PVP 12

Code: CE4T4

II B.Tech - II Semester – Regular Examinations - JUNE 2015

HYDRAULICS AND HYDRAULIC MACHINERY
(CIVIL ENGINEERING)

Duration: 3 hours Marks: 5x14=70

Answer any FIVE questions. All questions carry equal marks

1. a) Show that the hydraulic mean depth of a trapezoidal channel having the best proportion is half of the minimum depth. 7 M

   b) Water is flowing through a rectangular channel of 4 m in width at a rate of $12\,m/s$. The depth of water in the channel is $1.6\,m$. Calculate the specific energy head, the critical depth and the minimum specific energy head. State whether the flow is subcritical or supercritical. 7 M

2. a) Show that the variation of depth of flow along the length of the bed of the channel for steady gradually varied flow in open channel is given by:

$$\frac{dy}{dx} = \frac{S_e - S_b}{1 - F_r^2}$$

   Where, S_e is the slope of the energy line, S_b is the slope of the bed of the channel and F_r is the local Froude number of the flow. 7 M

b) Water is flowing non-uniformly through a rectangular channel of $3\,m$ width at a rate of $9.72\ m^3/s$. At a particular section of the channel, the depth of flow is $0.8\,m$. Determine whether a hydraulic jump will occur, and if so find its height. Also find the loss of energy and the power lost in the hydraulic jump. 7 M

3. a) What do you mean by similitude and what are the different types of similarities that must exist between a model and prototype? 7 M

b) The Power 'P' of a hydraulic turbine depends upon the, mass density of the fluid 'ρ', the speed of the pump 'N', the diameter of the impeller 'D', the manometric head 'H' and the acceleration due to gravity 'g'. Using the method of dimensional analysis, show that the power 'P' developed by a hydraulic turbine is given by the expression as: 7 M

$$P = \rho\ N^3\ D^5\ f_n\left[\frac{N^2D^2}{gH}\right]$$

4. a) What do you mean by impact of jet? Derive an expression for force exerted by the jet on a stationary vertical plate. 7 M

b) A jet of water having a velocity of 20 m/s enters tangentially a stationary curved vane without shock and is deflected through an angle of 150^0. If the volume flow rate of water is 0.002 m^3/s, find the magnitude and direction of the resultant force on the vane. 7 M

5. a) Draw a general layout of a hydroelectric power plant using an impulse turbine and explain the terms: Gross head, Net head, Hydraulic efficiency and Overall efficiency. 7 M

b) The following data refer to a Pelton wheel:
Tangential velocity of wheel = 40 m/s
Head = 250 m
Discharge = 0.3 m^3/s
Side clearance angle = 15^0
Coefficient of velocity = 0.98
Determine the power developed by the wheel. Neglect the frictional losses in the bucket. 7 M

6. a) Discuss the phenomenon of cavitation in hydraulic turbines. How and where does it occur in water power plant. 7 M

b) What are unit quantities and obtain an expression for unit speed, unit discharge and unit power of a hydraulic turbine. 7 M

7. a) Describe what do you mean by pumps in series and pumps in parallel as in case of centrifugal pump? What advantage we get from the above two arrangement? 7 M

b) A centrifugal pump running at 1000 r.p.m delivers water. The diameter of impeller at inlet is 120 mm and at outlet is 350 mm. The width of the impeller is 60 mm at inlet and 20 mm at outlet. The blade angle at outlet is 40^0. If the velocity of flow at inlet is $2.5\,m/s$, find the velocity of flow at outlet. Find the head developed if the manometric efficiency is 80 %. 7 M

8. a) Briefly describe the classification of hydropower plants. 7 M

b) Write a short note on: Load factor, Utilization factor and Capacity factor. 7 M