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B020412(020)

B. Tech. (Fourth Semester) Examination, April-May 2021

(AICTE Scheme)

(Civil Engineering Branch)

HYDRAULIC ENGINEERING

Time Allowed : Three hours

Maximum Marks : 100

Minimum Pass Marks : 35

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

Unit-I

1. (a) Write short note on Colebrook-White equation. 4

(b) Show that velocity distribution for turbulent flow through rough pipe is given by

$$\frac{u}{u_*} = 5\cdot 75 \log_{10}\left(y/K\right) + 8\cdot 5$$

u_* = Shear velocity, y = distance from pipe wall

K = roughness factor 8

(c) Determine the wall shearing stress in a pipe of diameter 100 mm which carries water. The velocities at the pipe centre and 30 mm from the pipe centre are 2 m/s & 1·5 m/s respectively. The flow in pipe is given as turbulent. 8

(d) An old water supply distribution pipe of 275 mm diameter of a city is to be replaced by two parallel pipe of smaller diameter having equal lengths & identical friction factor values. Find out the new diameter required. 8

Unit-II

2. (a) What do you mean by boundary layer separation? 4

(b) Find the ratio of displacement thickness to momentum thickness and momentum thickness to energy thickness for the velocity distribution in the boundary layer given by : 8

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

(c) Oil with a free-stream velocity 2·5 m/s flows over a thin plate 2·5 m wide and 2·5 m long. Calculate the boundary layer thickness and the shear stress at the trailing end point and determine the total surface resistance of the plate. Take specific gravity as 0·9 and kinematic viscosity as 10^{-5} m²/s. 8

(d) Prove that the momentum thickness for the boundary layer flows are given by 8

$$\theta = \int_0^\delta \frac{u}{U}\left[1 - \frac{u}{U}\right] dy$$

Unit-III

3. (a) Explain the terms : 4

Minimum specific energy, Critical depth, Critical velocity

(b) A sluice gate discharges water into a horizontal channel with a velocity of 12 m/s and depth of flow 1·2 m. Determine the depth of flow after the jump and consequent loss in total head. 8

(c) Derive the differential equation for steady gradually varied flow in open channels. 8

$$\frac{dh}{dx} = \frac{(i_b - i_e)}{(1 - F_e^2)}$$

(d) The discharge of water through a rectangular channel of width 10 m, is 12 m^3/sec when depth of flow of water is 1·0 m. Calculate :

(i) Specific energy of the flowing water.

(ii) Critical depth & critical velocity 8

Unit-IV

4. (a) What is meant by geometric, kinematic & dynamic similarities? 4

(b) The variable controlling the motion of a floating vessel through water are the drag force F, the speed V, the length L, the density ϱ and dynamic viscosity μ of water and acceleration due to gravity g. Derive an expression for F by dimensional analysis. 8

(c) In the model test of a spillway the discharge and velocity of flow over the model were 3 m^3/s and 2 m/s respectively. Calculate the velocity and discharge over the prototype which is 30 times the model size. 8

(d) The water is flowing with a velocity of 2·5 m/sec in a pipe of length 2500 m and of diameter 480 mm. At the end of the pipe, a valve is provided. Find the rise in pressure if the valve is closed in 20 seconds. Take the value of C = 1500 m/s. 8

Unit-V

5. (a) Differentiate between the turbines and pumps. 4

(b) Define the specific speed of a turbine. Derive an expression for the specific speed. 8

(c) What do you understand by the characteristics curves of a pump? What is the significance of the characteristics curves? 8

(d) A centrifugal pump is to discharge $0{\cdot}18$ m^3/sec at a speed of 1400 r.p.m. against a head of 20 m. The impeller diameter P_S' 200 mm, its width at outlet is 60 mm and manometric efficiency is 75%. Determine the vane angle at the outer periphery of the impeller. 8