53 (FPT 303) FLMC

2018

FLUID MECHANICS

Paper : FPT 303

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. *(a)* What is the difference between an ideal and a real fluid ? 2

   (b) Name some important properties of liquids. 2

   (c) How does a fluid differ from a solid ? 3

   (d) Distinguish between surface tension and capillarity. 3

   (e) Derive the equation for pressure inside the water droplet and soap bubble in terms of surface tension (σ). 3+3

(f) Fill in the blanks : 1×4=4

(i) An ideal fluid has ——— viscosity.

(ii) Specific weight is ——— times density in S.I. units.

(iii) Viscosity of liquid ——— with increase of temperature.

(iv) Viscosity of mercury is ——— than that of water.

2. (a) Prove that intensity of pressure at any point in a liquid is directly proportional to the depth of the point from the free surface of liquid. 4

(b) Explain briefly the following : **(any two)** 2×4=8

(i) Piezometer

(ii) U-tube Manometer

(iii) Bourdon tube pressure gauge.

(c) If a mercury barometer reads 700*mm* and a Bourdon gauge at a point in a flow system reads $500 kN/m^2$, what is the absolute pressure at the point? 5

(d) Find the depth of a point below water surface in sea where the pressure intensity is $100.55 kN/m^2$. Specific gravity of sea water is 1.025. 3

3. (a) How are fluid flows classified? 5

(b) Derive the continuity equation in Cartesian co-ordinates. 8

(c) State and prove the Pascal's law. 7

4. (a) A pipe *AB* branches into two pipes from *B*, one pipe (*C*) has a diameter of 150*mm* and the other pipe (*D*) has a diameter of 200*mm*. The diameter at (*A*) is 450*mm* and at (*B*) is 300*mm*. The velocity of water at (*A*) is $2 m/s$. If the velocity in pipe (*D*) be $4 m/s$, determine (*i*) discharge through the pipe *AB* (*ii*) velocity at *B* and (*iii*) velocity at *C*. 7

(b) Given the velocity field : 8

$$V = (6 + 2xy + t^2)i - (xy^2 + 10t)j + 25k$$

What is the velocity and acceleration of a particle at (3,0,2) at time $t = 1$?

(c) Determine the missing component of velocity distribution such that they satisfy continuity equation. 5

$$u = 2x^2 + y^2 z^3$$

$$v = -(xy + yz + zx)$$

$$w = ?$$

5. *(a)* Explain the different types of heads (or energies) of a liquid in motion. 5

(b) Derive Euler's equation of motion. 8

(c) The water is flowing through a tapering pipe having diameters 300*mm* and 150*mm* at section (1) and (2) respectively. The discharge through the pipe is 40 *lt/s*. The section (1) is 10 *m* above datum and section (2) is 6 *m* above datum. Find the intensity of pressure at section (2) if that at section (1) is 400 kN/m^2. 7

6. *(a)* In a circular pipe of diameter 100 *mm*, a fluid of viscosity 7 poise and specific gravity 1.3 is flowing. If the maximum shear stress at the wall of the pipe is 196.2 N/m^2, find :

(i) The pressure gradient

(ii) The average velocity, and

(iii) Reynolds number of flow. 7

(b) An oil of viscosity 0.2 poise and specific gravity 0.8 is flowing through 50 *mm* diameter pipe of length 500 *m* at the rate of 0.19 *lit/sec*. Determine : 8

(i) Reynolds number of flow

(ii) Centre-line velocity

(iii) Pressure gradient

(iv) Wall shear stress.

(c) What are the characteristics of a Laminar flow ? 5

7. *(a)* At a sudden enlargement of a water main from 240 *mm* to 480 *mm* diameter, the hydraulic gradient rises by 10 *mm*. Calculate the rate of flow. 7

(b) A horizontal pipe of 100 *mm* diameter is joined by sudden enlargement to a 150 *mm* diameter pipe. Water is flowing through it at the rate of 2 m^3/mm. Find :

(i) Loss of head due to abrupt expansion

(ii) Pressure difference in two pipes and

(iii) Change in pressure if the change of section is gradual, without any loss. 8

(c) Name the major and minor losses of head during flow of a liquid through a pipeline. 5
