R20 Regulation *Subject code:* 3P4AD

TKR COLLEGE OF ENGINEERING AND TECHNOLOGY

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

B.Tech IV Semester Regular Examinations, July 2022

HYDRAULICS AND HYDRAULIC MACHINERY

(CIVIL ENGINEERING)

Maximum Marks: 70 Date:28.07.2022 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 List out different types of flows and channels.
2 Define Specific energy.
3 Define the term similitude.
4 What is meant by dimensionless numbers?
5 What are the applications for radial flow.
6 What is meant by angular momentum principle?
7 What is the function of a draft tube?
8 What are the types of turbine based on the direction of flow?
9 What is meant by cavitation?
10 Differentiate static head and manometric head.

Part-B

Answer All the following questions. (10MX 5=50Marks)

11 (a) Find the velocity of flow and rate of flow of water through a rectangular channel of 6 m wide and 3 m deep, when it is running full. The channel is having bed slope as 1 in 2000. Take Chezy's constant C = 55. (5)

(b) Find the slope of the bed of a rectangular channel of width 5m when the depth of water is 2 m and the rate of flow is given as 20 m^3/s.Take Chezy's constant, C = 50. (5)

OR

12 (a) Find the rate of flow of water in a Trapezoidal section of 10 m wide and 1.5 m deep, when water is flowing with a velocity of 1 m/s. The flow of water through the channel of bed slope in 1 in 4000.(5)
(b) Obtain most econimal conditions for Trapezoidal section. (5)

13 Using Buckingham's π theorem, show that the velocity through a circular orifice is given by $V = \sqrt{2gH}\ \emptyset\ \left[\frac{D}{H}, \frac{\mu}{\rho v H}\right]$, where H is the head causing flow, D is the diameter of the orifice, μ is the co-efficient of viscosity, ρ is the mass density and g is the acceleration due to gravity. (10)

OR

14 Derive an expression for drag force on smooth sphere of diameter, rolling with a uniform velocity, in a fluid of density and dynamic viscosity using Rayleigh's Method. (10)

15 A rectangular plate weighing 58.86 N is suspended vertically by a hinge on the top of the horizontal edge. The centre of gravity of the plate is 10 cm from the hinge. A horizontal jet of water 2 cm diameter, whose axis is 15 cm below the hinge normally impinges on the plate with a velocity of 5 m/s. Find the horizontal force applied at the centre of the gravity to maintain the plate in its vertical position. Find the corresponding velocity of the jet, if the plate is deflected through 30° and the same force continues to act at the centre of gravity of the plate. (10)

OR

16 A jet of water of diameter 50 mm moving with a velocity of 25 m/s impinges on a fixed curved plate tangentially at one end at an angle of 30° to the horizontal. Calculate the resultant force of the jet on the plate if the jet is deflected through an angle of 50°. Take $g = 10\ m/s^2$. (10)

17 A Pelton wheel is to be designed for a head of 60 m when running at 200 r.p.m. The Pelton wheel develops 95.6475 kW shaft power. The velocity of the buckets = 0.45 times the velocity of the jet, overall efficiency = 0.85 and co-efficient of the velocity is equal to 0.98. (10)

OR

18 A Kaplan turbine develops 24647.6 kW power at an average head of 39 metres. Assuming a speed ratio of 2, the flow ratio of 0.6, the diameter of the boss equal to 0.35 times the diameter of the runner and an overall efficiency of 90%, calculate the diameter, speed and specific speed of the turbine. (10)

19 A centrifugal pump rotating at 1000 r.p.m. delivers 160 litres/s of water against a head of 30 m. The pump is installed at a place where atmospheric pressure is $1 \times 10^5\ P_a$ (abs.) and water vapour pressure is 3 kPa (abs.). The head loss in the suction pipe is equivalent to 0.2 m of water. Calculate (i) Minimum NPSH, and (ii) Maximum allowable height of the pump from free surface of the water in the sump. (10)

OR

20 Derive the expression for pressure head due to acceleration in the suction and delivery pipes of the reciprocating pumps. (10)