R09

Code No: 54063

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech II Year II Semester Examinations, November/December - 2015

MECHANICS OF FLUIDS AND HYDRAULIC MACHINES

(Common to ME, MIE)

Time: 3 hours **Max. Marks: 75**

Answer any five questions

All questions carry equal marks

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1.a) Describe the classification of manometers with neat sketches.

b) A piston 79.6mm diameter and 210 mm long works in a cylinder 80 mm diameter. If the annular space is filled with lubricating oil having a viscosity of 0.065 kg/ms, calculate the speed with which the piston will move through the cylinder when an axial load of 85.6 N is applied. Neglect the inertia of the piston. [7+8]

2.a) A three dimensional velocity field is given by u = -x, v = 2y and w = 5 – z. Find the equation of streamline through (2, 2, 1).

b) The velocity field in a steady flow is given in a rectangular Cartesian coordinate system as $\bar{V} = 6x\bar{i} + (4y+10)\bar{j} + 2t\bar{k}$. What is the path line of a particle which is at (2, 6, 4) at time t = 2s? [7+8]

3.a) Discuss the losses in pipe flow. Give the expressions for these losses.

b) A vertical venturimeter carries a liquid of specific gravity 0.8 and has inlet and throat diameter of 150 mm and 75 mm respectively. The pressure connection at the throat is 150 mm above that at the inlet. If the actual rate of flow is 40litres/s and the coefficient of discharge is 0.96, calculate (i) the pressure difference between inlet and throat, and (ii) the difference in levels of mercury in a vertical U-tube manometer connected between these points. [7+8]

4.a) Explain various methods of avoiding separation of boundary layer.

b) Explain the following:

i) Transitional boundary layer ii) Turbulent boundary layer. [7+8]

5. A 2.5 cm diameter jet having a velocity of 70 m/s impinges without shock on a series of vanes which move in the same direction as the jet. The shape of each vane is such that, if stationary, it would deflect the jet through and angle of 150°. Friction reduces the relative velocity by 10% as water flows across the vanes and there is further windage loss given by $0.4\ u^2/2g$ N m/N of water. Find (a) the velocity of vanes corresponding to maximum efficiency and the value of this efficiency, (b) the corresponding force on the vanes, in and right angles to the direction of their motion. [15]

6.a) Explain draft tube theory along with its functions and efficiency.

b) A Francis turbine has a wheel diameter of 1.2 m at the entrance and 0.6 m at the exit. The blade angle at the entrance is 90^0 and the guide vane angle is 15^0. The water at the exit leaves the blades without any tangential velocity. The available head is 30 m and the radial component of flow velocity is constant. What would be the speed of wheel in rpm and blade angle at exit? Neglect friction. [7+8]

7.a) Explain what is water hammer. What are the causes and effects of it?

b) A conical type draft tube attached to a Francis turbine has a inlet diameter of 3 m and its area at outlet is 20 m^2. The velocity of water at inlet, which is 5 m above tail race level, is 5 m/s. Assuming the loss in draft tube equals to 50% of the velocity head at outlet, find (i) the pressure head at the top of the draft tube (ii) the total head at the top of the draft tube taking tail race level as datum (iii) power lost in draft tube. [7+8]

8.a) Draw and explain indicator diagrams. What is the significance of it?

b) A centrifugal pump handles liquid whose kinematic viscosity is three times that of water. The dimensionless specific speed of the pump is 0.183 rev and it has to discharge 2 m^3/s of liquid against a total head of 15 m. Determine the speed, test head and flow rate for a one-quarter scale model investigation of the full size pump if the model uses water. [7+8]

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