MUEO

MOI UNIVERSITY

OFFICE OF THE DEPUTY VICE CHANCELLOR
(ACADEMICS, RESEARCH & EXTENSION)

UNIVERSITY EXAMINATIONS
2017/2018 ACADEMIC YEAR

THIRD YEAR FIRST SEMESTER EXAMINATION

FOR THE DEGREE OF

BACHELOR OF ENGINEERING
IN
INDUSTRIAL & TEXTILE ENGINEERING

COURSE CODE: MIT 311

COURSE TITLE: FUNDAMENTALS OF FLUID MECHANICS

DATE: 26TH FEBRUARY, 2018 **TIME:** 9.00 A.M. – 12.00 NOON.

INSTRUCTIONS TO CANDIDATES

- SEE INSIDE.

THIS PAPER CONSISTS OF (5) PRINTED PAGES

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MIT 331: FUNDAMENTALS OF FLUID MECHANICS *2017/2018*

Instructions:

1. This paper contains seven questions, all carrying equal marks.
2. Attempt any five questions.
3. Do not write anything on the question paper.
4. Unauthorized electronic gadgets e.g. mobile phones are not allowed in the exam room.
5. Examination duration is 3 hours.

Question 1

(a) With the aid of an illustration, describe the meaning of a fluid explaining how deformation plays an important distinguishing role between fluids from other forms of matter. *4 marks*

(b) "Although there can be no shear stresses in a fluid at rest, shear stresses are developed when the fluid is in motion"

(i) Explain why this is so. *3 marks*

(ii) Describe how the concept in (b) above relates to the Newtonian law of viscosity. *3 marks*

(c) For a soap, or hollow bubble:

(i) Derive the relationship between the surface tension σ, pressure intensity p, and bubble diameter d. *2 marks*

(ii) Calculate the surface tension in a soap bubble film, which has a diameter of 75mm and an internal pressure exceeding the outside pressure by 15 N/m^2. *2 marks*

Question 2

(a) Describe the meaning of 'statics of fluid systems' outlining the possible conditions of equilibrium expected for such static fluid systems. *5 marks*

(b) Derive the concept of Pascal's law as it applies to a fluid prism which has a constant cross-section A, and varying pressure P due to gravity, which acts from point to point of the static fluid. *4 marks*

(c) Fig. Q 2 (c) shows an inverted differential manometer having an oil of specific gravity 0.8 connected to two different pipes carrying water under pressure. The pressure in pipe A is 2.0 metre of water. Determine the pressure in the pipe B. *5 marks*

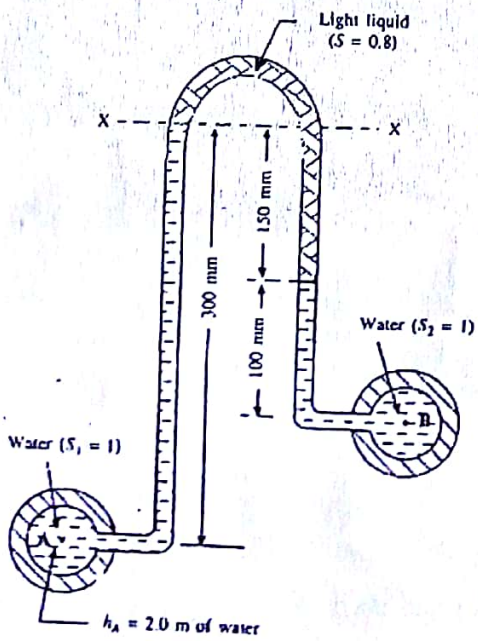

Fig. Q 2 (c)

Question 3

(a) Explain the concept of 'total pressure' and 'centre of pressure' considering how fluid pressure acts on a surface. *2 mark*

(b) For an inclined immersed surface, derive the equation for:
(i) Total pressure. *3 marks*
(ii) Centre of pressure. *4 marks*

(c) An inclined rectangular sluice gate AB 1.4 metre by 5.2 metre size as shown in Fig. Q 3 (c) is installed to control discharge of water in a dam. The end A is hinged. Determine the force normal to the gate applied at point B to open the gate. *5 marks*

