TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

UNIVERSITY EXAMINATION FOR:

THE DEGREE IN BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMG 2205 : FLUID MECHANICS I

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: AUGUST 2017

TIME: 2 HOURS

DATE: Pick Date Sep 2017

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 the following terms
   i. Specific weight
   ii. Density
   iii. Specific gravity
   iv. Specific volume (6 Marks)

b) State the Newton's law of viscosity (2marks)

c) Define the following types of thirds
   i. Newtonian
   ii. Non-Newtonian (3marks)

d) 2 litres of petrol weighs 13.72N. calculate
   i. Specific weight

ii. Density

iii. Specific volume

iv. Specific gravity with aspect to water (6marks)

e) Two horizontal flat plates are placed 0.15mm apart and the space between them is filled with an oil of viscosity 1poise. The upper plate of area $1.5m^2$ is required to move with a speed of 0.5m/relative to the other plate. Calculate the necessary force and power required to maintain this speed

(1 poise = 0.1 N_3/M^2) (3marks)

Question TWO

a) Explain the following terms

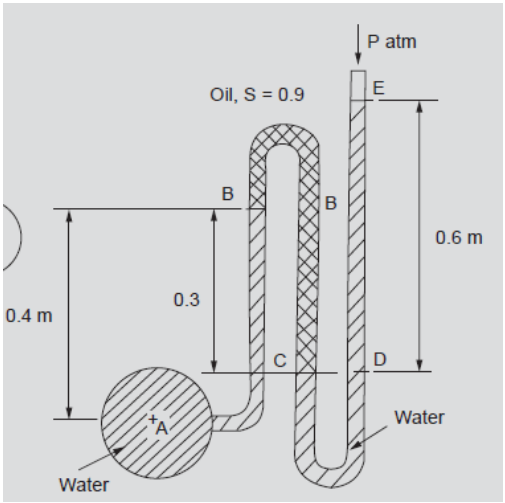
i. Absolute pressure

ii. Gauge pressure

iii. Vacuum pressure

(3marks)

b) A multiple U-tube manometer is fitted to a pipe with centre at A as shown in Fig 1.Determine the pressure at A.



(4 marks)

c) Explain the capillarity Phenomenon (2 marks)

d) Derive the expression for height of capillary rise (5marks)

e) Determine the capillary depression of mercury in a 2 mm ID glass tube. Assume $\sigma = 0.5$ N/m and $\beta = 130°$. Specific weight of mercury, $\gamma = 13600 \times 9.81$ N/m^3 (3marks)

Question THREE

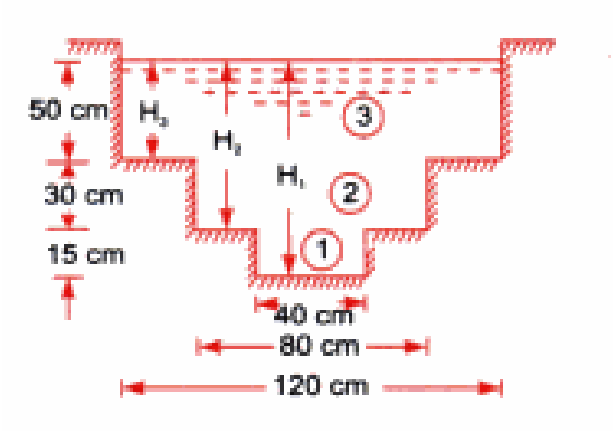
a) Describe the following devices used for measuring the rate of flow

i. Notch

ii. Weir

iii. Orifice (4marks)

b) Find the discharge over a stepped rectangular notch as shown below. Take co-efficient of discharge for all the portions as 0.62



(10marks)

c) Define the following terms

i. Total pressure

ii. Centre of pressure

(2marks)

d) An Isoscales triangular plate of base 3m and height 3m is immersed vertically in a specific gravity 0.8. The base of the plate coincides with the free surface of the Oil. Calculate

i. Total pressure on the plate

ii. Centre of pressure (4marks)

Question FOUR

a) Describe Ven-contracta (2marks)

b) Define the following co-efficients

i. Co-efficient of velocity

ii. Co-efficient of contraction

iii. Co-efficient of discharge (6marks)

c) A vertical sharp-edged orifice 120mm diameter is discharging water at the 98.2 litre/second under a constant head of 10 metres. A point of jet measured from Vena contracta of the jet has co-ordinates 4.5metres horizontal and 0.54 metres vertical. Find the following for the Orifice.

i. Co-efficient of velocity

ii. Coefficient of contractions

iii. Co-efficient of discharge (8marks)

d) Explain briefly how the coefficient of velocity of a jet issuing through an orifice can be determine experimentally (4marks)

e) Calculate the capillary effect in millimeters in a glass tube of 4mm diameter when inner side in

i. Water

ii. Mercury. The temperature of the liquid is 20^{o}c and the values of the surface tension of water and mercury at 20^{o}c in contact with air are 0.073575N/M and 0.51N/M respectively. The angle of contact for water is Zero and that for mercury 1.30^{o}. take density of water at 20^{o}c equal to $998Kg/M^3$ (4marks)

Question FIVE

a) (i) Describe a ventrimeter

(ii) Describe a pitot tube (4marks)

b) Show that the theoretical discharge of a venturimeter is given by

$$Q_{theoretical} = 2gh \frac{A_1 \ A_2}{\sqrt{A_1^2 - A_2^2}} \sqrt{\ }$$

Where A_1 and A_2 are cross-sectional at point 1 and point 2 (6marks)

c) A horizontal venturimeter with inlet diameter 200mm and throat diameter 100mm is used to measure the flow of water. The pressure at inlet is 0.18N/mm2 and the vacuum pressure at the throat is 280mm of mercury. Find the rate of flow. The value of d may be taken as 0.98. (6marks)

d) A pitot static tube is mounted on an aircraft travelling at a speed 300 kmph against a wind velocity of 20 kmph. If the specific weight of air is 12 N/m3 determine the pressure difference the instrument will register**.** (4 marks)