R20 Regulation *Subject code:3P4AD*

TKR COLLEGE OF ENGINEERING AND TECHNOLOGY

(Autonomous, Accredited by NAAC with 'A' Grade)

B.Tech IV Semester Regular/Supplementary Examinations, September 2023

Hydraulics and Hydraulic Machinery

(Civil Engineering)

Maximum Marks: 70 Date:24.09.2023 Duration: 3 hours

Note: 1.This question paper contains two parts A and B.
2. Part A is compulsory which carries 20 marks. Answer all questions in Part A.
3. Part B consists of 5 Units. Answer any one full question from each unit which carries 10M.
4. Each question carries 10 marks and may have a, b, c, d as sub questions.

Part-A

All the following questions carry equal marks (10x2M=20 Marks)

1 Distinguish between open channel flow and pipe flow.
2 Differentiate between critical, sub-critical and super-critical flow in a open channel.
3 State Buckingham's π-Theorem.
4 What do you mean by fundamental units and derived units?
5 Find the force exerted by a jet of water of diameter 75mm on a stationary flat plate, when the jet strikes the plate normally with velocity of 20 m/s.
6 Define angular momentum principle.
7 Draw the neat sketches of the Pelton Turbine.
8 What is Cavitation?
9 Outline centrifugal pump.
10 Define slip, percentage slip and negative slip in a reciprocating pump.

Part-B

Answer All the following questions. (5X10M=50Marks)

11 A. Explain the significance of channels of most efficient section. 5M
B. What do you understand by (a) steady and unsteady flow; (b) uniform and non-uniform flow in the case of channels? 5M

OR

12 A most efficient trapezoidal section is required to give a maximum discharge of 21.5 m^3/s of water. The slope of the channel bottom is 1 in 2500. Taking C= 70 in Chezy's equation, determine the dimensions of the channel. Also determine the value of Manning's n, taking the value of velocity of flow as obtained for the channel by Chezy's equation. 10M

13 Find the form of the equation for discharge Q through a sharp-edged triangular notch assuming Q depends on the central angle α of the notch, head H, gravitational acceleration g and on the density ρ, viscosity μ and surface tension σ of the fluid by using Rayleigh's method. 10M

OR

14 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 using the Buckingham's π-theorem that it can be represented by

$$Q = (ND^3)\phi\left[\left(\frac{gH}{N^2D^2}\right),\left(\frac{\upsilon}{ND^2}\right)\right]$$

where H = head and υ = kinematic viscosity of the fluid. 10M

15 Show that the force exerted by a jet of water on an inclined fixed plate in the direction of the jet is given by,

$$F_x = \rho A V^2 \sin^2\theta$$

Where A = area of the jet, V = velocity of the jet and θ = inclination of the plate with the jet. 10M

OR

16 A jet of water 75 mm diameter having a velocity of 20 m/s, strikes normally a flat smooth plate. Determine the thrust on the plate (a) if the plate is at rest, (b) 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. 10M

17 Derive the steps involved in design of Pelton wheel. 10M

OR

18 A. Explain the difference between Kaplan turbine and Fracis Turbine. 5M

B. By means of a neat sketch explain the governing mechanism of Francis Turbine. 5M

19 A single-acting reciprocating pump, running at 50 r.p.m., delivers 0.01 m^3/s of water. The diameter of the piston is 200mm and stroke length 400mm. Determine the following:

i) The theoretical discharge of the pump,

ii) The coefficient of discharge and

iii) Slip and the percentage slip of the pump. 10M

OR

20 Obtain an expression for the work done by impeller of a centrifugal pump on water per second per unit weight of water. 10 M