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Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Hydraulic and Hydraulic Machines

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. Assume missing data suitably and specify.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. State and explain Buckingham's π – method. Give the guidelines for selection of repeating variables. **(06 Marks)**

b. Explain Geometric similarity, Kinematic similarity and Dynamic similarity. **(06 Marks)**

c. Using Buckingham's π – theorem, show that the discharge (Q) over a spillway is given by $Q = VD^2 f\left[\frac{\sqrt{gD}}{V}, \frac{H}{D}\right]$, where V is velocity of flow, D is depth at the throat , H is Head of water and g is acceleration due to gravity. **(08 Marks)**

2 a. Give the differences between Open channel flow and Pipe flow. **(04 Marks)**

b. Derive the expression for velocity of uniform flow in open channel flow given by Chezy. **(08 Marks)**

c. Determine the dimensions of most economical trapezoidal channel section to carry a discharge of 25 cumecs with a velocity of 1.2 m/sec. The side slopes of the channel are 2V : 3H. Find also the necessary bed slope required. Take Manning's n = 0.025. **(08 Marks)**

3 a. Explain the specific energy diagram, with a neat sketch. **(05 Marks)**

b. Obtain the expression for loss of energy head for a hydraulic jump in a rectangular channel. **(07 Marks)**

c. A 8m wide channel conveys 15m^3/s of water at a depth of 1.2m. Calculate i) Specific energy of the flowing water ii) Critical depth , Critical velocity and Minimum specific energy. **(08 Marks)**

4 a. Give the practical applications of Impulse momentum principle. **(04 Marks)**

b. Obtain the expression for efficiency in case of jet striking series flat plates mounted on the periphery of a wheel and value of maximum efficiency. **(08 Marks)**

c. A jet of water 2.5cms diameter strikes a hinged square plate at its centre with a velocity of 20m/s. The plate is deflected through an angle of 30^0. Find the weight of the plate. If the plate is not allowed to swing, find the force required at the lower edge of the plate to keep the plate in vertical position. **(08 Marks)**

PART – B

5 a. Obtain the expression for efficiency when jet striking an unsymmetrical moving curved vane tangentially at one of the tips. **(10 Marks)**

b. A jet of water of diameter 50mm, having a velocity of 20m/s strikes a curved vane which is moving with a velocity of 10m/s in the direction of the jet. The jet leaves the vane at an angle 60^0 to the direction of motion of vane at outlet. Determine
i) the force exerted by the jet in the direction of the motion and
ii) work done per second by the jet. **(10 Marks)**

6 a. Explain different efficiencies in case of turbine. **(08 Marks)**

b. Draw a neat sketch of Pelton wheel turbine and name the different parts. **(04 Marks)**

c. A Pelton wheel is to be designed for the following specifications :
Power = 9560 kW ; Head = 350 meters ; Speed = 750 rpm ;
Overall efficiency = 85% ; Jet ratio = 6. Determine the following i) The wheel diameter ii) Diameter of the jet and iii) the number of jets required. **(08 Marks)**

7 a. Explain Cavitation in turbines. **(06 Marks)**

b. Define Efficiency of draft tube and give its mathematical expression. **(04 Marks)**

c. A Kaplan turbine runner is to be designed to develop 10,000 kW. The net available head is 6.0m. The speed ratio is 2.09. The flow ratio is 0.68. The overall efficiency is 80% and diameter of boss is 1/3 the diameter of the runner. Find the diameter of the runner , its speed and the specific speed of the turbine. **(10 Marks)**

8 a. What is Priming of a centrifugal pump? Why it is necessary? **(06 Marks)**

b. Obtain the expression for minimum starting speed in a centrifugal pump. **(04 Marks)**

c. The outer diameter of an impeller of a centrifugal pump is 500mm and its outer width is 50mm. The pump is running at 1000 rpm and is working against a total head of 20m. The vane angle at the outlet is 30^0 and manometric efficiency is 70%. Determine
i) Velocity of flow at the outlet.
ii) The velocity of water leaving the vane.
iii) Angle made by the absolute velocity at outlet with the direction of motion at the outlet.
iv) Discharge. **(10 Marks)**

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