TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

UNIVERSITY EXAMINATION FOR:

Institution Based

THE DEGREE IN BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING

TMC 4214 : FLUID MECHANICS I

END OF SEMESTER EXAMINATION

SERIES: APRIL 2017

TIME: 2 HOURS

DATE: Pick Date May 2016

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt any THREE questions.

Do not write on the question paper.

Question One

a) Define Newtonian and Non –Newtonian fluids (2 marks)

b) Explain the phenomenon of capillarity. (2 marks)

c) Derive the expression for capillary rise of a liquid. (5 marks)

d) Calculate the capillary effect in millimeters in a glass tube of 4 mm diameter, when immersed (i) water and (ii) mercury. The temperature of the liquids is 20^{o}C and the values of the surface tension of water and mercury at 20^{o}C in contact with air are 0.0733575N/m and 0.51 N/m

respectively. The angle of contact for water is zero that for mercury 1.30°.Take density of water at 20°C as equal to 998kg/m^3 (5 marks)

e) An isosceles triangular plate of base 3m and height 3m is immersed vertically in an oil of specific gravity 0.8.The base of the plate coincides with the free surface of oil. Calculate.

   i. Total pressure on the plate

   ii. Centre of pressure (6 marks)

Question Two

f) Define the following terms

   i. Orifice

   ii. Weir

   iii. Notch (6 marks)

g) Derive the expression for actual discharge over a triangular notch (9 marks)

h) A right angled V-notch is used for measuring a discharge of 30 litres /second. An error of 1.5 mm was made while measuring the head over the notch .Calculate the percentage error in the discharge. Take C_d=62 (5 marks)

Question Three

a. Define vena contracta (2 marks)

b. Explain how to determine the co-efficient of velocity (6 marks)

c. Show that

$$C_d = C_V X C_C$$ (3 marks)

d. Water discharged at the rate of 98.2 litres /seconds through a 120 mm diameter vertical sharp-edged orifice placed under a constant head of 10 metres.A point on the jet, measured from the vena-contracta of the jet has co-ordinates 4.5 metres horizontal and 0.54 metres vertical. Find

   i. Co-effientient of velocity

   ii. Co-efficient of contraction

iii. Co-efficient of discharge (9 marks)

Question Four

a. Describe a pitot tube (2 marks)

b. A pitot tube placed in the centre of a 300 mm pipe line has one orifice pointing upstream and other perpendicular to it. The mean velocity in the pipe is 0.8 of the central velocity. Find the discharge through the pipe if the pressure difference between the two orifices is 60 mm of water. Take the co-efficient of pitot tube as C_v =0.98. (5 marks)

c. Describe a venturimeter (4 marks)

d. In a vertical pipe conveying oil of specific gravity 0.8, two pressure gauge have been installed at A and B where the diameter are 16 cm and 8 cm respectively. A is 2 metres above B. The pressure gauge reading have shown that the pressure at B is greater than at A by 0.981 N/cm^2 .Neglecting all losses
   i. Calculate the rate flow.
   ii. If the gauges at A and B are replaced by tubes filled with the same liquid and connected to a U-tube containing mercury .Calculate the difference of level of mercury in the two limbs of the U-tube. (9 marks)

Question Five

a) Derive Bernoullis Equation and state the assumption made. (10 marks)

b) A pipe 200 m long slopes down at 1 in 100 and tapes from 600 mm diameter at the higher end to 300 mm diameter diameter at the lower end and carries 100 litres /sec 0f oil (specific gravity 0.8).If the pressure gauge at the higher reads $60kN/m^2$. Calculate:

   i. Velocities at the two ends
   ii. Pressure at the lower end (10 marks)