USN | | | | | | | | | |

10CV45

Fourth Semester B.E. Degree Examination, June/July 2017
Hydraulics and Hydraulic Machines

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Define Dimensional homogeneity of an equation. Give an example and state the uses of Dimensional Analysis. **(06 Marks)**

b. Using Buckingham's π – theorem, show that the efficiency (η) of a fan depends on the density (ρ) , Dynamic viscosity (μ) , Angular velocity (w), diameter 'D' of the rotor and the discharge 'Q'. Express efficiency (η) interms of dimensionless parameter. **(10 Marks)**

c. A 1:64 model is constructed of an open channel in concrete which has Mannings N = 0.014. Find the value of N for the model. **(04 Marks)**

2 a. Distinguish between Open channel flow and pipe flow. **(06 Marks)**

b. Show that the length of one sloping side of a most economical trapezoidal channel is equal to half of the top width. Also determine the hydraulic mean depth for this condition. **(08 Marks)**

c. A flow of water of 100 ℓps flows down in a Rectangular flume of width 600mm and having adjustable bottom slope of C = 56. Find the bottom slope necessary for uniform flow with a depth of flow of 300mm. Also find the conveyance 'K' of the flume. **(06 Marks)**

3 a. Define Specific Energy and draw Specific Energy diagram. Derive an expression for critical depth and critical velocity in case of non uniform flow through rectangular channel. **(08 Marks)**

b. Find the slope of the free water surface in a rectangular channel of width 20m, having depth of flow 5m. The discharge through the channel is $50 m^3/s$. The bed of the channel is having a slope of 1:4000. Take the value of C = 60. **(06 Marks)**

c. The hydraulic jump in a rectangular horizontal channel, the discharge per unit width is $2.5 m^3/s/m$ and the depth before the jump is 0.25m. Estimate
i) The sequent depth and ii) The energy loss. **(06 Marks)**

4 a. State Impulse Momentum principle and thus give Impulse Momentum equation. Give 2 uses. **(06 Marks)**

b. Show that the force exerted by a Jet of water on an Inclined fixed plate in the direction of the Jet is given by $Fx = \rho a V^2 \sin^2 \theta$. **(08 Marks)**

c. A jet of water 7.5cm in diameter having velocity of 20m/s strikes a series of the flat plates arranged around the periphery of a wheel. If the plates are moving at a velocity of 5m/s, compute the force exerted by the jet on the plate, the workdone / sec and the efficiency of the jet. **(06 Marks)**

PART – B

5 a. A jet of water strikes an unsymmetrical moving curves plate tangentially at one of the tips. Derive an expression for the force exerted by the jet in the horizontal direction of motion. Also describe the velocity triangles and obtain an expression for work done and efficiency. **(12 Marks)**

b. A 15cm diameter jet moving at 30m/s impinges on a series of vanes moving at 15m/s in the direction of the jet. The jet leaves the vanes at 60^0 with the direction of motion of the vanes. Calculate i) The force exerted by the jet in the direction of motion of the vanes.
ii) Work done by the jet/sec. **(08 Marks)**

6 a. How the Hydraulic turbines are classified? Give examples. Describe the working of an Impulse turbine with a neat sketch. **(10 Marks)**

b. A Pelton wheel is to be designed for the following specifications :
Shaft powers = 5800 kW , Net head = 310m , Speed = 600rpm , Overall efficiency = 85% , $\frac{D}{dj} = 10$. (Ratio of wheel diameter to the jet diameter). Determine
i) The wheel diameter ii) The number of jets required iii) Diameter of the jet
iv) Quantity of water required. Assume speed ratio = 0.46 and CV = 0.98. **(10 Marks)**

7 a. What are the uses of Draft tube? Describe with neat sketches different types of draft tubes. **(08 Marks)**

b. What is Cavitation? What are the effects of Cavitation? **(04 Marks)**

c. A Kaplan turbine develops 15000 kW power at a head of 30m. The diameter of the boss is 0.35 times the diameter of the runner. Assuming a speed ratio of 2.0 , a flow ratio of 0.65 and an overall efficiency of 90%. Calculate i) Diameter of the runner ii) Rotational speed and iii) Specific speed. **(08 Marks)**

8 a. Define a centrifugal pump. Explain the main parts and working principle of single stage centrifugal pump with neat sketch. **(08 Marks)**

b. What is Priming of a centrifugal pump and why it is necessary? **(04 Marks)**

c. Calculate the vane angle at Inlet of a centrifugal pump, impeller having 300mm diameter at inlet and 600mm diameter at outlet. The Impeller vanes are set back at an angle of 45^0 to the outer rim and the entry of the pump is radial. The pump runs at 1000 rpm and the velocity of flow through the impeller is constant at 3m/s. Also calculate the work done by unit weight of water and the velocity and direction of water at outlet. **(08 Marks)**

*****