



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

END OF SEMESTER EXAMINATION

SERIES: APRIL 2016

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.

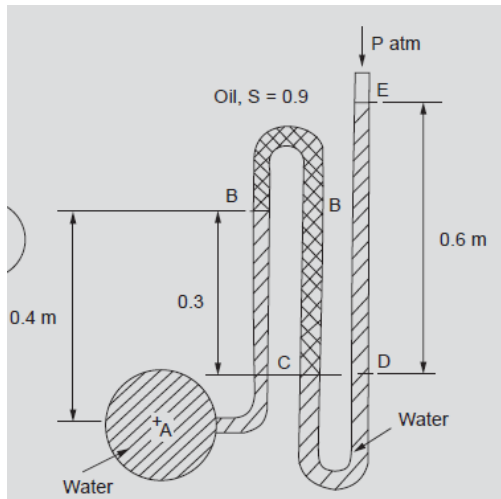
Question ONE

- a) Define 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 fluids
- 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 = $0.1 \text{ N}_3/\text{M}^2$) (3marks)

Question TWO

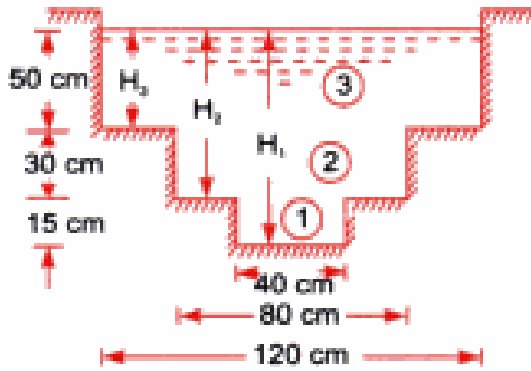
- a) Explain the following terms
- i. Absolute pressure
 - ii. Gauge pressure
 - iii. Vacuum pressure
- (3marks)
- b) A multiple U-tube manometer is fitted to a pipe with centre at A as shown in Fig 1. Determine the pressure at A.



- (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 $\sigma = 0.5 \text{ N/m}$ and $\beta = 130^\circ$.
Specific weight of mercury, $\gamma = 13600 \times 9.81 \text{ N/m}^3$ (3marks)

Question THREE

- a) Describe the following devices used for measuring the rate of flow
- Notch
 - Weir
 - 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
- Total pressure
 - 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
- Total pressure on the plate
 - Centre of pressure
- (4marks)

Question FOUR

- a) Describe Ven-contracta (2marks)
- b) Define the following co-efficients
- Co-efficient of velocity
 - Co-efficient of contraction
 - 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.
- Co-efficient of velocity
 - Coefficient of contractions
 - 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
- Water
 - Mercury. The temperature of the liquid is 20°C and the values of the surface tension of water and mercury at 20°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°. take density of water at 20°C equal to 998Kg/M³ (4marks)

Question FIVE

- a) (i) Describe a venturimeter
(ii) Describe a pitot tube (4marks)
- b) Show that the theoretical discharge of a venturimeter is given by

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

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)