CBCS SCHEME

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18CV43

Fourth Semester B.E. Degree Examination, June/July 2025
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. List various model laws (similarity laws) and explain any one of them in detail. **(06 Marks)**

b. Using Buckingham's π theorem, show that the velocity through a circular orifice is given by $V = \sqrt{2gH}\ \phi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$, where 'H' is head causing flow, 'D' is the diameter of the orifice, 'μ' is coefficient of viscosity, ρ is the mass density of liquid and 'g' is the acceleration due to gravity. **(10 Marks)**

c. Define the following:
i) Buoyancy
ii) Meta centre
iii) Meta centric height **(04 Marks)**

OR

2 a. Explain the experimental method of determination of metacentric height. **(06 Marks)**

b. A solid cylinder of 10 cm diameter and 40 cm long, consists of two parts made of different materials. The first part at the base is 1.0 cm long and of specific gravity = 6.0. The other part of the cylinder is made of the material having specific gravity 0.6. State, if it can float vertically in water. **(10 Marks)**

c. Define dimensionally homogeneous equation. Give one example for dimensionally homogeneous equation. **(04 Marks)**

Module-2

3 a. Derive Chezy's equation for uniform flow in open channel with usual notations. **(06 Marks)**

b. An open channel of trapezoidal shape with side slopes of 1 to 1 has to be designed to convey $10 m^3/s$ at a velocity of 2 m/s so that the amount of concrete lining for the bed and sides is the minimum. Calculate the area of lining required for one metre length of canal. **(10 Marks)**

c. Define most economical section of channel. Also mention the conditions for most economical rectangular channel. **(04 Marks)**

OR

4 a. Define specific energy of a flowing liquid and briefly explain the procedure of plotting specific energy curve with help of neat sketch. **(06 Marks)**

b. The discharge of water through a rectangular channel of width 8 m is 15 m^3/s when depth of water flow is 1.2 m. Calculate :
i) Specific energy of flowing curve
ii) Critical depth and critical velocity
iii) Value of minimum specific energy. **(10 Marks)**

c. Define: i) Critical depth ii) Critical velocity
Also mention expressions for these for a rectangular channel. **(04 Marks)**

Module-3

5 a. Derive an expression for the length of back water curve. **(06 Marks)**

b. A sluice gate discharges water in to a horizontal rectangular channel with a velocity of 6 m/s and depth of flow is 0.4 m. The width of channel is 8 m. Determine whether a hydraulic jump will occur, and if so, find its height and loss of energy. Also determine the power lost in the hydraulic jump. **(10 Marks)**

c. Define the following: i) Hydraulic jump ii) Length of hydraulic jump. **(04 Marks)**

OR

6 a. Derive an expression for loss of energy due to hydraulic jump. **(06 Marks)**

b. Find the slope of the free water surface in a rectangular channel of width 20 m having depth of flow 5 m. The discharge through the channel is 50 m^3/s. The bed of the channel is having a slope of 1 in 4000. Take the value of Chezy's constant C = 60. **(10 Marks)**

c. Define the following:
   i) Gradually varied flow
   ii) Back water curve
   iii) Afflux **(04 Marks)**

Module-4

7 a. Derive an expression for force exerted by the jet of water on the moving curved plate in the direction of jet when the jet of water strikes plate at its centre in the direction of motion of plate. **(06 Marks)**

b. A jet of water of diameter 50 mm having a velocity of 20 m/s strikes a curved vane which is moving with a velocity of 10 m/s in the direction of 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. **(10 Marks)**

c. Write a brief note on velocity triangles. **(04 Marks)**

OR

8 a. Draw a neat sketch of general layout of a hydro electric power plant and explain the components and heads on turbine. **(06 Marks)**

b. A pelton wheel is to be designed for the following specifications: shaft power = 11772 kW; Head = 380 m, speed = 750 rpm, overall efficiency = 86%, jet diameter is not to exceed one sixth of the wheel diameter. Determine:
   i) The wheel diameter
   ii) The number of jets required
   iii) Diameter of the jet
   Take $K_{v_i} = 0.985$ and $K_{u_{i i}} = 0.45$ **(10 Marks)**

c. Write a brief note on classification of hydraulic turbines based on i) Specific speed ii) Head available. Give examples. **(04 Marks)**

Module-5

9 a. Define draft tube. Draw neat sketches of different types of draft tubes. **(06 Marks)**

b. A Kaplan turbine develops 24647.6 KW power at an average head of 39 metres. 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. **(10 Marks)**

c. Draw a neat sketch of Kaplan turbine and label it. **(04 Marks)**

OR

10 a. Draw a neat sketch of centrifugal pump and explain its components. **(06 Marks)**

b. Derive an expression for minimum speed for starting a centrifugal pump. **(10 Marks)**

c. Write a brief note on multistage centrifugal pumps for high heads. **(04 Marks)**