Sem IV / CBCGS / Auto

09/12/2019

Paper / Subject Code: 40002 / FLUID MECHANICS

(3 Hours) **Total Marks: 80**

N.B. : (1) Question No.1 is Compulsory.
(2) Attempt any three Questions out of remaining five questions.
(3) Figures to the right indicate full marks.
(4) Assume any suitable data if necessary and justify the same.

Q1 Solve any Five 20

a) What is the effect of temperature on viscosity of water and that of air 4

b) The weight of a block of dimensions 1.2m X 1m X 1.8 m in water is 2542.8N. Find its weight in air. 4

c) If the velocity field is given by $u = x^2 - y^2$ and $v = -(2xy)$, Check whether 4

i) flow is possible or not ii) rotational or irrotational.

d) The velocity profile within boundary layer for steady, two-dimensional, incompressible, laminar flow over a flat is given by $\frac{u}{U_\infty} = A + B\left(\frac{y}{\delta}\right)$ Using suitable boundary condition, evaluate the constants A and B. 4

e) Explain losses of energy in the flow through pipe. 4

f) State the Bernoulli's Theorem. List out the assumptions and limitations of Bernoulli's equation. 4

Q2 a) The water in a 25 m deep reservoir is kept inside by a 150 m wide wall whose cross section is an equilateral triangle as shown in fig.1. Determine the total force acting on the inner surface of the wall and its line of action. 06

b) The stream function in a two- dimensional, incompressible flow field is given by $\psi = (x^3 - 3xy^2)$. Find the velocity at a point (1, 2) and the velocity potential function. 10

c) Water flows through a 300 mm x 150 mm Venturimeter at a rate of 0.065 m^3/s and the differential gauge is deflected 1.2 m. Specific gravity of the manometric fluid is 1.6. Determine the coefficient of discharge of the Venturimeter. 04

Q3 a) Water is flowing through a horizontal pipe of 15 cm diameter and of length 30 m. While one end of the pipe is connected to a tank, the other end is open to the atmosphere. If the height of water in the tank is 5 m above the centre of pipe, determine the rate of flow of water through the pipe. Take f = 0.03 10

b) A 45° reducing pipe-bend in a horizontal plane has an inlet diameter OD 300mm and outlet diameter of 150 mm. The pressure at outlet is 20 kPa gauge and rate of flow of water through bend is 0.09m^3/s. Neglecting friction, determine the magnitude and direction of force required to keep the bend in position. Neglect the weight of the water in the bend. 10

Q4 a) Derive an expression for the area velocity relationship for a compressible fluid flow in the form $\frac{dA}{A} = -\frac{dV}{V}(1 - M^2)$. Explain properly, with the help of diagrams, what are the important conclusions derived from the above relationship. 10

b) The local velocity u in a laminar, incompressible flow over a flat plate is given by $\frac{u}{U_\infty} = 2\left(\frac{y}{\delta}\right) - 2\left(\frac{y}{\delta}\right)^3 + \left(\frac{y}{\delta}\right)^4$ where y is perpendicular distance from the plate, δ is the boundary layer thickness and U_∞ is the free stream velocity. Obtain the expression for the displacement thickness and momentum thickness. 10

Q5 a) An aeroplane is flying at 900 km/hr through still air having a pressure of 80 kN/m^2 and temperature of – 8°C. Find the Mach number. Also find stagnation properties on the nose of the plane. Take R = 287 J/Kg°K and k = 1.4 . 10

b) Derive Euler's equation of motion along streamline 10

Q6 a) Explain what is meant by separation of boundary layer and describe in detail the methods to control this? 06

b) State Reynold's Transport theorem and explain each term in detail. 04

c) An oil with density 850 kg/m^3 and viscosity 0.16 Ns/m^2 flows through a 20 cm diameter pipe at a rate of 1.2 lit/sec. If the length of the pipe is 500 m, find the pressure drop between the two ends of the pipe. Also calculate the shear stress at the pipe wall. 10
