CBCS SCHEME

USN | | | | | | | | | | |

17CV43

Fourth Semester B.E. Degree Examination, June/July 2023
Applied Hydraulics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Missing data may be suitably assumed.

Module-1

1 a. Give the SI units and dimensions of following quantities:
i) Weight ii) Stress iii) Workdone iv) Strain v) Surface Tension
vi) Kinematic viscosity. **(06 Marks)**

b. Briefly explain different types of equilibrium of submerged bodies. **(04 Marks)**

c. Using Buckingham's theorem prove that –

$$V = \sqrt{gH}\ \phi\left[\frac{D}{H}, \frac{\mu}{\rho.H.\sqrt{gH}}\right]$$

Where, V = Velocity through circular orifice
D = Diameter of orifice
H = Head over orifice
μ = Dynamic viscosity
ρ = Density of fluid. **(10 Marks)**

OR

2 a. Water is flowing through a pipe of diameter 0.4m at a velocity 4m/s. Find the velocity of oil flowing in another pipe of diameter 0.1m, with dynamic similarity existing between two pipes. Viscosity of water is 0.01 poise and that of oil is 0.025 poise specific gravity of oil is 0.8. Density of water 1000kg/m^3. **(08 Marks)**

b. State and explain Buckingham's π theorem. **(04 Marks)**

c. A solid cylinder of 4m diameter has a height of 4m and specific gravity of its material being 0.6. Cylinder is floating with its axis vertical. Determine the metacentric height of the cylinder. Also check its type of equilibrium. **(08 Marks)**

Module-2

3 a. Differentiate between open channel flow and pipe flow. **(06 Marks)**

b. The discharge of water through a rectangular channel of width 8m is 15cumec. The depth of the flow is 1.2m. Determine:
i) Specific energy
ii) Critical depth
iii) Critical velocity
iv) Minimum specific energy
Also state the type of flow. **(06 Marks)**

c. A trapezoidal channel has a side slope of 1H:2V and bed slope of 1 in 1500. The cross section area is 40m^2. Determine the dimensions of the channel for most efficient section. **(08 Marks)**

OR

4 a. What is specific energy curve? Draw a neat sketch. Derive an expression for critical depth in a rectangular channel. **(06 Marks)**

b. Derive an expression for discharge through an open channel using Chezy's formula. **(06 Marks)**

c. Show that the relation between alternate depths y_1 and y_2 in a rectangular channel can be expressed as –

$$y_c^3 = \frac{2y_1^2 y_2^2}{y_1 + y_2}$$, where y_c = critical depth. **(08 Marks)**

Module-3

5 a. A sluice gate discharges water into a rectangular channel with a velocity 6m/s and depth of flow 0.4m. The channel is 8m wide. Determine:

i) If a jump can occur
ii) Conjugate of 0.4m depth
iii) Depth of hydraulic jump
iv) Loss of energy
v) Power lost in the jump. **(08 Marks)**

b. From the equation of hydraulic jump $d_2 = \frac{-d_1}{2} \pm \sqrt{\frac{d_1^2}{4} + \frac{2v_1^2 d_1}{g}}$, derive the hydraulic jump expression in the form of upstream Froude's number. **(06 Marks)**

c. Briefly explain: i) Hydraulic jump ii) GVF and RVF iii) Conjugate depths. **(06 Marks)**

OR

6 a. Derive dynamic equation for gradually varied flow in differential form using regular notations. State the assumptions made. **(10 Marks)**

b. With the help of neat sketches give water surface profiles depending on channel bed slopes. **(10 Marks)**

Module-4

7 a. Derive expression for force exerted by a moving jet striking a flat, inclined and fixed vane. **(06 Marks)**

b. Briefly explain various components of a hydroelectric power house with a neat sketch. **(06 Marks)**

c. A jet of water 75mm in diameter strikes a curved vane at the centre with a velocity 20m/s. The curved vane moves in the direction of jet with a velocity 8m/s and gets deflected by 165°. Determine:

i) Force exerted in x-direction.
ii) Force normal to vane.
iii) Magnitude and direction of the resultant force.
iv) Power developed.
v) Efficiency of jet. **(08 Marks)**

OR

8 a. Show neat sketches of velocity triangles at the inlet and outlet of curved vane when jet striking tangentially and vane moving in other direction. Mention the notations and names used. Also write the formula for force exerted in this case. **(06 Marks)**

b. Derive an expression for efficiency of a jet when it strikes series of flat vanes mounted on periphery of a wheel. Also prove that maximum efficiency cannot exceed 50%. **(06 Marks)**

c. A Pelton turbine has to be designed for following data:
Power developed = 6000kW
Net head = 300m
Speed = 550rpm
Overall efficiency = 85%
Jet diameter to wheel diameter ratio = 1/10
Determine:
i) Number of Jets
ii) Diameter of Jet
iii) Diameter of wheel
iv) Quantity of water required. **(08 Marks)**

Module-5

9 a. What is draft tube and what are the purposes? With the help of sketches, briefly explain various types of draft tubes. **(06 Marks)**

b. With neat sketch, explain components and working of a centrifugal pump. **(06 Marks)**

c. A Kaplan turbine produces 60000kW under a net head of 25m with an overall efficiency of 90%. Taking speed ratio as $K_u = 1.6$, flow ratio $\psi = 0.5$ and hub diameter as 0.35 times the outer diameter, find the diameter and speed of the turbine. **(08 Marks)**

OR

10 a. With a neat sketch of sectional view, explain the working of Kaplan turbine. **(06 Marks)**

b. Briefly explain following:
i) Pumps in series
ii) Pumps in parallel
iii) Minimum starting speed of pump. **(06 Marks)**

c. Find the power required to drive a centrifugal pump which delivers 40 liters per second of water to a height of 20m through a 150mm diameter and 100m long pipe. Over all efficiency of pump is 70% and Darcy's f = 0.06 (f = friction factor) for the pipeline. Assume inlet loss in suction pipe equal to 0.33m. **(08 Marks)**

* * * * *