

CBCS Scheme

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15CV43

Fourth Semester B.E. Degree Examination, June/July 2017
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 is meant by dimensionally homogeneous equation? Explain with an example. (04 Marks)
- b. Define i) Center of buoyancy ii) Metacenter. How these are used to identify the equilibrium condition of floating bodies? (06 Marks)
- c. In a 1:30 model of spillway, the velocity and discharge are 1.5m/s and 2m³/s. Find the corresponding velocity and discharge in prototype. (06 Marks)

OR

- 2 a. Using Buckingham π -theorem, derive the following relationship
- $$R = \rho V^2 D^2 \cdot \phi \left[\frac{\mu}{\rho V D}, \frac{H}{D} \right]$$
- Where R = Resistance. ρ = density, V = Velocity of flow, D = diameter, μ = Viscosity, H = height. (07 Marks)
- b. Define : (06 Marks)
- i) Geometric similarity ii) Kinematic similarity and iii) Dynamic similarity.
- c. A body of cross-sectional area 2m² and depth 5m has specific gravity 0.8. Determine the depth of immersion of the body. (03 Marks)

Module-2

- 3 a. Derive Chezy's equation for discharge through uniform flow in open channel. (08 Marks)
- b. A 3m wide rectangular channel carries 2.4m³/s discharge at a depth of 0.7m. Determine:
- i) Specific energy at 0.7m depth
- ii) Critical depth
- iii) Alternate depth to 0.7. (08 Marks)

OR

- 4 a. For the most economical trapezoidal section show that half of top width is equal to side slope length. (08 Marks)
- b. A rectangular channel 6m wide and 1m depth of water has a bed slope of 1 in 900 and is having $n = 0.012$. Determine the discharge. What will be the dimensions of the channel for maximum discharge with amount of lining being kept constant? Also compute percentage increase in discharge. (08 Marks)

Module-3

- 5 a. Derive the relationship between conjugate depths in case of hydraulic jump on a horizontal floor. (08 Marks)
- b. A rectangular channel with bottom width 4m and bed slope 0.0008 has a discharge of 1.5m³/s. In a GVF in this channel the depth at a certain section is 0.3m. If $n = 0.016$, determine the type of profile. (08 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
 2. Any revealing of identification, appeal to evaluator and/or equations written eg. 42+8 = 50, will be treated as malpractice.

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OR

- 6 a. Explain the classification of surface profiles in an open channel with neat sketches. (10 Marks)
- b. A rectangular channel 8m wide discharges water with a depth of 0.4m and 6m/s velocity. Find the formation of hydraulic jump and if so, determine jump height and energy loss in meters. (06 Marks)

Module-4

- 7 a. Show that the maximum efficiency of jet striking at the center of a symmetrical single curved vane is $\left(\frac{16}{27}\right)$. vane is semicircular. (08 Marks)
- b. A Pelton wheel turbine has to be designed for the following :
Data: Power = 6000kW, Net head = 300m, Speed = 550rpm, Jet ratio = 1/10, Overall efficiency = 85%, $C_v = 0.98$, Speed ratio is 0.46. Determine diameter of runner and jet, discharge and number of jets required. (08 Marks)

OR

- 8 a. Draw a neat sketch of a layout of hydroelectric power plant and explain the functions of each component. Also define different heads. (08 Marks)
- b. A jet of water moving at 30m/s impinges on a series of curved vanes moving with a velocity of 15m/s. The jet makes an angle of 30° to the direction of motion of vane when entering and leaves at an angle of 120° to the direction of motion of vanes. Draw the velocity triangles at inlet and outlet and find :
i) The vane angle at inlet and outlet
ii) Workdone per N of water
iii) Hydraulic efficiency. (08 Marks)

Module-5

- 9 a. Define :
i) Unit head ii) Unit discharge iii) Unit power. (03 Marks)
- b. Derive the expression for minimum starting speed of a centrifugal pump. (06 Marks)
- c. A Kaplan turbine runner is to be designed to develop 7350kW power under a head of 5.5m with $\eta_o = 85\%$. Boss diameter = $\frac{1}{3}$ diameter of runner, speed ratio = 2.1, Flow ratio = 0.7. Determine :
i) Diameter of runner and boss, ii) Speed. (07 Marks)

OR

- 10 a. Define draft tube. Explain its function. Draw the neat sketches of types of draft tubes. (06 Marks)
- b. Define: i) Manometric head ii) Static head iii) Suction head iv) Delivery head. (04 Marks)
- c. A centrifugal pump runs at 1000rpm and delivers water against a head of 15m. The impeller diameter and width at the outlet are 0.3m and 0.05m respectively. The vanes are curved back at 30° $\eta_{man} = 92\%$. Find discharge. (06 Marks)

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