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Fourth Semester B.E. Degree Examination, July/August 2022

Applied Hydraulics

Time: 3 hrs.

Max. Marks: 100

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

Module-1

- 1 a. State and prove Buckingham π -Theorem. Explain the selection of repeating variables. (08 Marks)
- b. Define : i) Centre of buoyancy ii) Meta centre. How these are used to identify the equilibrium condition of floating bodies. (06 Marks)
- c. In 1 in 40 model of a Spillway the velocity and discharge are 2m/s and 2.5m³/s. Find the corresponding velocity and discharge in prototype. (06 Marks)

OR

- 2 a. A block of wood of specific gravity 0.7, floats in water. Determine the meta centre height of the block if it size is 2m \times 1m \times 0.8m. (08 Marks)
- b. Define the terms : i) Model analysis ii) Hydraulic similitude iii) Dimensional homogeneity. (06 Marks)
- c. The velocity of sound in air varies as bulk modulus K and mass density ρ . Derive an expression for velocity in the form $C = \sqrt{\frac{K}{\rho}}$. (06 Marks)

Module-2

- 3 a. Derive the conditions for most economical trapezoidal section. (10 Marks)
- b. The discharge of water through a rectangular channel of width 6m is 18m³/s when depth of flow of water is 2m. Calculate i) Specific energy ii) Critical depth iii) Critical velocity iv) Minimum specific energy. (10 Marks)

OR

- 4 a. What is specific energy curve? Draw it and derive expressions for critical depth and critical velocity. (10 Marks)
- b. A trapezoidal channel with side-slopes of 1 to 1 has to be designed to convey 10m³/s at a velocity of 2m/s so that the amount of concrete lining for the bed and sides is minimum. Calculate the area of lining required for one meter length of canal. (10 Marks)

Module-3

- 5 a. A sluice gate discharge water into 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 hydraulic jump. (10 Marks)
- b. What is gradually varied flow and derive an expression for gradually varied flow. Mention the assumption made for derivation. (10 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.

OR

- 6 a. Derive an equation of a hydraulic jump in a horizontal rectangular channel. (08 Marks)
 b. Find the slope of free water surface in a rectangular channel of width 15m having depth of flow 4m. The discharge of channel is $40\text{m}^3/\text{s}$. The bed of channel is having a slope of 1 in 4000. Take Chezy's constant $C = 50$. (08 Marks)
 c. Explain the classification of channel bottom slopes. (04 Marks)

Module-4

- 7 a. Explain the concept of velocity triangles. Also obtain an expression for workdone per second by set striking on a unsymmetrical moving curved vane tangentially at one of the tips. (10 Marks)
 b. The water available for a Pelton wheel is 4cumec and total head from there reservoir to the nozzle is 250 meters. The turbine has two runners with two jets per runner. All the four jets have the same diameters. The pipe line is 300 meters long. The efficiency of power transmission through the pipe line and the nozzle is 91% and efficiency of each runner is 90%. The velocity coefficient of each nozzle is 0.975 and coefficient of friction $4f$ for pipe is 0.0045. Determine i) the power developed by the turbine ii) diameter of the jet iii) diameter of pipe line. (10 Marks)

OR

- 8 a. Classify and explain different types of turbines. (06 Marks)
 b. A jet of water moving at 12m/s impinges on vane shaped to deflect the jet through 120° when stationary. If the vane is moving at 5m/s. Find the angle of jet so that there is no shock at inlet. What is the absolute velocity of jet at exit its magnitude and direction and the work done per second per unit weight of water striking per second. Assume that vane is smooth. (08 Marks)
 c. Draw a neat sketch of layout of hydro electric power plant and explain the functions of each component. Also define different heads. (06 Marks)

Module-5

- 9 a. With the help of neat sketch, explain the components of Kaplan turbine. (06 Marks)
 b. Explain Manometric efficiency, Mechanical efficiency and overall efficiency of centrifugal pump. (06 Marks)
 c. A three stage centrifugal pump has impellers 40cm in diameter and 2cm wide at outlet. The vane are curved back at the outlet at 45° and reduce the circumferential area by 10%. The manometric efficiency is 90% and the overall efficiency is 80%. Determine the head generated by the pump when running at 1000rpm, delivering 50 litres per second. What should be the shaft horse power? (08 Marks)

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OR

- 10 a. What is draft tube, what are the functions of draft tube? (06 Marks)
 b. Describe with sketches pump in series and pump in parallel. (06 Marks)
 c. A Kaplan turbine develops 24647.6kW power at an average head of 39 meters. Assuming a speed ratio of 2% flow ratio of 0.6, diameter of 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 turbine. (08 Marks)

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