53 (FPT 303) FLMC

2016

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) Fill in the blanks :   1×5=5

    (i)   Viscosity of liquid ———— with the increase of temperature.

    (ii) Capillarity is due to combined effect of ———— and ————.

    (iii) A venturimeter is used to measure ————.

(iv) Surface tension is expressed in terms of ———— per ————.

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

(b) Distinguish between density and specific weight of a substance.   3

(c) What do you mean by absolute, gauge and vacuum pressure ?   6

(d) Explain briefly the following :   2×3=6

   (i) Surface tension

   (ii) Compressibility

   (iii) Capillarity

2. *(a)* What do you mean by :   2×3=6

   (i) streamline flow and turbulent flow

   (ii) steady flow and unsteady flow ?

(b) State and prove Pascal's law of pressure intensity.   7

(c) Define the terms 'hydrokinematics' and 'hydrokinetics'. 4

(d) Classify the types of heads (or energies) of a liquid in motion. 3

3. *(a)* Two plates are $0{\cdot}1\,cm$ apart. The bottom plate is fixed and the top plate is pulled at a velocity of 50 *cm/s* with a force of $4N$ per *sq.m* area. If there is some fluid in between these two plates, determine the viscosity of the fluid. 5

(b) For a fluid, viscosity is $0{\cdot}05$ poise and its kinematic viscosity is $0{\cdot}035$ stokes. Determine the specific gravity of the fluid. 5

(c) A rectangular plate $2m \times 1{\cdot}5m$ slides down an inclined plane of inclination $60°$ under the action of its own weight which is $500N$, the velocity of sliding being $0{\cdot}5\,m/s$. An oil of thickness $1{\cdot}5mm$ is maintained between the inclined plane and the sliding plate. Determine the dynamic viscosity of the oil. 6

Contd.

(d) Determine the bulk modulus of elasticity of a liquid, if the pressure of the liquid is increased from $7 MN/m^2$ to $13 MN/m^2$. The volume of liquid decreases by 0·15%. 4

4. (a) Velocity for a two dimensional flow field is given by —

$$V = \left(3 + 2xy + 4t^2\right)i + \left(xy^2 + 3t\right)j$$

Find the velocity and acceleration at a point (1,2) after 2 sec. 7

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

(i) discharge through the pipe AB

(ii) velocity at B and

(iii) velocity at C. 7

(c) Determine the mass density, specific volume and specific weight of a liquid whose specific gravity is 0·65. 6

5. (a) A horizontal conical water pipe has a diameter $1.2m$ at the larger end and $0.6m$ diameter at the smaller end. The pressure head at the larger end is $15m$ of water and at the smaller end $12m$ of water. Find the discharge through the pipe in m^3/s and in lpm. 7

(b) A liquid with a specific gravity 2·8 and a viscosity 0·8 poise flows through a smooth pipe of unknown diameter, resulting in a pressure drop of $800\,N/m^2$ in $2km$ length of the pipe. What is the pipe diameter if the mass flow rate is 2500 kg/h ? 6

(c) In a circular pipe of diameter $100mm$ 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 $196.2N/m^2$, find : 7

(i) The pressure gradient,

(ii) The average velocity, and

(iii) Reynolds number of flow.

6. *(a)* A horizontal pipe of $100mm$ diameter is joined by sudden enlargement to a $150mm$ diameter pipe. Water is flowing through it at the rate of $2m^3/min$. 7

Find :

(i) Loss of head due to abrupt expansion.

(ii) Pressure difference in two pipes.

(b) Water flows through a pipeline $20cm$ in diameter and $400m$ long, the mean velocity of flow is $3m/s$.

Determine the head loss in friction

(i) Using Darcy's formula and

(ii) Using Chezy's formula

Assume, $f = 0.01416$. 7

(c) A pipe $100mm$ diameter transmits oil with a velocity of $4m/s$. Determine the loss of head at inlet and exit of the pipe. Assuming length of the pipe as $200m$, determine the total loss of head. Take $f = 0.001$. 6

7. Write short notes on : *(any five)*   4×5=20

(i)   Fluid Mechanics

(ii) Manometers

(iii) Venturimeter

(iv) Laminar and turbulent flow

(v)   Major and minor energy losses

(vi) Characteristics of boundary layer theory.

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