B. TECH
(SEM IV) THEORY EXAMINATION 2022-23
HYDRAULIC ENGINEERING & MACHINES

Time: 3 Hours   *Total Marks: 100*

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1.   **Attempt *all* questions in brief.**   **2 x 10 = 20**

(a)   What is the main function of air vessels in a reciprocating pump?

(b)   Write down the manning's equation for uniform flow in open channel.

(c)   Define jet ratio in case of a Pelton turbine?

(d)   Define specific energy in open channel flow.

(e)   Find the force exerted by a jet of water of diameter 75 mm on a stationary flat plate when the jet strikes the plate normally with a velocity of 20 m/s.

(f)   Why NDL is above CDL in case of mild slope?

(g)   Write the dynamic equation of gradually varied flow in OCF.

(h)   List various type of surges.

(i)   What is a hydraulic jump in OCF?

(j)   What are the main parts of Pelton turbine?

SECTION B

2.   **Attempt any *three* of the following:**   **10x3=30**

(a)   Derive the condition for the most economic trapezoid channel section. Also show that the hydraulic mean depth for such channel is one half of the depth of flow.

(b)   (i) Write Chezy's equation and assumptions involved in deriving it.
       (ii) A trapezoidal channel has a bottom width of 6 m and side slopes of 1:1. The depth of flow is 1.5 m at a discharge of 15 m³/s. Determine the specific energy. If the critical depth is 0.9 m, discuss the type of flow corresponding to the critical depth.

(c)   What is a hydraulic jump? Deduce the relation between alternate depth of hydraulic jump and Froude Number.

(d)   A jet of water of diameter 50 mm moving with a velocity of 40 m/s, strikes a curved fixed symmetrical plate at the center. Find the force exerted by the jet of water in the direction of the jet, if the jet is deflected through an angle of 120° at the outlet of the curved plate.

(e)   What are different types of efficiencies of hydraulic turbine and explain hydraulic efficiency, mechanical efficiency and overall efficiency. Also Derive relationship among themselves.

SECTION C

3.   **Attempt any *one* part of the following:**   **10x1=10**

(a)   State the conditions under which the rectangular section of an open channel will be most economical. Derive these conditions.

(b)   A trapezoidal channel with one side vertical and the other sloping at 2H:1V carries a discharge of 28 m³/s at a mean velocity of 1.5m/sec. Determine the longitudinal slope and the channel dimensions for the best hydraulic efficiency, if manning's n = 0.014.

4.   **Attempt any *one* part of the following:**   10x1=10

(a) A rectangular channel with bottom width of 4 m and a bottom slope of 0.0008 has a discharge of 1.5 m³/s. In a gradually varied flow in this channel, the depth at a certain location is found to be 0.30 m. Assuming n = 0.016, determine & sketch the GVF profile.

(b) Uniform flow occurs at a depth of 1.5 m in a long rectangular channel 3 m wide laid at a slope of 0.0009. If manning's n =0.015. Calculate
(a) Maximum height of hump on floor to produce critical depth.
(b) The width of contraction which will produce critical depth without increasing the upstream depth of flow.

5.   **Attempt any *one* part of the following:**   10x1=10

(a) Explain various types of hydraulic jumps on the basis of (i) Froude's number and (ii) location with illustrative diagrams.

(b) A horizontal rectangular channel 4 m wide carries a discharge of 16 m³/s. Determine whether a jump may occur at an initial depth of 0.5 m or not. If a jump occurs, determine the sequent depth to this initial depth. Also determine the energy loss in the jump.

6.   **Attempt any *one* part of the following:**   10x1=10

(a) Explain with neat a sketch, the construction details and working principles of a centrifugal pump.

(b) Differentiate between single stage and multistage pumps. Write a note on characteristics curves on roto dynamic pumps.

7.   **Attempt any *one* part of the following:**   10x1=10

(a) Design a Pelton wheel which is required to develop1500KW, when working under a head of160m at a speed of 420rpm. The overall efficiency may be taken as 85% and assume other data required.

(b) Give the range of specific speed values of Kaplan, Francis turbine and Pelton wheel turbine. What is a draft tube and its use? List the different types of draft tube. Draw neat sketches of various shapes of draft tubes.