



End Term (Even) Semester Examination May-June 2025

Roll no.....

Name of the Program and semester: B.Tech (Civil Engineering) /VIII

Name of the Course: Water Power Engineering

Course Code: TCE 811

Time: 3 hour

Maximum Marks: 100

Note:

- (i) All the questions are compulsory.
- (ii) Answer any two sub questions from a, b and c in each main question.
- (iii) Total marks for each question is 20 (twenty).
- (iv) Each sub-question carries 10 marks.

Q1

(10X 2 = 20 Marks)

- a) Describe the various sources of energy also describe the constraints in hydropower development?
- b) A four way is to design to meet out the pondage requirement of a runoff river scheme. The daily flow in the river is $20 \text{ m}^3/\text{s}$. The plant is to be used as 15 hrs peaking station. Calculate the pondage factor and storage capacity of four ways? CO1
- c) The yearly output of a base load plant with 25 MW installed capacity is $125 \times 10^6 \text{ kWh}$. The plant takes a peak of 22.5 MW. Calculate the annual load factor and capacity factor?

Q2

(10X 2 = 20 Marks)

- a) In a hydroelectric station, water is available at the rate of $175 \text{ m}^3/\text{s}$ under a head of 18m the turbine run at speed of 150 r.p.m with overall efficiency of 82%. Predict the number of turbine required if they have the maximum specific speed of 460.
- b) Explain the Diversion Canal Plant with different layouts with a neat sketch?
- c) A runoff river plant on a stream have a inflow of $20 \text{ m}^3/\text{s}$ and net head of 30m with provision of pondage to meet daily peak demand with a load factor of 60% . Determine the power generation capacity of a plant at 80% of overall efficiency. The plant runs at a peak station for 3 hrs and balance period in a day for average load. Calculate the amount of pondage is needed? CO2

Q3

(10X 2 = 20 Marks)

- a) Describe underground power station also explain the ways of locating an underground power station with neat sketch?
- b) Explain all the types of an underground power station with a neat sketch?
- c) "An underground powerhouse may be laid out in one of the following ways" Describe the arrangements or types of layout of an underground power station with a neat diagram? CO3

Q4

(10X 2 = 20 Marks)

- a) "Penstocks may be classified on the certain basis" explain the entire basis in detail?
- b) A power canal, bed width 15 m, may be assumed to be rectangular in shape with a steady state depth of flow of 3 m. The canal supplies water to a power house with 3 turbines, each turbine CO4



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rated at a discharge of $30\text{m}^3/\text{s}$. If the load in the power house is suddenly thrown off so that two of the turbines have to be shut down, Predict the height of the surge in the canal?

- c) The Tallulah Falls Project in USA has a surge tank at the end a 2030 m long tunnel, 4.22 m in dia. The surge tank, which is rectangular in section, may be presumed to be of a circular cross section, 15.85 m in diameter. The penstock system consists of 5 penstock each 1.525 m in dia. and 380 m long. These can be represented by a single penstock, 380 m long and 3.41m in diameter. Friction factor f for tunnel and the penstock in 0.018 and 0.03 respectively. The acoustic wave velocity in the penstock is 1370 m/s. In steady state, the head reservoir level is El.457.00 with a discharge of $26.2 \text{ m}^3/\text{s}$. Determine the water hammer pressure for a sudden closure.

Q5

(10X 2 = 20 Marks)

- a) Koyna (first stage) power house is equipped with 4 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 505m and the transmission efficiency of head race tunnel and penstock together is to be 94 percent. The four units together will provide for a power of 348000hp at a guaranteed efficiency of 91 percent. The nozzle efficiency is 0.98. Find the design discharge for the turbine, jet dia. And no. of jets, the nozzle tip diameter, the pitch circle dia. Of the wheel, the specific speed and number of buckets on the wheel. If the turning angle of buckets of the wheel is 165degree, the bucket friction k is 0.98 , Calculate the theoretical work done per kg water done per kg of water on the wheel and establish the budget of the head loss. Assume discharge n= 99.75 percent.
- b) Explain governing of turbine also describe the Hydraulic governing?
- c) At the Volgaimeni V.I. Lenin hydroelectric plant , in USSR, the Kaplan turbine used has the following data: Operation head is 22.5m, Output power at this head is 126 MW, Discharge at this head is $615 \text{ m}^3/\text{sec}$, Speed is 68.2 rpm, Runner tip-to-tip diameter (D) is 9.3 m, Hub diameter (D_h) is 4.3 m, Number of blades is 6. Calculate the speed ratio, the flow ratio and the overall efficiency and the maximum suction draft head.

CO5