Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
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 the terms: (i) Model (ii) Prototype (iii) Model analysis (iv) Hydraulic similitude **(06 Marks)**

b. In 1 in 40 model of spillway the velocity and discharge are 2m/s and 2.5 m^3/s. Find the corresponding velocity and discharge in the prototype. **(04 Marks)**

c. Using Buckingham's π - theorem, derive the following relationship $R = \rho V^2 D^2 \phi\left(\frac{\mu}{\rho VD}, \frac{H}{D}\right)$ where R = resistance, ρ = density, V = velocity of flow, D = diameter, μ = viscosity and H = height. **(10 Marks)**

OR

2 a. Explain the types of similarities in model analysis. **(06 Marks)**

b. A pipe of diameter 1.8 m is required to transport an oil of specific gravity 0.8 and viscosity 0.04 poise at the rate of 4 m^3/s. Tests were conducted on a 20 cm diameter pipe using water at 20°C. Find the velocity and rate of flow in model, viscosity of water at 20°C is 0.01 poise. **(08 Marks)**

c. Explain the experimental method of determination of meta-centric height. **(06 Marks)**

Module-2

3 a. Distinguish between pipe flow and open channel flow. **(04 Marks)**

b. Derive Chezy's equation for uniform flow in open channel with usual notations. **(08 Marks)**

c. A trapezoidal channel with side slopes 3H:2V has to be designed to carry 10 m^3/s at velocity of 1.5 m/s, so that the amount of concrete lining for the bed and sides is minimum. Find: (i) The wetted perimeter (ii) Slope of bed if Manning's N = 0.014 **(08 Marks)**

OR

4 a. For most economical trapezoidal section show that half of the top width is equal to one of the side slope length. **(06 Marks)**

b. Explain with neat sketch the specific energy curve. **(06 Marks)**

c. A discharge of 18 m^3/s flows through a rectangular channel 6m wide at a depth of 1.6 m. Find: (i) specific energy (ii) critical depth (iii) critical velocity (iv) value of minimum specific energy. **(08 Marks)**

Module-3

5 a. Define the term hydraulic jump. Derive an expression for a hydraulic jump in a horizontal rectangular channel. **(10 Marks)**

b. Find the slope of the free water surface in a rectangular channel of width 20 m having depth of flow 5m. 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)**

OR

6 a. Explain the following slope profiler, (i) Critical slope (ii) Mild slope (iii) Steep slope and also draw profile of M_1, M_2 and M_3. **(10 Marks)**

b. A sluice gate discharges water into a horizontal channel with a velocity of 5m/s and depth of flow is 0.4 m. The width of the channel is 6m. 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 the hydraulic jump. **(10 Marks)**

Module-4

7 a. Find an expression for the efficiency of a series of moving curved vanes when a jet of water strokes the vanes at one of the tips. Prove that maximum efficiency is 50% when u > v. **(10 Marks)**

b. A pelton wheel has to develop 13200 KW under a net head of 820 m while running at a speed of 600 rpm. If the coefficient of jet $C_V = 0.98$, speed ratio $\phi = 0.46$ and jet diameter is $\frac{1}{16}$ of wheel diameter, calculate (i) pitch circle diameter (ii) the diameter of the jet (iii) quantity of water supplied to the wheel (iv) Number of jets required. Assume overall efficiency as 85%. **(10 Marks)**

OR

8 a. Draw a neat sketch of a layout of hydroelectric power plant and explain the functions of each component. Also define different heads. **(10 Marks)**

b. A jet of water having a velocity of 35 m/s impinges on a series of vanes moving with a velocity of 20 m/s. The jet makes an angle of 30° to the direction of vanes when entering and leaves at an angle of 120°. Draw the triangles of velocities at inlet and outlet and find,
(i) The angles of vanes tips so that water enters and leaves without shock.
(ii) The work done per unit weight of water entering the vanes
(iii) Efficiency. **(10 Marks)**

Module-5

9 a. What is a draft tube? What are the functions of draft tube? **(04 Marks)**

b. Derive the expression for minimum starting speed of a centrifugal pump. **(06 Marks)**

c. A Kaplan turbine develops 24647.6 KW power at an average head of 39 m. Assuming the speed ratio of 2, flow ratio of 0.6, diameter of boss equals to 0.35 times the diameter of runner and an overall efficiency of 90%, calculate the diameter, speed and specific speed of the turbine. **(10 Marks)**

OR

10 a. Explain manometric efficiency, mechanical efficiency and overall efficiency of a centrifugal pump. **(06 Marks)**

b. Define unit head, unit discharge and unit power. **(04 Marks)**

c. A centrifugal pump is to deliver 0.12 m^3/s at a speed of 1450 rpm against a head of 25 m. The impeller diameter is 250 mm, width at outlet is 50 mm. The manometric efficiency is 75%. Determine the vane angles at the outer periphery of the impeller. **(10 Marks)**