Exam.Code:0940
Sub. Code: 33859

2015
B.E. (Mechanical Engineering)
Fourth Semester
MEC-405: Fluid Mechanics

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: Attempt five questions in all, including Question No.1 which are compulsory and selecting two questions from each Part.

x-x-x

1 a State and explain Newton's law of viscosity. 10

b Explain the practical significance of capillarity.

c What are the factors that affect surface tension?

d State Pascal's law of hydrostatics.

e For a vertical plane surface submerged in liquid, differentiate between total pressure and centre of pressure.

f Distinguish between rotational flow and irrotational flow.

g Why is the angle of the converging cone in a venturimeter steeper than the diffuser angle?

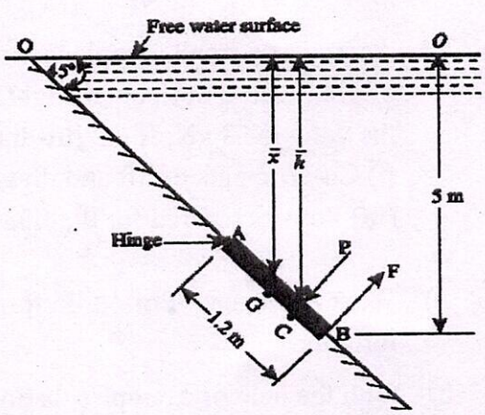
h What are the advantages of triangular notch over a rectangular notch?

i Write down Navier—Stokes equations for steady, incompressible flow in rectangular Cartesian coordinate system.

j Why Buckingham's PI theorem is considered superior over the Rayleigh's method for dimensional analysis?

PART-A

2 a) An inclined rectangular sluice gate AB 1.2 m by 5 m size as shown in Fig. is installed to control the discharge of water. The end A is hinged. Determine the force normal to the gate applied at B to open it. 6



b) Draw schematic diagram showing the gauge pressure, vacuum pressure and the absolute pressure. 4

3 a) The tangential component of velocity in a two-dimensional flow of incompressible Fluid is 6

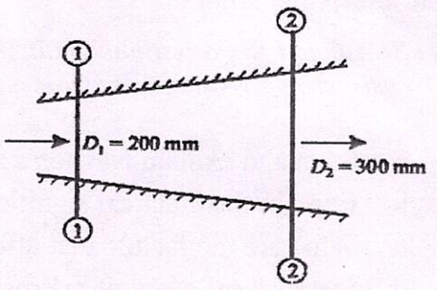
$$v_\theta = -\frac{C \sin\theta}{r^2}$$

where C is a constant.

(i) Using continuity equation, determine the expression for radial velocity v.
(ii) Find the magnitude and direction of resultant velocity.

P.T.O.

b) The diameters of a pipe at the sections 1-1 and 2-2 are 200 mm and 300 mm respectively. If the velocity of water flowing through the pipe at section 1-1 is 4m/s, find: (i) Discharge through the pipe, and (ii) Velocity of water at section 2-2 4



4 a) Describe Buckingham's method or π–theorem to formulate a dimensionally homogeneous equation between the various physical quantities effecting a certain phenomenon. 6

b) What are repeating variables? How are these selected by dimensional analysis? 4

PART-B

5 a) A convergent-divergent mouthpiece is fitted to the side of a tank. It is discharging 5.5 liters/sec. of water under a constant head of 2.0 m. If the head lost in the divergent portion is 1/ 10^{th} of the kinetic head at outlet and the separation pressure is 2.5 m, find the throat and exit diameters. Take atmospheric pressure = 10.3 m of water. 5

b) A wing of a small aeroplane is rectangular in plan having a span of 12 m and chord of 1.8 m. In a horizontal flight at 200 km/h the total aerodynamic force acting on the wing is 28 kN. If the lift-drag ratio is 10, determine: (i) Co-efficients of lift and drag, (ii) Total weight the aeroplane can carry, and (iii) Power required for the flight. Take ρ for air = 1.2 kg/m^3 5

6 a) What is Hagen—Poiseuille formula? Derive an expression for Hagen—Poiseuille formula. 6

b) With the help of examples distinguish between streamlined and bluff bodies. 4

7 A large tank contains air at a temperature of 25°C. A convergent nozzle with outlet diameter of 20 mm is provided to discharge the air to the atmosphere. Assuming adiabatic flow, find the mass flow rate when the pressure in the tank is (a) 150 kN/m^2 and (b) 400 kN/m^2. Take atmospheric pressure as 100 kN/m^2 and R = 287 J/Kg-K and k =1.4. 10

x-x-x