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# TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONICS

ENGINEERING

THE DEGREE IN BACHELOR OF TECHNOLOGY IN

ELECTRICAL ENGINEERING

**TMC 4252 : FLUID MECHANICS**

SPECIAL/SUPPLEMENTARY EXAMINATION

**SERIES: SEPTEMBER 2018**

**TIME: 2 HOURS**

**DATE:** Pick Date Sep 2018

**Instructions to Candidates**

You should have the following for this examination

*-Answer Booklet, examination pass and student ID*

This paper consists of Choose No questions. Attempt Choose instruction.

**Do not write on the question paper.**

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Q.1

a. Describe the following types of fluids:

- (i) Ideal fluid
- (ii) Real fluids
- (iii) Newtonian fluids
- (iv) Non-Newtonian fluids

(6 marks)

b. Explain the following terms

- i. Density
- ii. Specific Volume
- iii. Specific gravity
- iv. Adhesion
- v. Surface Tension

( 5marks)

c. A reservoir of glycerin has a mass of 1200kg and volume of  $0.952\text{m}^3$ . find the following:

- i. The glycerin's weight
- ii. The glycerin's density
- iii. The glycerin's specific weight
- iv. The glycerin's specific gravity

(6 marks)

d The volume of a rock is found to be  $.00015\text{m}^3$ .If the rock's specific gravity is 2.60.What is weight? (3marks)

Q.2

a. Derive the equation for the relationship between gauge pressure P inside a droplet of liquid and surface tension. (4marks)

b. The pressure outside the droplet of water of diameter 0.04mm is 10.32 N/cm<sup>2</sup>(atmospheric pressure).Calculate the pressure within the droplet if the surface tension is given as 0.0725N/m of water. (4 marks)

c. Explain the phenomenon of capillary (2 marks)

d. Find the minimum size of glass tube that can be used to measure water level if the capillary rise in the tube is to be restricted to 2mm.Consider the surface tension of water in contact with air as 0.07375N/m (4 marks)

e. A U-tube is made up of two capillaries of bores 1.2 m and 2.4 mm respectively.The tube is held vertical and partially filled with liquid of surface tension 0.06 N/m and zero contactangle. If the estimated difference in the level of two menisci is 15 mm, determine the mass density of the liquid. (6 marks)

Q.3

a. Benzene flows through a 100mm diameter pipe at a mean velocity of 3.00m/s. Find the following

- i. Volume flow rate in  $\text{m}^3/\text{s}$
- ii. Mass flow rate  
Use (density of Benzene  $879\text{kg}/\text{m}^3$ ) (4 marks)

- b. A pipe (1) 450 mm in diameter branches into two pipes (2 and 3) of diameters 300 mm and 200 mm respectively as shown in Fig. 1. If the average velocity in 450 mm diameter pipe is 3 m/s find:
- i. Discharge through 450 mm diameter pipe;
  - ii. Velocity in 200 mm diameter pipe if the average velocity in 300 mm pipe is 2.5 m/s. (5 marks)

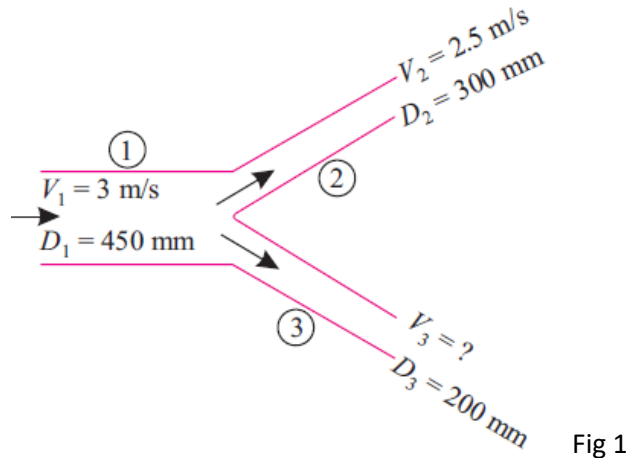


Fig 1

- c. List the assumptions which are made while deriving Bernoulli's equation (5 marks)
- d. A pipe 200 m long slopes down at 1 in 100 and tapers from 600 mm diameter at the higher end to 300 mm diameter at the lower end, and carries 100 litres/sec of oil (sp. gravity 0.8). If the pressure gauge at the higher end reads  $60 \text{ kN}/\text{m}^2$ , Calculate:
  - i. Velocities at the two ends;
  - ii. Pressure at the lower end. (6 marks)

Neglect all losses.

Q4

- a. Define the following terms
  - i. Total Pressure
  - ii. Centre of pressure (4 marks)

- b. A rectangular plane surface is 2 m wide and 3 m deep It lies in vertical plane in water. Determine the total pressure and the centre of pressure on the plane surface when its upper edge is horizontal and coincides with the water surface. (6 marks)

$$\text{Use } I_G = \frac{bd^3}{12}$$

- c. Define the following terms
- Buoyancy
  - Centre of buoyancy (4 marks)
- d. Find the volume of the water displaced and the position of centre of buoyancy for a wooden block of width 2.5 and of depth 1.5,when it floats horizontally in water. The wooden block 650kg/m<sup>3</sup> and its length 6 m. (6 marks)

### Question Five

- a) Explain the following non-uniform flow in open channels terms
- Rapidly varied flow
  - Gradually varied flow (4 marks)
- b) Find the velocity of flow and the rate of water through a rectangle channel. Of 6 m wide and 3 meter deep, when it is running full. The channel is having bed slope as 1in 2000.Take the chezy's constant C= 55. ( 6 marks)
- c) Describe the working of venturimeter with a neat sketch. ( 4 marks)
- d) A horizontal venturimeter with inlet diameter 200 mm and throat diameter 100 mm is used to measure the flow of water. The pressure at inlet is 0.18 N/mm<sup>2</sup> and the vacuum pressure at the throat is 280 mm of mercury. Find the rate of flow. The value of Cd may be taken as 0.98.

### Question Six

- a) Define the following co-efficients
- Co-efficient of velocity
  - Co-efficient of contraction
  - Co-efficient of discharge ( 6 marks)

b) 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

a. Co-efficient of velocity

b. Co-efficient of contraction

c. Co-efficient of discharge

(6 marks)

c) Describe the following devices used for measuring the rate of flow

i. Notch

ii. Weir

iii. Orifice

(3marks)

d) A rectangular notch has a discharge of 0.24 m<sup>3</sup>/s, when head of water is 800 mm.

Find the length of the notch. Assume  $C_d = 0.6$ .

(5 marks)