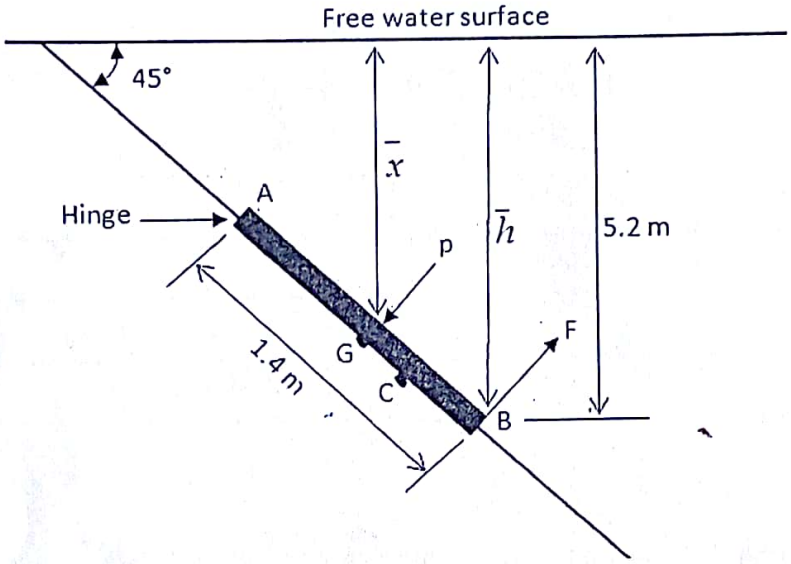

Fig. Q 3 (c)

Question 4

(a) With reference to motion of fluid particles and streams:
(i) Explain why analyzing mathematically the motion of a fluid particle is usually extremely complex. *2 marks*
(ii) Distinguish between uniform flow and steady flow. *2 marks*
(iii) Distinguish between laminar flow and turbulent flow. *2 marks*

(b) Derive the equation for continuity of flow. *3 marks*

(c) Water flows from point A to points D and E as shown in Fig. Q 4 (c). Some of the flow parameters are known and shown in Table Q 4 (c). Calculate the values of discharge and unknown velocities throughout the pipe section. *5 marks*

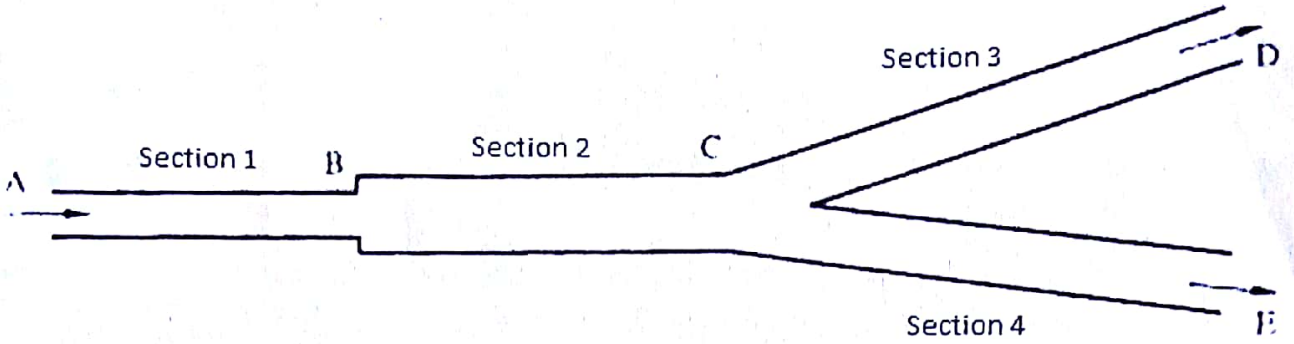

Fig. Q 4 (c)

Table Q 4 (c)

Section	Diameter (mm)	Flow Rate (m^3/s)	Velocity (m/s)
AB	300	?	?
BC	600	?	1.2
CD	?	$Q_3 = 2Q_4$	1.4
CE	150	$Q_4 = 0.5Q_3$	?

Question 5

(a) Derive the Bernoulli's equation outlining any two assumptions which need to be considered in the derivation process. *7 marks*

(b) Outline any two practical applications of the Bernoulli's equation. *2 marks*

(c) A pipe 200 metre 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 (of specific gravity 0.8). If the pressure gauge at the higher end reads 60 KN/m^2, determine the following:

(i) Velocities at the two ends of the pipe; *2 marks*

(ii) Pressure at the lower end. *3 marks*

For all the above, neglect all losses

Question 6

(a) Describe the function of the venturimeter outlining any two types. *2 marks*

(b) For a horizontal venturimeter, describe the relationship between the rate of flow Q_{act}, coefficient of discharge C_d, area at inlet A_1, area at the throat A_2, gravity g, and pressure head h. *7 marks*

(c) A horizontal venturimeter with inlet diameter and throat diameters 350 mm and 150 mm respectively is used to measure the flow of water. The pressure intensity at inlet is 200 KN/m^2 while the vacuum pressure head at the throat is 350 mm of mercury. Find the rate of flow. Take C_d 0.98. *5 marks*

Question 7

(a) With reference to the steady flow energy equation:

(i) State the principle of conservation of energy. *1 mark*

(ii) Describe the three different forms of energy for a mass of fluid. *3 marks*

(b) Discuss using the illustration of energy addition or extraction for rotodynamic machines, why the steady flow energy equation is a powerful tool for defining a wide range of flow conditions. *6 marks*

(c) Describe how the pitot tube measures the velocity of flow of a stream. *4 marks*