CBCS SCHEME

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Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024
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. What is dimensional analysis? Write its uses. **(06 Marks)**

b. Define the following Model Laws :
i) Reynolds Model Law
ii) Froude Model Law
iii) Euler Model Law
iv) Mach Model Law. **(08 Marks)**

c. What is buoyancy? Explain the terms metacentre and metacentric height. **(06 Marks)**

OR

2 a. Explain Rayleighs method of dimensional analysis. **(07 Marks)**

b. Explain how metacentric height is determined by theoretical method? **(07 Marks)**

c. In the model test of a spillway the discharge and velocity of flow over the model were $2.5m^3/sec$ and 1.5m/sec respectively. Calculate the velocity and discharge over the prototype which is 36 times the model size. **(06 Marks)**

Module-2

3 a. What is an open channel flow? Classify. **(05 Marks)**

b. Define specific energy. Explain specific energy curve with neat sketch and then derive an expression for critical depth and critical velocity in a rectangular channel. **(08 Marks)**

c. Derive the Chezy's equation for uniform flow in open channel with usual notation. **(07 Marks)**

OR

4 a. For a trapezoidal channel of most economical section prove that :
i) Half of top width = length of one of the sloping sides
ii) Hydraulic depth = $\frac{1}{2}$ × depth of flow. **(10 Marks)**

b. A rectangular channel 4m wide has depth of water 1.5m. The slope of the bed of the channel is 1 : 1000 and value of Chezy's constant c = 55. It is desired to increase the discharge to a maximum by changing the dimensions of the section for constant area of cross section, slope of the bed and roughness of the channel. Find the new dimensions of the channel and increase in discharge. **(10 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. Define the terms GVF and RVF, Derive an expression for GVF in an open channel flow. **(10 Marks)**

OR

6 a. With a neat sketch explain the following terms : i) Back water curve ii) Afflux. **(05 Marks)**

b. A sluice gate discharges water into horizontal rectangular channel with a velocity of 10m/sec and depth of flow of 1m. Determine the depth of flow of water after the jump and consequent loss in total head. **(05 Marks)**

c. With neat sketches give the classification of surface profiles in case of GVF. **(10 Marks)**

Module-4

7 a. What is impact of jet? With neat sketch derive an expression for force exerted and work done by jet on moving curved vane in the direction of jet. The jet is striking the vane at the centre of vane. **(10 Marks)**

b. A jet of water having a velocity of 20m/sec strikes a curved vane which is moving with the velocity of 10m/sec. The jet makes an angle of 20° with the direction of motion of vane at inlet and leaves at an angle of 130° to the direction of motion of vane at outlet. Calculate :

i) Vane angles so that the water enters and leaves the vane without shock

ii) Work done per second per unit weight of water striking the vane. **(10 Marks)**

OR

8 a. Define turbine. Give its classification. Explain heads and efficiencies of Pelton turbine. **(10 Marks)**

b. Design a Pelton wheel turbine required to develop 9560KW power under a head of 350m@ 750rpm. The overall efficiency may be taken as 85%. Assume $C_v = 0.985$, speed ratio $\phi = 0.45$, Jet ratio = 6. **(10 Marks)**

Module-5

9 a. Draw the neat sketch of Kaplan turbine and mention its parts. **(07 Marks)**

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

c. In an inward flow reaction turbine the head on the turbine is 32m. the external and internal diameters are 1.44m and 0.72m respectively. The velocity of flow through the runner is constant and equal to 3cm/sec. The guide blade angle is 10° and the runner vanes are rigid at inlet. If the discharge at outlet is radial determine :

i) The speed of the turbine

ii) The vane angle at outlet of the runner

iii) Hydraulic efficiency. **(07 Marks)**

OR

10 a. With neat sketch, explain the different types of draft tubes. **(06 Marks)**

b. Explain heads and efficiencies of centrifugal pump. **(07 Marks)**

c. A centrifugal pump is to discharge $0.118 m^3$/sec at a speed of 1450rpm against a heat of 25m. The impeller diameter is 250mm. Its width at outlet is 50mm and manometric efficiency is 75%. Determine the vane angle at the outer periphery of the impeller. **(07 Marks)**

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