PAPER ID-411533

Roll No: | | | | | | | | | | | | |

BTECH
(SEM IV) THEORY EXAMINATION 2023-24
HYDRAULIC ENGINEERING AND MACHINES

TIME: 3 HRS **M.MARKS: 100**

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

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

Q no.	Question	Marks	CO
a.	State the specific energy in open channel flow.	02	1
b.	Write Manning's equation for uniform flow in an open channel.	02	1
c.	Discuss the limitations of the equation of gradually varied flow in open channels.	02	2
d.	Differentiate between critical and sub-critical flow.	02	2
e.	What are the key elements to evaluate in a hydraulic jump in a rectangular channel?	02	3
f.	Describe the celerity of a gravity wave in the context of open channel flow.	02	3
g.	Define impulse momentum equation.	02	4
h.	What is pump slip and how is it calculated?	02	4
i.	What are the main parts of Pelton turbine?	02	5
j.	Define specific speed.	02	5

SECTION B

2. Attempt any *three* of the following: **3 x 10 = 30**

a.	Explain the Concept of the Most Efficient Channel Section and Derive the Conditions for Maximum Hydraulic Efficiency.	10	1
b.	In a rectangular channel of width 4 meters, the flow depth is 2 meters and the discharge is 16 cubic meters per second. Calculate the specific energy and determine if the flow is subcritical or supercritical.	10	2
c.	A sudden gate closure in a rectangular channel of width 5 m and initial depth of 2 m causes an open channel surge. If the wave celerity is 5 m/s, determine the depth of water behind the surge.	10	3
d.	Discuss the Operation and Performance Curves of Centrifugal Pumps.	10	4
e.	Describe the working principle of reaction turbines, particularly the Francis and Kaplan turbines. Discuss the concepts of head on a reaction turbine, unit quantities, specific speed, cavitation, and characteristic curves.	10	5

SECTION C

3. Attempt any *one* part of the following: **1 x 10 = 10**

a.	A rectangular channel has a width of 5 meters and carries water with a discharge of 20 cubic meters per second. Determine the critical depth and the specific energy at the critical depth.	10	1
b.	Describe the Velocity and Pressure Distribution in Open Channel Flows and Their Impact on Flow Characteristics.	10	1

4. Attempt any *one* part of the following: **1 x 10 = 10**

a.	Derive the equation of gradually varied flow (GVF) and explain its assumptions and limitations.	10	2
b.	Classify surface profiles in open channel hydraulics. Give examples and implications for flow behavior.	10	2

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5. Attempt any *one* part of the following: 1 x 10 = 10

a.	A rectangular channel with a width of 4 m carries a flow with a discharge of 20 m^3/s. The depth of flow before the jump is 0.5 m. Determine the sequent depth after the jump and the energy loss.	10	3
b.	Describe the principles of wave celerity and the difference between deep and shallow water waves. How do these principles apply to the design of hydraulic structures?	10	3

6. Attempt any *one* part of the following: 1 x 10 = 10

a.	Derive the Impulse Momentum Equation for a Jet Striking a Stationary Flat Plate.	10	4
b.	A jet of water with a velocity of 15 m/s and a cross-sectional area of 0.005 m^2 strikes a plate moving in the direction of the jet with a velocity of 5 m/s. Calculate the force exerted by the jet on the moving plate. Assume the density of water is 1000 kg/m^3.	10	4

7. Attempt any *one* part of the following: 1 x 10 = 10

a.	Explain the working principle and components of a Pelton turbine. Derive the equations for the jet and rotor size, and discuss the efficiency of the Pelton turbine.	10	5
b.	A Pelton wheel is designed to operate under a head of 400 m. The rate of water flow through the nozzle is 2 m^3/s. Calculate the jet velocity, diameter of the jet, and the diameter of the runner if the speed ratio is 0.46 and the wheel is to run at 300 rpm. Assume the efficiency of the nozzle is 95%.	10	5