

Code No: 114AA

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech II Year II Semester Examinations, February - 2024

HYDRAULICS AND HYDRAULIC MACHINERY

(Civil Engineering)

Time: 3 Hours

Max. Marks: 75

- Note:** i) Question paper consists of Part A, Part B.
 ii) Part A is compulsory, which carries 25 marks. In Part A, answer all questions.
 iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART - A**(25 Marks)**

- 1.a) What are the various channel bed slopes? [2]
- b) Differentiate between Open channel flow and Pipe flow. [3]
- c) What are the applications of Rayleigh's method? [2]
- d) What are different practical conditions for the formation of M type surface profiles? [3]
- e) Write expression for force when jet striking a moving flat plate. [2]
- f) What are radial flow turbines? Write its applications? [3]
- g) Derive the expression for work done and efficiency of pelton turbine. [2]
- h) Explain the function of draft tube. [3]
- i) What are the various elements of a typical hydropower installation? [2]
- j) Explain different losses in Centrifugal pumps. [3]

PART - B**(50 Marks)**

- 2.a) Derive the dynamic equation for steady gradually varied flow in an open channel.
 - b) Water is released at the rate of $6 \text{ m}^3/\text{s}/\text{m}$ with on a wide horizontal concrete apron with a roughness factor of 0.012. Determine the length of water surface profile between depths of 0.3 m and 0.4 m. Use a single step of direct step method. What is the type of GVF profile? [5+5]
- OR**
- 3.a) A trapezoidal channel having bottom width 8m and slope 1:1 carries a discharge of $80 \text{ m}^3/\text{sec}$. Find the depth conjugate to initial depth of 0.75m before the jump. Also determine the loss of energy in the jump.
 - b) A channel has two sides vertical and semi circular bottom of 3 m dia. Calculate the discharge of water through the channel when the depth of flow is 3 m. $C=50$ and slope of the bed is 1 in 1500. [5+5]
- 4.a) State Buckingham's π -theorem. Why this theorem is considered superior over the Rayleigh's method for dimensional analysis.
 - b) What is meant by geometric, kinematic and dynamic similarities? [5+5]

OR

- 5.a) What do you mean by dimensionally homogenous equation? Give few examples.
- b) Assuming that the rate of discharge Q of a centrifugal pump is dependent upon the mass density ρ of fluid, pump speed N (rpm), the diameter of impeller D , the pressure p and the viscosity of fluid μ . Show that it can be represented by $Q = (ND^3)\phi \left[\left(\frac{gH}{N^2 D^2} \right), \left(\frac{\nu}{ND^2} \right) \right]$. [5+5]

- 6.a) Discuss layout of a typical Hydropower installation.
- b) A jet of water having a velocity of 15m/s strikes a curved vane which is moving with velocity of 5m/s. The vane is symmetrical and is so shaped that the jet is deflected through 120° . Find the angle of the jet at the inlet of the vane so that there is no shock. What is the absolute velocity of the jet at outlet in magnitude and direction and the work done per unit weight of water? Assume the vane to be smooth. [5+5]

OR

- 7.a) Discuss Heads and efficiencies of a Hydropower layout.
- b) A jet of water 75 mm diameter having a velocity of 20m/s, strikes normally a flat smooth plate. Determine the thrust on the plate (i) if the plate is at rest (ii) if the plate is moving in the same direction as the jet with a velocity of 5 m/s. Also find the work done per second on the plate in each case and the efficiency of the jet when the plate is moving. [5+5]

8. A Kaplan turbine develops 60,000 kw of power under a head of 25m with an overall efficiency of 90%. Taking the value of flow ratio $\phi = 0.5$, speed ratio $\varphi = 1.6$, the hub diameter as 0.35 times the diameter of the runner, find:
- a) The diameter of the runner
b) The speed of the turbine
c) The specific speed of the turbine. [4+3+3]

OR

- 9.a) Describe briefly the functions of various main components of pelton turbine.
- b) A Pelton wheel has to be designed for the following data Power to be developed = 6000 kW. Net head available = 300 m; Speed = 550 r.p.m.; Ratio of jet diameter to wheel diameter = 1/10; and overall efficiency = 85%. Find the number of jets; diameter of the jet; diameter of the wheel; and the quantity of water required. [5+5]

- 10.a) Briefly explain the characteristics of centrifugal pumps.
- b) The diameter and width of a centrifugal pump impeller are 50 cm and 2.5 cm. The pump runs at 1200 rpm. The suction head is 6 m and the delivery head is 40m. The frictional drop in suction is 2 m and in the delivery 8 m. The blade angle at out let is 30° . The manometric efficiency is 80% and the overall efficiency is 75%. Determine the power required to drive the pump. Also calculate the pressures at the suction and delivery side of the pump. [5+5]

OR

11. Write short notes on:
- a) Estimation of hydropower potential
b) Diversion canal plants
c) High head diversion plants. [4+3+3]