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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Fourth Semester, B.E. - Civil Engineering

Semester End Examination; June - 2016

Hydraulic and Hydraulic Machines

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Missing data if any, may suitably assumed.

UNIT - I

1 a. Derive the condition for the most economical Trapezoidal section. 10

b. A Trapezoidal channel has a side slope of 1H : 2V and the slope of its bed is 1 in 1000. Determine the optimum dimensions of the channel, if it is to carry water at 0.5 m^3/s. Take the value of Chezy's constant as 60. 10

2 a. Derive the expression for the loss of energy head for a hydraulic jump. 10

b. The discharge of water through a rectangular channel of width 6 m, is 18 m^3/s. When the depth of water is 2 m, calculate;
(i) Specific energy of flowing water
(ii) Critical depth and critical velocity
(iii) Value of minimum specific energy. 10

UNIT - II

3 a. What is Rayleigh's method of dimensional analysis? Explain with an example. 10

b. Water is flowing through a pipe of diameter 30 cm at a velocity of 4 m/s. Find the velocity of oil flowing in another pipe of diameter 10 cm, if the condition of dynamic similarity is satisfied between the two pipes. The viscosity of oil and water is 0.025 and 0.01 poise respectively. Take G of oil as 0.80. 10

4 a. Explain briefly the following :
(i) Geometric similarity (ii) Kinematic similarity (iii) Dynamic similarity. 10

b. In 1 in 40 model of spillway, the velocity and discharge are 2 m/s and 2.5 m^3/s. Find the corresponding velocity and the discharge in the prototype. 10

UNIT - III

5 a. Derive an expression for the force exerted by a jet of water on an inclined fixed plate in the direction of the jet is given by $Fx = \rho\, av^2 \sin^2\theta$. 10

b. A jet of water of dia 100 mm moving with a velocity of 30 m/s strikes a curved fixed symmetrical plate at the centre. Find the force exerted by the jet if the jet is deflected through an angle of 120º at the outlet of the curved plate. 10

Contd…2

6 a. Show that the efficiency of a free jet striking normally on a series of flat plates mounted on the periphery of a wheel can never exceed 50%. 10

b. A jet of water having a velocity of 40 m/s strikes a curved vane, which is moving with a velocity of 20 m/g. The jet makes an angle of 30º with the direction of the motion of the vane at inlet and leaves at an angle of 90º to the direction of the motion of the Vane at outlet, Draw the velocity triangles at inlet and outlet and determine the vane angles at inlet and outlet so that water enters and leaves the vane without shock. 10

UNIT - IV

7 a. What are turbines? Discuss in detail the classification of turbines. 10

b. A Pelton wheel is having a mean bucket diameter of 1 m and is running at 1000 rpm. The net head on the Pelton wheel is 700 m. If the side clearance angle is 15º and the discharge through the nozzle is 0.1 m^3/s. Find; 10

(i) Power available at the nozzle (ii) Hydraulic efficiency of the turbine.

8 a. With a neat sketch explain the working principle of Francis turbine. 10

b. The external and internal diameters of an inward flow reaction turbine are 1.2 m and 0.6 m respectively. The head on the turbine is 22 m and velocity of the flow through the runner is constant and equal to 2.5 m/s. The guide blade angle is given as 10º and the runner vanes are radial at inlet. If the discharge at the outlet is radial. Determine ; 10

(i) The speed of the turbine,

(ii) The vane angle at outlet of the runner and hydraulic efficiency.

UNIT - V

9 a. Define a draft tube. What are the uses of draft tube? Describe with a sketch two different types of draft tubes. 10

b. A water turbine has a velocity of 6 m/s at the entrance to the draft-tube and a velocity of 1.2 m is at the exit. For friction loss of 0.1 m and a tail water 5 m below the entrance to the draft tube. Find the prenure head at the entrance. 10

10 a. Define the specific speed of a centrifugal pump. Derive an expression for the minimum starting speed of a centrifugal pump. 10

b. The diameters of an impellor of a centrifugal pump of inlet and outlet are 300 mm and 600 mm respectively. The velocity of the flow at the outlet is 2 m/s and the vanes are set back at an angle of 45º at the outlet. Determine the minimum starting speed of the pump if the manometric efficiency is 70%. 10

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