T.E – II / Mech / Fri

03.12.12

72 : 2nd half-12-(j) JP

Con. 9759-12.

KR–5192

(3 Hours) [Total Marks : 100

N.B. (1) Question 1 is compulsory.
(2) Attempt any 4 questions out of remaining 6 questions.
(3) Clearly mention the assumptions made if any.

1, Attempt any FOUR : 20

a) Define a fluid and distinguish between:
i. ideal and real fluids
ii. compressible and incompressible fluids

b) State and explain the principal of floatation. How does it differ from the principal of buoyancy?

c) Differentiate between the Eulerian and Lagrangian method of representing fluid motion

d) Write a note on major and minor losses in pipe.

e) Discuss the phenomenon of boundary layer separation

2. a) Starting from the Navier stokes equation for an incompressible Newtonian fluid derive Bernoulli's equation stating the assumptions 10

b) A large thin plate is pulled at constant velocity 'U' through a narrow gap of height 'h'. On one side of the plate is oil of viscosity 'μ 'and on other side oil of viscosity 'αμ' where α is constant. Calculate the position of plate so that drag force on it will be minimum 10

3 a) A sliding gate 3m wide and 1.5m high situated in a vertical plane has a coefficient of friction between itself and guide of 0.18. If the gate weight is 19 kN and if its upper edge is at a depth of 9 m, what vertical force is required to raise it? Neglect buoyancy force on gate 10

b) Derive Darcy-weisbach equation and state its utility 10

4 a) Using the laminar boundary layer velocity distribution:

$$\frac{u}{U} = 2\left(\frac{Y}{\delta}\right) - 2\left(\frac{Y}{\delta}\right)^2 + \left(\frac{Y}{\delta}\right)^4$$

Check if boundary layer separation occurs. Also determine in terms of Reynolds Number,

i. Boundary layer thickness
ii. Shear stress at surface
iii. Local coefficient of drag
iv. Average coefficient of drag

b) Write a note on Prandtl's mixing length theory. **04**

c) Two horizontal plates are placed 1.25 cm apart, the space between them being filled with oil of viscosity 14 poise. Calculate the shear stress in oil if upper plate is moved with a velocity of 2.5 m/s **04**

5 a) Consider a two dimensional viscous incompressible flow of a Newtonian fluid between 2 parallel plates, separated by a distance 'c'. One of the plates is stationary and the other is moving with a uniform velocity V. There is no pressure gradient in the flow. Obtain the governing equations from the general Navier stokes equations. Discretize the equation. Specify the boundary condition for a CFD solution **15**

b) A stream function is given by $\psi = 5x-6y$. Calculate the velocity components and also magnitude and direction of the resultant velocity at any point. **05**

6. a) Explain Reynold's transport theorem with its proof. **12**

b) A lubricating oil of viscosity 1 poise and specific gravity 0.9 is pumped through a 30 mm diameter pipe. If the pressure drop per meter length of pipe is 20 KN/m^2, determine

i. mass flow rate in kg/min,

ii. shear stress at the pipe wall,

iii. Reynolds number of flow. **08**

7. a) Derive continuity equation in Cartesian coordinates. The diameter of a pipe at the sections 1 and 2 are 10 cm and 15 cm respectively. Find the discharge through the pipe if the velocity of water flowing through the pipe at section 1 is 5 m/s. Also determine the velocity at section 2. **08**

b) State and derive hydrostatic law. **06**

c) Define path lines, stream lines and streak lines. **06**