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A – 6565

Reg. No. : .....

Name : .....

Third Semester B.Tech. Degree Examination, October 2016
(2013 Scheme)
13.303 : FLUID MECHANICS (MS)

Time : 3 Hours

Max. Marks : 100

PART – A

Answer **all** questions. **Each** question carries **2** marks.

1. Define Vorticity.
2. Define Viscosity.
3. Differentiate uniform and non-uniform flow.
4. Define stream function.
5. Write the expression rate of flow through venturimeter.
6. What is Hagen Poisuille's formula ?
7. Define momentum correction factor.
8. Define momentum thickness.
9. Define displacement thickness.
10. Define Reynolds number.

PART – B

Answer **any one full** question from **each** Module. **Each** full question carries **20** marks.

Module – I

11. a) Derive expression for capillary rise and fall. **5**

P.T.O.

b) The dynamic viscosity of oil, used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4 m and rotates at 190 rpm. Calculate the power lost in the bearing for a sleeve length of 90 mm the thickness of the oil film is 1.5 mm. **10**

c) What is Laplace equation ? Write an application of Laplace equation in fluid mechanics. **5**

12. a) Explain why the stress vector acting on a surface in contact with a stationary fluid must be purely compressive in its action. **5**

b) A vertical sluice gate is used to cover an opening in a dam. The opening is 2 m wide and 1.2 m high. On the upstream of the gate, the liquid of sp. Gr 1.45, lies up to a height of 1.5 m above the top of the gate, whereas on the downstream side the water is available up to a height touching the top of the gate. Find the resultant force acting on the gate and position of centre of pressure. Find also the force acting horizontally at the top of the gate which is capable of opening it. Assume the gate is hinged at the bottom. **15**

Module – II

13. a) Derive the continuity equation for a three dimensional incompressible flow. **5**

b) A fluid flow field is given by $V = x^2y\hat{i} + y^2z\hat{j} - (2xyz + yz^2)\hat{k}$ prove that it is a case of possible steady incompressible flow. Calculate the velocity and acceleration at the point (2, 1, 3). **15**

14. a) Water flows through a diffuser with a centerline velocity of $u = 5(1 - x) \sin(0.5t)\ \hat{i}$ m/s, where x is in meters and t is in seconds. Determine the pressure gradient in the diffuser as a function of time. **10**

b) 250 litres/s of water is flowing in a pipe having a diameter of 300 mm. of the pipe is bent by 135°, find the magnitude and direction of the resultant force on the bend. The pressure of water flowing is 4 bar. **10**

Module – III

15. a) Derive an expression for the velocity distribution for developed viscous flow through a circular pipe. **7**

b) A main pipe divides into two parallel pipes, which again forms one pipe. The length and diameter for the first parallel pipe are 2000 m and 1 m respectively, while the length and diameter of second parallel pipe are 2000 and 0.8 m respectively. Find the rate of flow in each parallel pipe, if total flow in the main is 3 m^3/s. The coefficient of friction for each parallel pipe is same and equal to 0.005. **13**

16. Determine the length of an equivalent pipe of diameter 20 cm and friction factor 0.02 for a given pipe system discharging 0.1 m^3/s. The pipe system consists of the following :

i) A 10 m line of 20 cm dia with f = 0.03.

ii) Three 90° bend, k = 0.5 for each

iii) Two sudden expansion of diameter 20 to 30 cm

iv) A 15 m line of 30 m diameter with f = 0.025 and

v) A global valve, fully open, k = 10.

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Module – IV

17. a) Find the displacement thickness, the momentum thickness and energy thickness for the velocity distribution in the boundary layer given by $u/U = 2(y/\delta) - (y/\delta)^2$. **10**

b) For the velocity profile $u/U = 2(y/\delta) - (y/\delta)^2$, find the thickness of boundary layer at the end of the plate and the drag force on one side of a plate 1 m long and 0.8 m wide when placed in water flowing with a velocity of 150 mm/sec. Calculate the value of coefficient of drag also. Take μ for water = 0.01 poise. **10**

18. a) Derive the relation using Buckingham's π theorem $F = \rho U^2 D^2 f(\mu/UD\rho)$, N D/U). **10**

b) In an aeroplane model of size 1/10 of its prototype the pressure drop is 7.5 kN/m^3. The model is tested in water. Find the corresponding pressure drop in the prototype. Take density of air is 1.4 kg/m^3, density of water is 1000 kg/m^3, viscosity of air is 0.00018 poise and viscosity of water is 0.01 poise. **10**