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10CV45

Fourth Semester B.E. Degree Examination, June / July 2014
Hydraulics and Hydraulic Machines

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. Missing data if any may be suitably assumed

PART - A

1 a. Define the terms : i) Model ii) Prototype iii) Model Analysis iv) Hydraulic similitude. **(06 Marks)**

b. State and explain Buckingham π – theorem citing an example. Also explain its advantages over Rayleigh's method of dimensional analysis. **(06 Marks)**

c. A pipe of diameter 1.8m is required to transport an oil of sp.gr 0.8 and viscosity 0.04 poise at the rate of $4m^3/s$. Tests were conducted on a 20cm diameter pipe using water at 20^0C. Find velocity and rate of flow in model. Viscosity of water at 20^0C is 0.01 poise. **(08 Marks)**

2 a. Differentiate between : i) Hydraulic depth and hydraulic mean depth ii) Steady and uniform flow iii) Alternate depth and conjugate depth iv) Open channel flow and pipe flow. **(06 Marks)**

b. Prove that for a trapezoidal channel of most economical section :
i) Half of top width = length of one of sloping sides ii) Hydraulic mean depth = ½ depth of flow. **(06 Marks)**

c. An open channel is to be constructed of trapezoidal section and with side slopes 1 vertical to 1.5 Horizontal. Find relation between bottom width and depth of flow for minimum excavation. If flow is to be 2.7 cumec, calculate the bottom width and depth of flow assuming C in Chezy's formula as 44.5 and bed slope is 1 in 4000. **(08 Marks)**

3 a. Derive an equation for gradually varied flow in open channels. Also state assumptions made in it. **(06 Marks)**

b. Explain classification of surface profiles in open channels with neat sketches. **(08 Marks)**

c. The specific energy for 6m wide rectangular channel is to be 5 kg – m/kg. if the rate of flow of water through channel is $24m^3/s$, determine alternate depths of channel. **(06 Marks)**

4 a. Explain impulse momentum principle and mention its applications. **(02 Marks)**

b. Show that maximum efficiency of jet striking on series of flat vanes mounted on periphery of a wheel never exceeds 50%. **(08 Marks)**

c. A 50mm diameter jet having a velocity of 25m/s, strikes a flat plate, the normal of which is inclined at 30^0 to axis of jet. Calculate the normal force exerted on plate i) when plate is stationary ii) when plate is moving with a velocity of 10m/s in the direction of jet. Find work done and efficiency when plate is moving. **(10 Marks)**

PART - B

5 a. Explain the concept of velocity triangles. Also obtain an expression for work done per second by jet striking unsymmetrical moving vane tangentially at one end of the tips. **(10 Marks)**

b. A jet of water moving at 20m/s impinges on a symmetrical curved vane so shaped to deflect the jet through 120^0. If the vane is moving at 5m/s, find the angle of the jet so that there is no shock at inlet. Also determine the absolute velocity of jet at exit in magnitude and direction and the work done. **(10 Marks)**

6 a. Differentiate between : i) Impulse and Reaction turbine ii) Radial and Axial flow turbine iii) Kaplan and Propellor turbine. **(03 Marks)**

b. Show that maximum hydraulic efficiency of Pelton wheel is equal to $\frac{1+\cos\phi}{2}$ in which ϕ cannot be equal to zero for increasing efficiency. **(07 Marks)**

c. A Pelton wheel has to be designed for following data : Power to be developed ; 6000 kW. Net head available = 300m ; Speed = 550 r.p.m. Ratio of jet diameter to wheel diameter = $\frac{1}{10}$; and overall efficiency = 85%. Find number of jets ; diameter of jet ; diameter of wheel ; and the quantity of water required. Assume co-eff of velocity as 0.98 and speed ratio as 0.46. **(10 Marks)**

7 a. Explain different types of draft tubes with neat sketches. Also explain their functions. **(04 Marks)**

b. Draw neat sketch of Kaplan turbine and explain its different parts. **(06 Marks)**

c. A Kaplan turbine produces 60,000 kW under a net head of 25m with an overall efficiency of 90%. Taking the value of speed ratio as 1.6, flow ratio as 0.5 and hub diameter as 0.35 times the outer diameter, find diameter and speed of turbine. **(10 Marks)**

8 a. Explain the following : i) Suction head ii) Delivery head iii) Static head iv) Manometric head. **(06 Marks)**

b. Derive an expression for minimum speed for starting a centrifugal pump. **(06 Marks)**

c. A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 r.p.m works against a total head of 40m. The velocity of flow through the impeller is constant and equal to 2.5m/s. The vanes are set back at an angle of 40^0 at outlet. If the outer diameter of the impeller is 500mm and width at outlet is 50mm, determine :
i) Vane angle at inlet ii) Work done by impeller on water iii) Manometric efficiency. **(08 Marks)**

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