provide power of 256000 kW at a guaranteed efficiency of 91%. The nozzle efficiency is 0.98. Find (i) the design discharge for the turbine (ii) jet diameter and number of jets (iii) nozzle tip diameter (iv) the pitch circle diameter of the wheel (v) the specific speed (vi) number of buckets on the wheel. 14

9. (a) Briefly explain the characteristics of turbines.

   (b) Discuss the classification of turbine based on specific speed. 7+7

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Code : 011846

B.Tech. 8th Semester Exam., 2017

Water Power Engineering

Time : 3 hours *Full Marks : 70*

Instructions :

(i) The marks are indicated in the right-hand margin.

*(ii) There are **Nine** questions in this paper.*

*(iii) Attempt **Five** questions in all.*

(iv) Questions No. 1 is compulsory.

1. Write short answers (Answer any seven): 2×7=14

   (a) Load Curve

   (b) Load duration curve

   (c) Classification of power plant based on head

   (d) Water Hammer

   (e) Run-of-river plants

   (f) Surge tanks

   (g) Specific speed

   (h) Components of hydropower plant

   (i) Penstock

   (j) Flow duration curve

2. When a run-off-river plant operates as a peak load station with a weekly load factor of 20%, all its capacity is firm capacity. What must be the minimum flow in the river so that the station may serve as the base load station? It is given that

   Rated installed capacity of generator = 10000 kW

   Operating head = 15m

   Plant efficiency = 80%

   Estimate the daily load factor of the plant if the stream flow is 15 cumec. 14

3. The load on a hydel plant varies from a minimum of 10000 kW to a maximum of 35000 kW. Two turbo-generators of capacity 22000 kW each have been installed. Calculate the (i) total installed capacity of the plant (ii) plant factor (iii) maximum demand (iv) load factor (v) utilization factor. 14

4. Briefly explain the components of a hydropower scheme. 14

5. A penstock pipe, 750 m long, takes off from a reservoir and feeds water to a turbine, the level of which is 220m below the reservoir water level. The first 250 m length of the penstock has a cross-sectional area of 5 m^2 and the rest has an area of 3 m^2. The steady state discharge is 9 m^3/s. If the turbine gates are closed in a period of 4.5 seconds completely at a uniform rate, how much water hammer pressure would be developing? The value of Z^2 is 1.32 from the Allievi chart. Assume the wave velocity to be 1000 m/s. 14

6. Derive elastic water column theory. 14

7. (a) A penstock with an internal diameter of 1.20 m, supplies water at a head equivalent to 17.6 kg/cm^2. There is a possibility of 20% increase in the pressure due to transient conditions. The design stress and the efficiency of the joint may be assumed to be 1020 kg/cm^2 and 85% respectively. Calculate the required wall thickness of the penstock approximately.

   (b) What is meant by economical diameter of a penstock? How can it be found? 7+7

8. Koyna (first stage) powerhouse is equipped with four units of vertical shaft Pelton turbines to be coupled with 70000 kVA, 3-phase, 50 Hertz generators. The generators are provided with 10 pairs of poles. The gross design head is 505 m and the transmission efficiency of the headrace tunnel and penstocks together is to be 94%. The four units together will