15CV43

Fourth Semester B.E. Degree Examination, Aug./Sept. 2020
Applied Hydraulics

Time: 3 hrs. | Max. Marks: 80

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. What do you understand by dimensional homogeneity in dimensional analysis? Explain with an example. **(04 Marks)**

   b. For a laminar flow in a pipe, the drop in pressure ΔP is a function of the pipe length l, its diameter d, mean velocity of flow v and dynamic viscosity μ. Using Rayleigh's method develop the expression for ΔP. **(08 Marks)**

   c. Define centre of buoyancy, Meta centre, Meta centric height and buoyancy. **(04 Marks)**

OR

2 a. Chezy's formula for velocity of flow V for uniform flow in a open channel is written as $V = C\sqrt{RS}$.
   where R = Hydraulic mean radius, S = Slope of bed of channel. Find dimension of Chezy's constant C. **(04 Marks)**

   b. Oil of density 917 kg/m³ and dynamic viscosity = 0.29 PaS flows in a pipe of diameter 15 cm at a velocity of 2 m/sec. What would be the velocity of flow of water in a 1 cm diameter pipe, to make the flows dynamically similar? The density and viscosity of water can be taken as 998 kg/m³ and 1.31×10^{-3} PaS respectively. **(04 Marks)**

   c. A solid cylinder of diameter 30 cm and height 15 cm is to float in water with its axis vertical in sea water (SG = 1.03). If the relative density of the cylinder material is 0.9, examine the stability of the cylinder. **(08 Marks)**

Module-2

3 a. What size of a circular drainage pipe is needed to carry 1.10 m³/sec of discharge when flowing half full? The pipe is laid at a slope of 0.0004 and Mannings n for the material of the pipe can be taken as 0.018. **(05 Marks)**

   b. Draw the specific energy curve for flow through a channel and mark salient points on it. **(05 Marks)**

   c. A rectangular channel 2 m wide carries a discharge of 6.0 m³/sec. Calculate the critical depth, specific energy at critical depth and critical velocity. **(06 Marks)**

OR

4 a. A wide rectangular channel carries a flow of 2.76 m³/sec per metre width, the depth of flow being 1.524 m. Calculate the Critical depth, Velocity, Froude number and check type of flow. **(06 Marks)**

   b. A trapezoidal channel with side slopes of 2H : 1 V has to be designed to carry 15 m³/sec at a slope of 1/5000. Determine the dimensions of the most efficient section. Assume Manning's $\eta = 0.014$. **(08 Marks)**

   c. State the conditions for a most economical rectangular channel section. **(02 Marks)**

Module-3

5 a. If in a hydraulic Jump occurring in a horizontal rectangular channel, the Froude's number before jump is 10.0 and energy loss is 3.20 m. Estimate the (i) Sequent depths (ii) The discharge intensity (iii) Froude's number after jump. **(08 Marks)**

   b. Derive an expression for loss in head due to hydraulic jump. **(05 Marks)**

   c. Briefly explain different types of slopes in a gradually varied flow in a channel section. **(03 Marks)**

OR

6 a. Derive the dynamic equation for a gradually varied flow in an open channel flow with usual notations. **(08 Marks)**

   b. Water flows in a triangular channel of side slope 1 H : 1 V and longitudinal slope of 0.001. Determine whether the flow is mild, steep or critical when a discharge of 0.2 m^3/sec flows through it. Assume Manning's $\eta = 0.015$. For what range of depths will the flow be of type 1, 2 or 3? **(08 Marks)**

Module-4

7 a. A Pelton wheel is working under a head of 45 m and the discharge is 0.8 m^3/sec. The mean bucket speed is 14 m/sec. Find the overall efficiency and power produced if the Jet is deflected by the blades through an angle of 165°. Assume coefficient of velocity = 0.985 and mechanical efficiency $\eta_m = 0.95$. **(08 Marks)**

   b. Derive an expression for a Jet striking a series of moving curved vanes at centre. Also find the condition for maximum efficiency of jet and maximum efficiency. **(08 Marks)**

OR

8 a. Give brief descriptions of classification of turbines. **(04 Marks)**

   b. A Jet of water having a velocity of 45 m/sec impinges without shock on a series of vanes moving at 15 m/sec. The direction of motion of vanes being inclined at 20° to that of the jet. The relative velocity at outlet is 0.9 of that at inlet, and absolute velocity of water at exit is to be normal to motion of vanes. Find
   - (i) Vane angles at entrance and exit.
   - (ii) Workdone on vanes per unit weight of the water supplied by the jet.
   - (iii) The hydraulic efficiency. **(08 Marks)**

   c. State and explain impulse momentum equation. **(04 Marks)**

Module-5

9 a. A Kaplan turbine produces 60000 kW under a net head of 25 m with an overall efficiency of 90%. Taking the value of speed ratio as 1.6 and flow ratio as 0.5 and hub diameter as 0.35 times the outer diameter, find the diameter and speed of turbine. **(08 Marks)**

   b. What is a draft tube? List the functions of draft tube. Explain different types of draft tube with appropriate diagram. **(08 Marks)**

OR

10 a. With a neat diagram, explain principle, components and working of centrifugal pumps. **(08 Marks)**

   b. A centrifugal pump has the following characteristics: Outer diameter of impeller = 800 mm. Width of impeller at outlet = 100 mm. Angle of impeller at outlet = 40°. The impeller runs at 550 rpm and delivers 0.98 m^3/sec of water under an effective head of 35 m. A 500 kW is motor is used to drive the pump. Determine manometric, mechanical and overall efficiencies of the pump. Assume water enters the impeller vanes radially at inlet. **(08 Marks)**

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