TE - sem V - Mechanical - Old

FM

25/5/15

QP Code : 3719

(3 Hours) [Total Marks : 100

- **Question No 1 is compulsory.**
- **Answer any four out of remaining six questions..**
- **Assumptions made should be clearly stated .**
- **Assume suitable data wherever required, but justify the same.**

Q-1 Answer the following questions. 20

a Define surface tension. Derive an expression for excess pressure inside a spherical liquid droplet.

b An oil having a viscosity of 0.048 Kg/m.s flows through a 50 mm diameter tube at an average velocity of 0.16 m/s. Calculate the pressure drop in 100 m length of the tube and the velocity 10 mm from the wall.

c Write a note on methods to prevent separation of boundary layer

d Write a note on Couette flow and its applications.

2 a A cylindrical buoy ,diameter 1.4 m and 1.1 m high weighing 4.25 kN is floating in sea water with its axis vertical. Find the maximum permissible height above the top of the buoy of the centre of gravity of a 500 N load which is placed centrally on top of the buoy. Take specific gravity of sea water as 1.025. 12

b The velocity components in a two dimensional flow field for an incompressible fluid are expressed as $u = \frac{y^3}{3} + 2x - x^2y$ 8

$$v = xy^2 - xy - \frac{x^3}{3}$$

(i) Show that these functions represent a possible case of an irrotational flow

(ii) Obtain a expression for Stream Function ψ.

3 a A cubical box , 2 m on each edge has its base horizontal and is half filled with a 12

liquid of specific gravity 1.5 . The remainder of the box is filled with an oil of specific gravity 0.80. One of the sides is held in position by means of four screws one at each corner. Find the tension in each screw due to hydrostatic pressure.

b A vertical Venturimeter of d/D ratio equal to 0.5 is fitted in a 10 cm diameter pipe. The throat is 20 cm above the inlet. The meter has a coefficient of discharge of 0.97. A liquid of S.G. 0.8 flows through the meter at the rate of 50 lps. 8

Determine :

(i) Pressure difference as recorded by two gauges fitted at inlet and throat.

(ii) Difference on a vertical differential mercury manometer.

4 a Assuming that the velocity distribution in the boundary layer is given by $u/U = (y/\delta)^{1/7}$ calculate displacement, momentum and energy thickness. If at a certain section ,free stream velocity U was observed to be 22 m/s and the thickness of the boundary layer as 25 mm ,then determine the energy loss per unit length due to the formation of the boundary layer. Take $\rho = 1.226$ kg/m^3. 12

b Derive expressions for Total Pressure and Centre of pressure for a fully submerged inclined lamina with usual notations 8

5 a A pipe bend is initially horizontal with an inlet diameter of 500mm and pressure of 40 kN/m^2. It tapers downwards at an angle of 45 degrees to a diameter of 250 mm and an outlet pressure of 25 kN/m^2. The pipe conveys oil which has a density of 850 kg/m^3.Calculate the magnitude and direction of the resultant force on the bend if oil is flowing at a rate of 0.45 m^3/s. The bend is in a horizontal plane. 10

b A pipe of diameter 0.4 m and of length 2000 m is connected to a reservoir at one end. The other end of the pipe is connected to a junction from which two pipes of lengths 1000m and diameter 30 cm run in parallel. These parallel pipes are 10

connected to another reservoir which is having a level of water 10 m below the water level of the above reservoir. Determine the total discharge if coefficient of friction f = 0.015. Neglect minor losses.

6 a An oil of viscocity 15 poise flows between two parallel fixed plates which are kept at a distance of 5cm apart. Find the rate of flow of oil between the plates if the drop of pressure in a length of 120 cm be 0.3 N/cm. The width of plates is 20 cm. 10

b The velocity distribution for a turbulent flow in a pipe is given approximately by Prandtl's one-seventh power law: 10

$u = U_m(y/r_o)^{1/9}$ where u is the local velocity of flow at a distance y from the pipe wall U_m is the maximum velocity at the centre line of the pipe and r_o is the pipe radius. Determine the average velocity of flow and Kinetic Energy Correction factor.

7 a With reference to CFD write notes on the following : 12

i) Structured and Unstructured Grids

ii) Implicit and Explicit Methods

iii) Grid Independence

iv)Under relaxation and Over relaxation

b Derive Euler's equations of motion for a three dimensional flow. State clearly the relevant assumptions. 8