd=coefficient of discharge

iii) a V-notch is designed to discrge 0.41m3/sec over a head of 0.6m. calculate the value of inclined angle in degrees. Assume Cd for notch = 0.6 (6 marks)