Total No. of Questions :6]

SEAT No. :

**P5060**

[Total No. of Pages : 2

# T.E./Insem.-609
# T.E.(Mechanical) (Semester - I)
# TURBO MACHINES
# (2015 Pattern)

*Time : 1 Hour]* *[Max. Marks :30*

***Instructions to the candidates:***

1) ***Answer Q.1 or Q.2, Q.3 or Q.4 & Q.5 or Q.6.***
2) ***Figures to the right indicate full marks.***
3) ***Use of scientific calculator is allowed.***
4) ***Assume data wherever necessary and mention it.***
5) ***Draw neat and suitable figures wherever necessary.***

***Q1)*** a) A 7.5 cm diameter jet having velocity of 12 m/s impinges on a smooth plate at an angle of 60°,to the normal to the plate. What will be the force when (I) the plate is stationary and (II) when the plate is moving in the direction of jet at 6 m/s. Determine also the work done per second on the plate in each case. **[6]**

b) Derive the expression for the force exerted by a jet of water on an inclined fixed plate in the direction of jet. **[4]**

OR

***Q2)*** a) Derive the expression of work done per sec for symmetrical moving curved vane with tangential entry of jet. **[4]**

b) A circular jet of water having velocity of 60 m/s impinges tangentially on a series of curved vanes moving uniformly at 25 m/s. The jet makes an angle of 30 degrees with the direction of motion of the vanes. Relative to a vane, the jet turns through an angle of 100 degrees as it flows over the vane. The flow speed along the vane drops by 15% due to frictional loss. Draw neat inlet and outlet velocity triangles showing all the relevant details and determine: **[6]**

i) Vane tip angles at inlet and outlet for the smooth flow,

ii) Absolute velocity of water leaving the vanes.

***P.T.O.***

***Q3)*** a) Sketch Pelton wheel bucket giving its approximate dimensions and answer question in brief: The ideal jet deflection angle is 180 degree, however bucket deflects the jet through 160 to 165 degree. **[4]**

b) A Pelton wheel of 2.5 m diameter operates under the following conditions: Net available head = 300m; Speed = 300r.p.m.; Blade angle at outlet = 165°; $C_V$ of nozzle = 0.98; Mechanical Efficiency = 95%. Determine: i) The Power developed ii) Specific speed iii) Hydraulic Efficiency. **[6]**

OR

***Q4)*** a) Define
1) Gross head 2) Jet ratio 3) Hydraulic efficiency 4) Mechanical Efficiency. **[4]**

b) Show that the maximum efficiency of the Pelton wheel is given by $(1+k\cos\phi)/2$ where K= Bucket friction factor, $\Phi$ = Bucket outlet angle. **[6]**

***Q5)*** a) Compare Francis turbine & Kaplan turbine. **[4]**

b) Design a Francis turbine runner with the following data.
Net Head = 68 m ; Speed=750RPM Power output = 330 kW; Hydraulic efficiency = 94 %; Overall Efficiency = 85%; Flow ratio = 0.15: Ratio of breadth to diameter = 0.1; Inner diameter of the runner is half of outer diameter of the runner. 6% of circumferential area of the runner is occupied by the thickness of the vanes. Assume velocity of flow remains constant and flow is radial at exit. **[6]**

OR

***Q6)*** a) In an inward flow reaction turbine the head on the turbine is 32 m. The external and internal diameters are 1.44 m and 0.72 m. The velocity of flow through the runner is constant and equal to 3 m/s. The guide blade angle is 10 degree and the runner vanes are radial at inlet. If the discharge at outlet is radial. Determine: **[6]**

i) The speed of the turbine

ii) The vane angle at outlet of the runner and

iii) Hydraulic efficiency.

b) What is the significance of specific speed? Derive the relation for the same. **[4]**

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