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B020412(020)

B. Tech. (Fourth Semester) Examination, Nov.-Dec. 2021

(AICTE Scheme)

(Civil Engineering Branch)

HYDRAULIC ENGINEERING

Time Allowed : Three hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note : *Attempt all questions part (a) is compulsory carries 4 marks. Attempt any two part from (b), (c) and (d) carries 8 marks.*

Unit-I

1. (a) What are the conditions for the change of flow from

laminar to turbulent in a pipe? What is the application of Reynold's experiment?

(b) Explain friction loss in the pipe flow? Derive an expression for head loss due to friction in pipos.

(c) Discuss Prandtl mixing length theory for turbulent shear stress. Write an expression for Reynolds expression for turbulent shear stress.

(d) A smooth pipe of diameter 400 mm and length 800 m carries water at the rate of 0.04 m^3/s. Determine the load lost due to friction, wall shear stress, controlling velocity and thickness of laminar sublayer.

Take $\sqrt{} = 0{\cdot}018$ stokes.

Where $\sqrt{} =$ kinematic viscosity.

Unit-II

2. (a) What are the conditions for the boundary layer formation? What are the effect of boundary layer formation on the fluid flow.

(b) Drive an expression for displacment thickness.

(c) What is momentum thickness and energy thickness. Drive an equation an equation for both momentum and energy thickness.

(d) Find the displacement thickness, m_0 momentum thickness and energy thickness for the velocity distribution in the boundary layer given by $\frac{u}{U} = \frac{y}{\delta}$, where u is the velocity at a distance y fromt the plate and $u = v \quad a + \quad y = \delta$ where δ=boundary layer thickness.

Unit-III

3. (a) Classify flow in open channel. What do you understand by steady and unsteady flow in open channel.

(b) What a detailed derivation for discharge through open channel by Chezy's formula.

(c) The discharge of water through a rectangular channel of width 8m, is 15 m^3/sec when the depth of flow of water is 1.2 m. Calculate specific energy, critical depth and velocity, value of specific energy.

(d) A sluice gate discharges water into horizontal rectangular channel with a velocity of 6 m/sec and depth of flow is 0.4 m. The wideth 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 hydraulic jump.

Unit-IV

4. (a) Name the various methods of dimensional analysis.

(b) Using Buckingham's π theorem, show that m_0 velocity through a circular orifice is given, by $V = \sqrt{2gH\phi}\left[\frac{P}{H}, \frac{\mu}{VH}\right]$ where H is the head causing flow, D is m_0 diameter of orifice, μ is coefficient of viscosity, ϱ is the mass density and g is acceleration due to gravity.

(c) What is dimension less numbers? Explain some of the important dimension less numbers.

(d) The pressure drop in an aeroplane model of size $\frac{1}{10}$ of its prototype is 80 N/cm^2. The model is tested in water. Find the corresponding pressure drop in Prototype. Take density of air = 1·24 kg/m^3. The viscosity of water is 0·01 poise while the viscosity of air is 0·00018 poise.

Unit-V

5. (a) What is centrifugal pump, name different efficiencies of centrifugal pump.

(b) A pelton wheel has a mean bucket speed of 10 m/s with a jet of water flowing at the rate of 700 litre/s under a head of 30 m. The buckets deflect the jet through an angle of 160°. Calculate the power given by water to the runner and hydraulic efficiency of the turbine. Assume coefficient of velocity is 0·98.

(c) A pelton wheel is to be designed for following specifications :

Shaft Power = 11772 kW, Head = 3.00 m, speed = 750 rpm, Overall efficiency = 86%, Jet diameter is not to exceed one sixth of wheel diameter. Determine wheel diameter, the number of jets and diameter of jet. Take $K_{u_1} = 0{\cdot}985$ and $K_{w_1} = 0{\cdot}45$.

(d) Explain specific speed of a centrifugal pump. Derive an expression for specific speed of pump.