CBCS SCHEME

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

15CV43

Fourth Semester B.E. Degree Examination, Jan./Feb.2021
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. State and explain Buckingham π-theorem. **(06 Marks)**

b. Derive the scale ratios of the following as per Reynolds model law:
(i) Time (ii) Discharge (iii) Force (iv) Acceleration
(v) Work (vi) Power **(06 Marks)**

c. A spillway model is constructed such that the velocity and discharge in the model are respectively 2 m/s and 3 m^3/s. If the velocity in the prototype is 20 m/s, what is the length scale ratio and the discharge in the prototype? **(04 Marks)**

OR

2 a. Explain the procedure of determining the metacenter in the laboratory. **(08 Marks)**

b. The efficiency η of a fan depends on density ρ, dynamic viscosity μ of the fluid, angular velocity ω, diameter D of the rotor and discharge Q. Express η as,

$$\eta = \phi\left[\frac{Q}{\omega D^3}, \frac{\mu}{\rho\omega D^2}\right]$$

where ϕ is the function. **(08 Marks)**

Module-2

3 a. Differentiate between:
(i) Hydraulic mean depth and hydraulic depth.
(ii) Steady flow and unsteady flow.
(iii) Critical flow, subcritical flow and supercritical flow. **(06 Marks)**

b. For most economical triangular section, show that crest angle is 90°. **(04 Marks)**

c. Water is flowing through a circular open channel at the rate of 500 lps, when the channel bed slope is 1 in 10000. Manning's n = 0.015. Find the diameter of channel if flow depth is 0.75 times the diameter. **(06 Marks)**

OR

4 a. Define specific energy. Draw specific energy curve and explain salient points. For rectangular channel prove that $E_{min} = 1.5y_c$ at critical flow condition. E_{min} = minimum specific energy, y_c = Critical depth. **(10 Marks)**

b. A concrete lined circular channel of 3.6 m diameter has a bed slope of 1 in 600. Determine velocity and discharge for maximum velocity condition. Chezy's C = 50. **(06 Marks)**

Module-3

5 a. Derive the relationship between sequent depths of hydraulic jump in rectangular jump in terms of approaching Froude number. **(08 Marks)**

b. A horizontal rectangular channel 4 m wide carries a discharge of 16 m^3/s. Determine whether a jump occurs at an initial depth of 0.5 m or not. If a jump occurs, determine the sequent depth and energy loss. **(08 Marks)**

OR

6 a. In a rectangular channel, the Froude number before jump $F_1 = 2.5$. Compute the Froude number after jump. **(04 Marks)**

b. Give the classification of GVF profiles with neat sketches. **(12 Marks)**

Module-4

7 a. Show that for a free jet of water sriking at the center of semicircular vane, the maximum efficiency occurs when vane velocity is $\frac{1}{3}$ of jet velocity and $\eta_{max} = 59.2\%$. **(08 Marks)**

b. A jet of water having velocity 45 m/s impinges without shock on a series of curved vanes moving at 15 m/s, the direction of motion of vanes being 20° to that of jet. The relative velocity at the outlet is 0.9 of that at inlet and the absolute velocity of water at the exit is to be normal to the motion of vanes. Find : (i) Vane angles at entrance and exit
(ii) Hydraulic efficiency. **(08 Marks)**

OR

8 a. Give the classification of turbines based on different criteria. **(08 Marks)**

b. A penstock supplies water form a reservoir to the Pelton wheel with a gross head of 500 m. One third of the gross head is lost in friction in the penstock. The rate of flow of water through the nozzle fitted at the end of the penstock is 2 m^3/s. The angle of deflection of jet is 165° when the vanes are stationary. Determine the power given by the water to the runner and also hydraulic efficiency. Take $C_V = 1.0$ and Speed ratio = 0.45. **(08 Marks)**

Module-5

9 a. Differentiate between :
(i) Francis turbine and Kaplan turbine.
(ii) Unit discharge and actual discharge.
(iii) Unit speed and specific speed. **(06 Marks)**

b. What is draft tube? What are its functions? **(04 Marks)**

c. A centrifugal pump running at 1450 rpm discharges 700 lps against a head of 23 m. If the diameter of the impeller is 250 mm and width is 50 mm, find the vane angle at the outer periphery. Take $\eta_{man} = 75\%$. **(06 Marks)**

OR

10 a. Define minimum starting speed of a centrifugal pump and derive the expression for the same. **(06 Marks)**

b. Define : (i) Suction head, (ii) Delivery head, (iii) Static head
(iv) Manometric head **(04 Marks)**

c. A Kaplan turbine produces 60000 kW power under net head of 25 m with an overall efficiency of 90%. Taking speed ratio = 1.6 and flow ratio = 0.5 with hub diameter = 0.35 times diameter, find the diameter and speed of the turbine. **(06 Marks)**

* * * * *