24172

B. Tech (ME) 4th Semester F. Scheme

Examination, May–2015

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) Define Reynolds number.

(ii) What do you mean by unstable floating body ?

(iii) State Pascal's law.

(iv) Define bouncy force.

(v) Define ideal fluid. 2×5

(b) Define the following term and mention their SI units :

(i) Specific weight

(ii) Dynamic viscosity

(iii) Kinematic viscosity

(iv) Surface tension

(v) Capillarity. 2×5

Section–A

2. (a) Differentiate between gauge pressure and absolute pressure. Represent positive and negative gauge pressure on a chart. 8

   (b) Calculate the capillary effect in mm in a glass tube of 3 mm diameter, when, immersed in mercury. The value of the surface tension for mercury at 20° C in contact with air is 0.51 N/m. Contact angle for mercury = 130°. 12

3. (a) Show that the streamline and equipotential lines are orthogonal to each other. 8

   (b) Derive with usual notations, the continuity equation for 3 D flow in the form

$$\frac{\partial \rho}{\partial t}+\frac{\partial(\rho u)}{\partial x}+\frac{\partial(\rho v)}{\partial y}+\frac{\partial(\rho w)}{\partial z}=0$$

   modifies the equation for steady flow and incompressible flow. 12

Section–B

4. (a) An orifice meter with orifice diameter 10 cm is inserted in a pipe of 20 cm diameter. The pressure gauges fitted upstream and downstream of the orifice meter give readings of 19.62 N/cm^2 and 9.81 N/cm^2 respectively. C_d for the meter is 0.6. Find the discharge of water through the pipe. 10

(b) With the neat sketch, explain how a Pitot tube is used to find the velocity in an open channel. 10

5. (a) Differentiate between the compressible and incompressible flow. Mention some of the flow situations where compressibility of the fluid has to be considered. 10

(b) A certain air craft flies at the same Mach number regardless of its altitude and at 10 Km altitude, its speed is ascertained to be 80 km/hr less than that at sea level. Calculate the mach number at which the aircraft flies. For standard atmosphere, the temperature values at sea level and at 10 km above sea level are 15°C and –50°C respectively. 10

Section–C

6. The resistance R due to wind on a tall vertical chimney is dependent upon the density ρ, wavelength λ, and surface tension σ of air, the wind velocity V, the diameter D and height H of the chimney. By means of Pi-theorem, develop an expression for the resistance of the chimney in terms of these parameters. 20

7. (a) What is Hagen-Poiseuilli law, explain ? 10

(b) A pipe of dia 30 cm and length 1000 m connects two reservoirs having difference of water levels as 15 m. Determine discharge through the pipe.

If an additional pipe of diameter 30 cm and length 600 m is attached to the last 600 m length, find the increase in discharge. Take f = 0.02 and neglect minor losses. 10

Section–D

8. (a) Derive an expression for lift for uniform flow around a circular cylinder with clockwise direction. 12

(b) An aircraft weighing 800 KN when empty has a wing area of 225 m^2. It is to take off at a velocity of 250 Km/hr and a 20° angle of attack. Calculate the allowable weight of cargo. The wing have the characteristics of the airfoil ; it has a coefficient of lift C_L = 1.4 and 20° angle of attack. Assume $\rho_{air} = 1.2\ Kg/m^3$. 8

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

(b) A pipeline carrying water has height of irregularities projecting from the surface of the boundary of the pipe as 0.155 mm. If the shear stress developed is 4.9 N/m^2, indicate the type of the boundary : smooth or rough. Take kinematic viscosity of water as 0.01 stokes. 8