24172

B. Tech. 4th Semester (Mechanical Engg.) Examination,

May–2013

FLUID MECHANICS

Paper–ME-208–F

Time allowed : 3 hours] *[Maximum marks : 100*

Note : *All questions have equal marks.* **First *question is compulsory.* *Attempt at least one question from each section.***

1. (a) (i) State Pascal's law.

(ii) Define Weber number.

(iii) What do you mean by Dynamic Viscosity ?

(iv) Define surface tension.

(v) What is Capillarity ? 2×5

(b) Give reasons for the following :

(i) Viscosity changes with temperature rise.

(ii) Mercury (H_g) is preffered as a mano metric liquid.

(iii) Free surface of water in a capillary tube is concave.

(iv) Light weight object can float on the free surface of liquids.

(v) Meta centric height is positive for stable equilibrium of floating bodies. 2×5

Section–A

2. (a) Define compressibility. Derive an expression for the bulk modulus of elasticity for perfect gas undergoing the isothermal process. 8

(b) If the equation of velocity profile over a flat plate is $V = 2y^{2/3}$ where 'V' is the velocity in m/s and 'y' is the distance in m, determine shear stress at y = 75 mm. Take μ=8.35 poise. 12

3. (a) Sketch the streamlines representation by $\psi = x^2 + y^2$. Also find out the velocity and its direction at the point (1, 2). 12

(b) Differentiate between the Lagrangian approach and Eulerian approach. 8

Section–B

4. (a) Explain velocity of flow at any point in a pipe or a channel can be measured, with a Pitot tube. 10

(b) At a sudden enlargement of a water line from 240 mm to 480 mm diameter pipe, the hydraulic gradient rises by 10 mm. Estimate the rate of flow. 10

5. (a) A supersonic plane files at 2000 km/hr at an altitude of 9 Km above sea level in standard atmosphere. If the pressure and density of air at this altitude are stated to be 30 KN/m^2 absolute

and 0.45 kg/m^3, make calculations for the pressure, temperature and density at the stagnation point on the nose of the plane. Take R = 287 J/kg k and γ = 1.4. 10

(b) State the characteristic of

(i) an isogeothermal and adiabatic process

(ii) constant volume and constant pressure. 10

Section–C

6. The pressure difference Δ p for a viscous flow in a pipe depends upon the diameter of the pipe 'D', length of pipe 'L', velocity of flow 'V', viscosity of fluid μ and the density of fluid 'ρ'. Using Buckingham's theorem, show that the relation for pressure difference Δ p is given by

$$\Delta p = \rho V^2 f\left(\frac{1}{R_e}, \frac{L}{D}\right)$$ 20

7. (a) What are the energy losses that occur in pipes ? Derive an expression for loss of head due to friction in pipes. 10

(b) A pipeline 50 m long, connects two reservoirs, having water level difference of 10 m. Diameter of the pipe is 300 mm. Find rate of water flow, considering all the losses. Coefficient of friction for pipe material is 0.01. 10

Section–D

8. (a) How are the drag and lift forces caused on a body immersed in a moving fluid. 10

(b) A cylindrical tower has a diameter of 2.5 m and 50 m high. Estimate the drag force on the tower and the bending moment at its bottom when a wind at 80 km/hr blow across it. Take $C_d = 0.33$ and assume $\rho = 1.3$ kg/m^3 for air. 10

9. (a) How would you distinguish between hydraulically smooth and rough boundaries ? Calculate the average velocity distribution for smooth pipe. 12

(b) For turbulent flow in pipes, compute the distance from the pipe wall at which the velocity is equal to the average velocity to flow. 8