Code: CE4T4

II B.Tech - II Semester – Regular/Supplementary Examinations October 2020

HYDRAULICS AND HYDRAULIC MACHINERY
(CIVIL ENGINEERING)

Duration: 3 hours   Max. Marks: 70

PART – A

Answer **all** the questions.   All questions carry equal marks

11 x 2 = 22 M

1.
   a) What are the different types of flow in open channel?
   b) What are the conditions for the most economical trapezoidal channel section?
   c) Define the principle of Dimensional Homogeneity.
   d) What are merits of distorted models over undistorted models?
   e) Define Angular – Momentum Principle.
   f) What are the different types of hydropower plants?
   g) Differentiate Hydraulic efficiency and Mechanical efficiency.
   h) Classify the turbines according to the main direction of flow of water in the runner.
   i) Define Specific speed of a turbine.
   j) Differentiate Static head and Manometric head of a centrifugal pump.
   k) What are the effects of cavitation?

PART – B

Answer any **THREE** questions.   All questions carry equal marks.

$$3 \times 16 = 48 \text{ M}$$

2. a) A rectangular channel 7.5 m wide has a uniform depth of flow of 2.0 m and has a bed slope of 1 in 3000. If due to weir constructed at the downstream end of the channel, water surface at a section is raised by 0.75 m, determine the water surface slope with respect to horizontal at this section. Assume Manning's n = 0.02.   8 M

   b) Derive the energy loss equation for hydraulic jump in rectangular channel and explain the uses of hydraulic jump.   8 M

3. a) What are the various similarities that should exist between the model and prototype so that the prototype represents the model. Explain them in detail.   8 M

   b) The resisting force 'F' of a plane during flight can be considered as depending upon length of the air craft 'L', velocity 'V', air viscosity 'μ', air density 'ρ' and bulk modulus of air 'k'. Explain the functional relationship between these variables using dimensional analysis. Give the physical meaning of dimensionless groups.   8 M

4. a) Prove that the force exerted by a jet of water on a fixed semi-circular plate in the direction of the jet when the jet

strikes at the centre of the semi-circular plate is two
times the force exerted by the jet on an fixed vertical plate.

8 M

b) Three turbo generators each of capacity 10,000 kW have
been installed at a hydel power station. During a certain
period of load, the load on the plant varies from
12,000 kW to 26,000 kW. Calculate (i) total installed
capacity (ii) load factor (iii) plant factor and (iv) utilization
factor.

8 M

5. a) Explain Unit speed, Unit discharge and Unit power of a
hydraulic turbine. Derive expressions for each of them.

8 M

b) A Kaplan turbine runner is to be designed to develop
9100 kW. The net available head is 5.6m. If the speed
ratio =2.09, flow ratio =0.68, overall efficiency 86% and
the diameter of the boss is 1/3 the diameter of the runner.
Find the diameter of the runner, its speed and specific
speed of the turbine.

8 M

6. a) Draw and discuss the main and operating characteristic
curves of a centrifugal pump.

8 M

b) The diameter of a centrifugal pump, which is discharging
$0.03m^3$/s of water against a total head of 20 m is 0.40 m.
The pump is running at 1500 r.p.m. Find the head,

discharge and ratio of powers of a geometrically similar pump of diameter 0.25 m when it is running at 3000 r.p.m..

8 M