CBCS SCHEME

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15CV43

Fourth Semester B.E. Degree Examination, June/July 2019
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. State and prove the Buckingham π-Theorem. Also explain its advantages over Rayleigh's method of dimensional analysis. **(05 Marks)**

b. A ship 300m long moves in sea-water, whose density is 1030 kg/m^3. A 1:100 model of this ship is to be tested in a wind tunnel. The velocity of air in the wind tunnel around the model is 30 m/s and the resistance of the model is 60N. Determine the velocity of ship in sea-water and also the resistance of the ship in sea-water. The density of air is given as 1.24 kg/m^3. Take the kinematic viscosity of sea-water and air as 0.012 strokes and 0.018 strokes respectively. **(08 Marks)**

c. Define: Buoyancy, Metacentre Metacentric height. **(03 Marks)**

OR

2 a. Explain the Froude model law. Derive the different scale ratio for Froude model law. **(08 Marks)**

b. Derive on the basis of dimensional analysis suitable parameters to present the thrust developed by a propeller. Assume that the thrust P depends upon the angular velocity W speed of advance V, diameter D, dynamic viscosity μ, mass density ρ, elasticity of the fluid medium which can be denoted by the speed of sound in the medium C. **(08 Marks)**

Module-2

3 a. Prove that for a channel of circular section the depth of flow d = 0.81D for maximum velocity. Where D = Diameter of circular channel, d = depth of flow. **(08 Marks)**

b. The discharge of water through a rectangular channel of which width 8m is 15m^3/s when depth of flow of water is 1.2m. Calculate:

i) Specific energy of the flowing water
ii) Critical depth and critical velocity
iii) Value of maximum specific energy. **(08 Marks)**

OR

4 a. Explain specific energy curve, and thus derive expression for critical depth and critical velocity. **(08 Marks)**

b. An open channel of most economical section, having the form of a half hexagon with horizontal bottom is required to give a maximum discharge of 20.2 m^3/s of water. The slope of the channel bottom is 1 in 2500. Taking Chezy's constant C = 60 in Chezy's equation, determine the dimensions of the cross-section. **(08 Marks)**

Module-3

5 a. Define the term hydraulic jump. Derive an expression for depth of hydraulic jump in terms of u/s Froude's number. **(08 Marks)**

b. Find the slope of the free water surface in a rectangular channel of width 20m having depth of flow 5m. The discharge through the channel is $50m^3/s$. The bed of the channel is having a slope of 1 in 4000. Take the value of Chezy's constant C = 60. **(08 Marks)**

OR

6 a. Derive an expression for the length of Back water curve **(08 Marks)**

b. A sluice gate discharge water in to a horizontal rectangular channel with a velocity of 6m/s and depth of flow is 0.4m. The width of the channel is 8m. 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. **(08 Marks)**

Module-4

7 a. Derive an equation for the force existed by a jet of water on a fixed curved plate in the direction of the jet when the jet strikes at the centre of the plate. Hence show that the force exerted on semi circular plate is two times the force exerted by the jet on an fixed vertical plane plate. **(08 Marks)**

b. A pelton wheel is having a mean bucket diameter of 1m and is running at 999.9 rpm. The net head on the pelton wheel is 699m. If the side clearance angle is 15° and discharges through nozzle is $0.1m^3/s$ find:

i) Power available at the nozzle

ii) Hydraulic efficiency of the turbine. **(08 Marks)**

OR

8 a. A jet of water of diameter 50mm, having a velocity of 20 m/s strikes a curved vane which is moving with a velocity of 10m/s in the direction of the jet. The jet leaves the vane at an angle of 60° to the direction of motion of vane at outlet.

Determine:

i) The force exerted by the jet on the vane in the direction of motion.

ii) Work done per second by the jet. **(08 Marks)**

b. What do you mean by gross had, net Head and efficiency of turbine? Explain the different types of the efficiency of a turbine. **(08 Marks)**

Module-5

9 a. Define draft tube. What are the different types of draft tube? Explain draft tube theory and its efficiency. **(08 Marks)**

b. A centrifugal pump is to discharge $0.118\ m^3/sec$ a speed of 1450 rpm against a head of 25m. The impeller diameter is 250mm. Its width at outlet is 50mm and manometric efficiency is 75%. Determine the vane angle at the outer periphery of the impeller. **(08 Marks)**

OR

10 a. Define specific speed of a centrifugal pump. Derive an expression for the same. **(08 Marks)**

b. A Kaplan turbine develops 24647.6 kW power at an average head of 39m. Assuming a speed ratio of 2. Flow ratio of 0.6, diameter of the boss equal to 0.35 times the diameter of the runner and an overall efficiency of 90%. Calculate the diameter, speed and specific speed of the turbine. **(08 Marks)**

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