4E4113

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B.Tech. IVSemester (Main/Back) Examination, June/July - 2015

Civil Engineering

4CE3A Hydraulics and Hydraulic Machines

Time : 3 Hours **Maximum Marks : 80**

Min. Passing Marks : 26

Instructions to Candidates:

*Attempt any **five** questions, selecting **one** question from **each unit**. All questions carry **equal** marks. (Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.*

Unit - I

1. a) Define the dimensional homogeneity with at least two suitable examples. **(8)**

   b) A 7.2 m high and 15 m long spillway discharge 94m/s of water under a head of 2.0m. if a 1:9 scale model of this spillway is to be constructed, determine model dimension, head over the spillway model and model discharge. If model experience a force of 7500 N, determine force on the prototype. **(8)**

OR

1. a) Illustrate the difference between flow through pipes and flow through channels. **(4)**

   b) A rectangular channel carries water at the rate of 400 liters/sec when bed slope is 1 in 2000. Find the most economical dimension of the channel if C=50 and justify your answer. **(4)**

   c) Show that Reynolds number, $\rho ud/\mu$ is non-dimensional. If the discharge Q through an orifice is a function of the diameter d, the pressure difference p, the density ρ, and the viscosity μ, show that $Q=Cp^{1/2}d^2/\rho^{1/2}$, where C is some function of the non-dimensional group $\left(d\rho^{1/2}p^{1/2}/\mu\right)$ . . . **(8)**

Unit - II

2. a) Explain why pressure gradient in the direction of flow is equal to the shear gradient in the direction normal to the direction of flow. Derive a generalized equation for all types of flow and boundary conditions for the above statement. **(10)**

b) A total of 12 liters/sec of oil is pumped through two pipes in parallel, one 12 cm in diameter and the other is 10 cm in diameter, both pipes are 1000m long. The specific gravity of the oil is 0.97 and the kinematic viscosity 9.0 cm^2/s. Calculate the flow rate through each pipe and the power of the pump. **(6)**

OR

2. a) Derive an expression for pressure drop down a pipe in terms of friction factor. **(4)**

b) In a pipe of diameter 100mm, carrying water, the velocities at the pipe center and 30 mm from the pipe center are found to be 2.5 m/s and 2.2 m/s respectively. Find the wall shearing stress. **(4)**

c) Consider a circular ring of radius, r and thickness dr, derive a common expression for velocity distribution for smooth and rough pipe. **(8)**

Unit - III

3. a) State and explain the Geometric properties of Rectangular, Triangular, Trapezoidal and Circular channels with suitable example **(8)**

b) A concrete lined trapezoidal channel with uniform flow has a normal depth is 2m. The base width is 5m and the side slopes are equal at 1:2 Manning's 'n' can be taken as 0.015 And the bed slope S_0=0.001. Calculate Discharge (Q), Mean velocity (V) and Reynolds number (Re). Given ρ = 1000 kg/m^3 and Viscosity 'μ' =1.14×10^{-3}N-s/m^2. **(8)**

OR

3. a) A triangular gutter whose sides include an angle of 60° conveys water at a uniform depth of 300 mm. If the bed gradient is 1 in 150 find the discharge. Take Chezy's constant C=55 $m^{1/2}/s$. **(8)**

b) A canal has a bottom width of 4m and sides with a slope of 1 vertical to 1.5 horizontal. The depth of water is 1.0m when the discharge is $4m^3/s$.

a) Calculate the slope of the channel bed using the Manning formula with n=0.022.

b) Calculate the discharge in m^3/s when the depth of flow is 1.2m. **(8)**

Unit - IV

4. a) Why hydraulic jump is used as an energy dissipater at the toe of the spillway of a dam? Discuss different way of obtaining hydraulic jump. **(8)**

b) A sluice gate discharges water into a rectangular channel with a velocity of 5.0 m/s and depth of flow is 0.4 m. The width of the channel is 6.0 m. Determine hydraulic jump will occur, if yes find its height and loss of energy per kg of water. Determine the power lost in the hydraulic jump. **(8)**

OR

4. a) Derive an expression for force exerted by a jet of water on a moving semi circular plate in the direction of the jet when the jet strikes at the centre of the semi circular plate. **(8)**

b) A jet of water with a velocity of 40 m/s strikes a curved vane which moves with a velocity of 20 m/s. The jet makes an angle of 30° in the direction of motion of vane at the inlet and leaves at 90° to the direction of motion of the vane at the outlet. Determine vane angle at the outlet, if water enters and leaves without shock a id also determine effuciency. **(8)**

Unit - V

5. a) Derive an expression for the minimum starting speed of a centrifugal pump. **(6)**

b) Define priming of a centrifugal pump and how it is done? **(4)**

c) A centrifugal pump runs at 1000 rpm and delivers water against a head of 15.0 m, The impeller diameter and width at the outlet are 0.3 and 0.05m respectively. The vanes are curved back at an angle of 30^0 with the periphery at the outlet. If the maximum efficiency is 92%, find the discharge. **(6)**

OR

5. a) Draw the neat sketch of a Kaplan turbine with its parts and explain its working. **(8)**

b) A Kaplan turbine runner is to be designed to develop 10MW. The net head is 0.6m, the speed ratio = 2.09, flow ratio = 0.68, overall efficiency is 80% and the diameter of the boss is 1/3 diameter of the runner. Find the diameter of the runner, speed and specific speed of the turbine. **(8)**
