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B020412(020)

B. Tech. (Fourth Semester) Examination, April-May 2022

(AICTE Scheme)

(Civil Engg. Branch)

HYDRAULIC ENGINEERING

Time Allowed : Three hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note : *Attempt all questions. Part (a) of each question is compulsory and carries 4 marks. Attempt any* ***two*** *parts from (b), (c) and (d) which carry 8 marks each.*

Unit-I

1. (a) Define Hydro-dynamically Smooth and Rough Boundaries? 4

(b) Derive velocity distribution formula for Turbulent flow in Smooth Pipes. 8

(c) A main pipe divides into two parallel pipes which again forms one pipe. The length and diameter for the first parallel pipe are 2000 and 1 m respectively, while the length and diameter of 2nd parallel pipe are 2000 m and 0·8 m. Find the rate of flow in each parallel pipe, if total flow in the main is 3·0 m^3/s. The coefficient of friction for each parallel pipe is same and equal to 0·005. 8

(d) Determine the distance from the pipe wall at which the local velocity is equal of the average velocity for turbulent flow in pipes. 8

Unit-II

2. (a) Define Turbulent Boundary Layer. 4

(b) Derive equation for Displacement Thickness δ^*. 8

(c) Find the displacement thickness, the momentum thickness and energy thickness for the velocity distribution in the boundary layer given by : 8

$$\frac{u}{U} = 2\left(\frac{u}{\delta}\right) - \left(\frac{u}{\delta}\right)^2$$

(d) For the velocity profile given in above question, find the thickness of boundary layer at the end of the plate and the drag force on one side of a plate 1 m long and 0·8 m wide when placed in water flowing with a velocity of 150 mm per second. Calculate the valve of coefficient of drag also. Take μ for water = 0·01 poise. 8

Unit-III

3. (a) Define Back Water and Afflux. 4

(b) Derive equation of Gradually Varied flow. 8

(c) Define critical flow and their types and what are the condition for maximum discharge for given value of

$$E = h + \frac{v^2}{2g}$$ 8

(d) A sluice gate discharges water into a horizontal rectangular channel with a velocity of 6 m/s and depth of flow is 0·4 m. The width of the channel is 8 m. Determine whether a hydraulic jump will occur,

and if so, find its height and loss of energy per kg of water. Also determine the power lost in the hydraulic jump. 8

Unit-IV

4. (a) Write dimensions of the quantities of angular velocity, kinematic viscosity, specific weight and force. 4

(b) State Buckingham's π theorems and the Efficiency of torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity u and ρ density in a turbulent flow is given by

$$T = D^2 N^2 \rho\phi \frac{\mu}{D^2 N \rho^*}$$ 8

Prove this by the method of Dimensions.

(c) Define model analysis and different dimensionless numbers in brief. 8

(d) Water is flowing through a pipe of diameter 30 cm at a velocity of 4 m/s. Find the velocity of oil flowing in another pipe of diameter 10 cm, if the condition of dynamic similarity is satisfied between the two pipes.

The viscosity of water and oil is given as 0·01 poise and 0·025 poise.
The sp. gr. of oil = 0·8 8

Unit-V

5. (a) Define hydraulic and mechanical efficiency of turbine. 4

(b) A Kalpan turbine runner is to be designed to develop 7357 kW shaft power. The net available. head is 5·50 m. Assume that the speed ratio is 2·09 and flow ratio is 0·68, and the overall efficiency as 60%. The diameter of the boss is 1/3rd of diameter of the runner. Find the diameter of the runner, its speed and its specific speed. 8

(c) What is a draft tube? Explain in detail. Explain the theory of draft tube? Also give the expression for efficiency of draft tube. 8

(d) A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 r. p. m. work against a total head of 40 m. The velocity of flow through the impeller is constant and equal to 2·5 m/s. The vanes are set back at an angle of 40° at outlet. If the outer diameter of the

impleller is 500 mm and width at outlet is 50 mm, determine :

(i) Vane angle at inlet

(ii) Work done by impeller on water per second and

(iii) Manometric efficiency 8