T2625 / T0472 APPLIED HYDRAULICS I

23.5.17

Q.P.Code: 013330

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T.E. Civil V - CBSGS

(3 hours) Max.Marks: 80

Note: (1) Question no.1 is compulsory
(2) Solve any 3 questions out of remaining
(3) Assume data wherever necessary and clearly mention the assumptions made.
(4) Draw neat figures as required.

Q1 **Solve any Four** 20

a Define Moment of Momentum Equation.

b Obtain an expression for the force exerted by a jet of water on a flat vertical plate moving in the direction of flow.

c Describe briefly the functions of main components of Pelton wheel turbine with neat sketches.

d Obtain an expression for unit speed, unit discharge and unit power for a turbine.

e What do you mean by manometric efficiency, mechanical efficiency and overall efficiency of a centrifugal pump?

f Write a short note on Hydraulic Accumulator.

Q2 a The angle of reducing bend is 60°(that is the deviation from initial direction to final direction). Its initial diameter is 300 mm and final diameter is 150 mm and is filled in a pipeline carrying a discharge of 360 litres/sec. The pressure at the commencement of the bend is 2.943 bar. The friction loss in the pipe bend may be assumed as 10 percent of kinetic energy at the exit of the bend. Determine the force exerted by the reducing bend. 10

b A water sprinkler has 10 mm diameter nozzle at either end of a rotating arm, each of which is discharging water in opposite direction at right angle to the rotating arm, at a velocity of 8 m/s. If the axis of rotation is at a distance of 0.15 m from one end and 0.2 m from the other, determine the torque required to hold the arm stationary. If friction is neglected, determine the constant angular speed of the arm 10

Q3 a Find the form of equation for discharge Q through a sharp edged triangular notch assuming Q depends on the central angle α of the notch, head H, gravitational acceleration g , density ρ, viscosity μ, and surface tension σ of the fluid. 10

b (a) With Froude's number as the criterion of dynamic similarity for a certain flow situation, work out the scale factors for velocity, time, discharge, acceleration, force, work done and power in terms of the scale factor for length. 10
(b) A geometrically similar model of spillway is to be laid to a scale of 1 in 50, calculate the velocity ratio, discharge ratio and acceleration ratio.

TURN OVER

Q 4 a A pelton wheel is to be designed for a head of 60 m when running at 200 r.p.m. the pelton wheel develops 95.6475 KW shaft power. The velocity of the buckets = 0.45 times the velocity of the jet, overall efficiency = 0.85 and coefficient of velocity is equal to 0.98. 10

b A reaction turbine works at 500 r.p.m. under a head of 120 m. Its diameter at inlet is 120 cm and the flow area is 0.4 m^2. The angles made by absolute and relative velocities at inlet are 20^0 and 60^0 respectively with the tangential velocity. Determine: 10

(a) Thc volume flow rate.
(b) Power developed.
(c) Hydraulic efficiency.

Q 5 a A Kaplan turbine runner is to be designed to develop 7358 kW shaft power. The net available head is 5m. Assume that the speed ratio is 2.09 and flow ratio is 0.68, and the overall efficiency is 60%. The diameter of the boss is 1/3 rd of the diameter of the runner. Find the diameter of the runner, its speed and its specific speed. 10

b A conical draft tube having inlet and outlet diameters 1 m and 1.5 m discharges water at outlet with a velocity of 2.5 m/s. The total length of the draft tube is 6 m and 1.3 m of the length of draft tube is immersed in water. If the atmospheric pressure head is 10.3 meters of water and loss of head due to friction in the draft tube is equal to 0.2 x velocity head at outlet of the tube, find Pressure head at inlet and efficiency of the draft tube. 10

Q 6 a A three stage centrifugal pump has impeller 400 mm in diameter and 20 mm wide. The vane angle at outlet is 45^0 and the area occupied by the thickness of the vanes may be assumed 8 % of the total area. If the pump delivers 3.6 m^3 of water per minute when running at 920 r.p.m. determine: 10

(i) Power of the pump,
(ii) Manometric head,and
(iii) Specific speed.

Assume mechanical efficiency as 88% and manometric efficiency as 77%.

b Write a short note on 1. Hydraulic ram 2. Hydraulic lift. 10

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