53 (FPT 303) FLMC

2019

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)* Define a fluid and distinguish between
   (i) ideal and real fluids
   (ii) compressible and incompressible fluids. 4

   (b) Define compressibility. How is it related to bulk modulus of elasticity? 2+1

   (c) What do you mean by viscosity of a fluid, how does it manifest and in what units is it measured? 5

(d) State and explain the Newton's law of viscosity. 3

(e) Define : mass density, specific weight, specific volume and specific gravity. 5

2. (a) $3{\cdot}2m^3$ of a certain oil weighs $27{\cdot}5kN$. Calculate the specific weight, mass density, specific volume and specific gravity with respect to water. If kinematic viscosity of the oil is 7×10^{-3} stokes, what would be its dynamic viscosity in centipoise? 7

(b) Find the kinematic viscosity in stokes of a liquid whose specific gravity is 0·95 and viscosity is 0·011 poise. 4

(c) Derive an expression of pressure inside a water droplet, soap bubble and a liquid jet. 9

3. (a) State and prove 'Pascal's law'. 8

(b) What are Manometers? 2

(c) The diameters of ram and plunger of a hydraulic press are 200*mm* and 30*mm* respectively. Find the weight lifted by the hydraulic press when the force applied at the plunger is 400*N*. 5

(d) What is meant by intensity of pressure? How it varies with the depth of fluid? 2+1

(e) What is Pressure head? How pressure can be expressed in terms of height of a liquid column? 1+1

4. (a) Derive the general three-dimensional equation of continuity and deduce from it the continuity equation for one-dimensional flow. 10

(b) Water flows through a 10*cm* diameter pipe with velocity $8m/s$. Compute the discharge rate. If the same flow now takes place through a 20*cm* diameter pipe, evaluate the new flow velocity. 5

(c) Define and explain briefly the following : 2·5×2=5

(i) Velocity potential

(ii) Stream function.

5. (a) Given the velocity field :

$$V = \left(x^2y\right)i + \left(y^2z\right)j - \left(2xyz + yz^2\right)k$$

Calculate the velocity at the point (2, 1, 3). 7

(b) State Bernoulli's theorem and mention some of its engineering applications. 3

(c) Derive Euler's equation of motion along a streamline, and hence derive the Bernoulli's theorem. 10

6. (a) A pipe 200*m* long slopes down at 1 in 100 and tapers from 800*mm* diameter at the higher end to 400*mm* diameter at the lower end, and carries 100 litre/*s* of oil (specific gravity 0·85). If the pressure gauge at the higher end reads $50kN/m^2$, determine :

(i) Velocities at the two ends and

(ii) Pressure at the higher end. 10

(b) In a pipe of 200*mm* diameter the maximum velocity of flow is found to be 1·5*m*/*s*. If the flow in the pipe is laminar, find :

(i) The average velocity and the radius at which it occurs, and

(ii) The velocity of 40*mm* from the wall of the pipe. 10