CBCS SCHEME

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

18CV43

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. Define repeating variables. What are the guidelines for selecting repeating variables? **(06 Marks)**

b. Derive the scale ratios for the following quantities as per Froude model law:
(i) Velocity (ii) Discharge (iii) Force (iv) Pressure **(08 Marks)**

c. A spillway model is constructed in the laboratory such that the velocity and discharge in the model are respectively 2 m/s and 2.5 m^3/s. If the velocity in the prototype is 40 m/s, what is the scale ratio and the discharge in the prototype? **(06 Marks)**

OR

2 a. Define: (i) Meta center (ii) Metacentric height. Explain how these are used to check the stability of floating bodies. **(06 Marks)**

b. The resisting torque T against the motion of a shaft in a lubricated bearing depends on viscosity μ, the rotational speed N, the diameter D and bearing pressure p. Show that $T = \mu N D^3 . \phi\left[\frac{p}{\mu N}\right]$ where ϕ represents function. **(08 Marks)**

c. Find the volume of water displaced and position of center of buoyancy for a wooden block of density 650 kg/m^3 when it floats in water horizontally. The width of block is 2.5 m, depth is 1.5 m and length is 6m. **(06 Marks)**

Module-2

3 a. Distinguish between:
(i) Gradually varied flow and rapidly varied flow
(ii) Total energy and specific energy
(iii) Subcritical flow and supercritical flow **(06 Marks)**

b. The discharge of water through a rectangular channel of 8m width is 16 m^3/s when the depth of water is 1.2 m. Calculate:
(i) Specific energy
(ii) Critical depth and critical velocity
(iii) Minimum specific energy **(06 Marks)**

c. For most economical trapezoidal section, prove that half of top width is equal to side slope length. Also show that hydraulic mean depth is equal to half of the flow depth. **(08 Marks)**

OR

4 a. List the conditions at critical point on specific energy curve. **(04 Marks)**

b. Derive Chezy's equation for uniform rate of flow in a channel. Hence write Manning's equation. **(08 Marks)**

c. A rectangular channel 6m wide and 1m depth of water has a bed slope of 1 in 900 and n = 0.012. Determine the discharge. What will be the dimensions of this channel for maximum discharge? Also compute percentage increase in discharge. **(08 Marks)**

Module-3

5 a. Define hydraulic jump. List the application of hydraulic jump. **(04 Marks)**

b. Derive dynamic or differential equation for GVF. **(08 Marks)**

c. A rectangular channel 8m wide discharges water with a depth of 0.4 m. If the critical depth of flow is 0.8 m, compute the depth of flow after jump, if jump occurs. Further, also calculate energy loss. **(08 Marks)**

OR

6 a. Give the flow depth condition for M1, S3, C1, H2 water surface profiles. **(04 Marks)**

b. Derive the relationship between conjugate depths in case of a hydraulic jump in a rectangular channel. **(08 Marks)**

c. A rectangular channel with bottom width 4m and bed slope 0.0008 has a discharge of 1.5 m^3/s. The depth of flow at a certain section in GVF is 0.5 m. If n = 0.016, identify type of profile. **(08 Marks)**

Module-4

7 a. Define efficiencies of turbines and give relationship between them. **(05 Marks)**

b. Show that the maximum efficiency of jet striking at the center of series of symmetrical curves vanes is $\eta_{max} = \frac{1}{2}(1+\cos\theta)$ **(08 Marks)**

c. A pelton wheel turbine has to be designed for the following specification:

Shaft power = 12000 KW, Head = 380 m, speed = 750 rpm, η_0 = 85%, $d = \frac{D}{10}$, C_V = 0.98, C_u = 0.45. Determine: (i) Runner diameter (ii) Jet diameter (iii) Number of jets **(07 Marks)**

OR

8 a. State impulse-momentum equation. Give its applications. **(04 Marks)**

b. Sketch and explain general layout of hydroelectric power plant. **(06 Marks)**

c. A jet of water moving at 15 m/s impinges on a symmetrically curved moving vane tangentially to deflect the jet through 120°, the velocity of vane is 5 m/s. Find the angle of jet so that there is no shock. What is the absolute velocity of jet at exit in magnitude and direction? Also compute work done per N of water. **(10 Marks)**

Module-5

9 a. Define draft tube. List its functions. **(04 Marks)**

b. Compute the minimum starting speed of a centrifugal pump having 90 cm and 45 cm as impeller diameters at outlet and inlet working against 10m head. **(06 Marks)**

c. The inner and outer diameter of an inward flow Francis turbine are 0.6 m and 1 m, respectively. The width at both inlet and outlet is 12 cm. The head over the turbine is 9m. Hydraulic efficiency = 90%, Vane angle at outlet is 20° and discharge at outlet is radial with flow velocity of 2.7 m/s. Compute:

(i) Guide blade angle (ii) Vane angle at inlet (iii) Speed of turbine

(iv) Discharge (v) Water power **(10 Marks)**

OR

10 a. Explain with sketch various components of a centrifugal pump. **(07 Marks)**

b. A centrifugal pump is to delivery 0.15 m^3/s at a speed of 1450 rpm against a head of 25 m. The impeller diameter is 250 mm and width is 50 mm at outlet. η_{man} = 75%. Determine the vane angle at the outer periphery of impeller. **(08 Marks)**

c. Write a note of multistage centrifugal pumps. **(05 Marks)**

* * * * *