6E3053

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B. Tech. VI Sem. (Main & Back) Exam., May-2014

Mechanical Engineering

6ME5 Hydraulic Machines & Hydroelectric Power Plant

Time: 3 Hours **Maximum Marks: 80**

Min. Passing Marks: 24

Instructions to Candidates:-

*Attempt any **five questions,** selecting **one question** from **each unit.** All Questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly.*

Units of quantities used/ calculated must be stated clearly.

Use of following supporting material is permitted during examination.

1._____ 2._____

UNIT-I

Q.1 (a) Derive Euler's momentum equation applicable to turbo – machine and also give its physical significances. [8]

(b) A, jet of water moving at 12m/sec impinges on concave vane shaped to deflect the jet through 120^0 when stationary. If the vane is moving at 5m/sec, find the angle of the jet so that there is no shock at inlet. What is the absolute velocity of the jet at exit in magnitude and direction? Assume vane is smooth. [8]

OR

Q.1 (a) What is Specific Speed of turbine? Derive an expression for Non dimensional Specific Speed of turbine. [8]

(b) The following data relates to a turbine operating at 200 rpm with full gate opening:-

Head, H (m)	7.5	6.78	6.18	5.67	5.22	4.8
Power, P (KW)	266	231	201	176	153	131
Overall efficiency η_0 %	81.1	83.1	84.4	84.8	85	84.1

Draw the graphs of unit Power (P_u) and overall efficiency (η_0) against unit speed (N_u) and find how much water is required per second for getting the maximum output under a head of 6.5m. [8]

UNIT-II

Q.2 (a) How are the hydraulic turbines classified? Explain. [8]

(b) Prove that the maximum efficiency of Delton wheel is given by [8]

$$\eta_{max} = \frac{1 + K \cos \phi}{2}$$

OR

Q.2 (a) What are the various efficiencies involved in pelton wheel performance Analysis? Explain and also state and draw the sketches of different types of pelton wheel buckets. [8]

(b) A pelton wheel turbine develops 10 MW under a head of 500 m. taking the overall efficiency of turbine as 90%, jet ratio as 12, Speed ratio as 0.45. Find the nozzle diameter, wheel diameter and the speed. [8]

UNIT-III

Q.3 (a) An inward flow reaction turbine discharges radially and the velocity of flow is constant and equal to velocity of discharge from the turbine. Show that the hydraulic efficiency can be expressed by -

$$\eta_h = \frac{1}{1 + \frac{\frac{\tan^2 2}{2}}{\left[1 - \frac{\tan \alpha}{\tan \theta}\right]}}$$

If vanes are radially at inlet, also show that

$$\eta_h = \frac{2}{2 + \tan^2 \alpha}$$ [8]

(b) A Kaplan turbine develops 10 MW under a net available head of 18m. Assuming a speed ratio of 2, flow ratio 0.7, hydraulic efficiency 93% and overall efficiency 82% and the diameter of boss equal to one third of runner diameter, determine (i) dia of runner and its speed (ii) Inlet blade angle at the edge of the blade. [8]

OR

Q.3 (a) Explain the theory and function of a draft tube. Derive an expression for draft tube. [8]

(b) Prove that cavitation of reaction turbine is - [8]

$$\sigma_c = \frac{Ha - Hmin. - Hs}{H}$$

UNIT-IV

Q.4 (a) Working from the first principles show that the work saved, against friction in delivery pipe of a double acting reciprocating pump, by fitting an air vessel, is 39.2% . [8]

(b) A double acting reciprocating pump, running at 40 rpm is discharging 16.2 liters/sec. The diameter of the piston is 200 mm and stroke length 400 mm. The suction and delivery heads are 6m and 24m respectively. Find the percentage of slip and power required to drive the pump. Take mechanical efficiency as 80%.

[8]

OR

Q.4 Describe the following -

(i) Hydraulic Ram

(ii) Hydraulic torque converter

(iii) Hydraulic Coupling

(iv) Air lift pump. [4x4=16]

UNIT-V

Q.5 (a) State and explain the essential components of Hydro Electric Power Station (HEPS) with the help of neat sketches. [8]

(b) What are the factors considered for site selection of HEPS? Explain. [8]

OR

Q.5 (a) What is Surge tank? Explain the various types of surge tanks used in HEPS with heat sketches. [8]

(b) Explain the development of Hydro power in India as well as in Rajasthan. Also give the present status of hydro power in India and Rajasthan. [8]
