

# CBCS SCHEME



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18CV43

## Fourth Semester B.E. Degree Examination, Jan./Feb. 2023 Applied Hydraulics

Time: 3 hrs.

Max. Marks: 100

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

### Module-1

- Discuss the stability of floating bodies with sketches. (06 Marks)
  - What is dimensional analysis? Explain Rayleigh's method of dimensional analysis. (06 Marks)
  - The efficiency  $\eta$  of a fan depends on density  $\rho$ , dynamic viscosity  $\mu$  of the fluid, angular velocity  $\omega$ , diameter  $D$  of the rotor and discharge  $Q$ . Express  $\eta$  as

$$\eta = f \left[ \frac{Q}{WD^3}, \frac{\mu}{\rho WD^2} \right] \quad (08 \text{ Marks})$$

OR

- In the model test of a spillway, the discharge and velocity of flow over the model were  $2.5 \text{ m}^3/\text{sec}$  and  $1.5 \text{ m}/\text{sec}$  respectively. Calculate the velocity and discharge over the prototype which is 36 times the model size. (06 Marks)
  - What is buoyancy? Explain how metacentric height is determined by theoretical method. (10 Marks)
  - Define the following terms:
    - Model
    - Prototype
    - Model analysis
    - Hydraulic similitude(04 Marks)

### Module-2

- Derive the Chezy's equation for uniform flow in open channel with usual notations. (07 Marks)
  - With neat sketches, differentiate between flow through pipes and flow through open channels. (05 Marks)
  - A rectangular channel 5.5 m wide and 1.25 m depth has a slope of 1 in 900. Determine the discharge when Manning's  $N = 0.015$ . If it is desired to increase the discharge to a maximum by changing the size of the channel but keeping the same quantity of lining, determine the new dimensions and percentage increase in discharge. (08 Marks)

OR

- Define specific energy. Draw and explain specific energy curve. Also derive an expression for critical depth and critical velocity in rectangular channels. (09 Marks)
  - For a trapezoidal channel of most economical section, prove that:
    - Half of top width = Length of one of the sloping sides
    - Hydraulic depth =  $\frac{1}{2} \times$  depth of flow. (07 Marks)
  - Find the critical depth and critical velocity of the water flowing through a rectangular channel of width 5m, when discharge is  $15 \text{ m}^3/\text{sec}$ . (04 Marks)



**Module-3**

- 5 a. Explain the following terms with neat sketches: (i) Back water curve (ii) Afflux (05 Marks)  
 b. The depth of flow of water at a certain section of rectangular channel of 2m wide is 0.3 m. The discharge through the channel is  $1.5 \text{ m}^3/\text{sec}$ . Determine whether the hydraulic jump will occur and if so find its height and loss of energy per kg of water. (07 Marks)  
 c. Define GVF and RVF. Derive an expression for GVF in an open channel flow. (08 Marks)

OR

- 6 a. With neat sketches give the classification of surface profiles in case of GVF. (10 Marks)  
 b. What is hydraulic jump? Derive an expression for depth of flow after jump in an open channel flow. (10 Marks)

**Module-4**

- 7 a. Design a pelton wheel turbine required to develop 1471.5 KW power under a head of 160 m at 420 rpm. The overall efficiency may be taken as 85%. Assume  $C_v = 0.98$ , speed ratio  $\phi = 0.46$ , jet ratio = 12. (10 Marks)  
 b. What is impact of jet? Derive an expression for force exerted by jet on moving curved vane in the direction of jet. (08 Marks)  
 c. State Impulse Momentum equation. (02 Marks)

OR

- 8 a. Define turbine. Give its classification. Also explain heads and efficiencies of pelton turbine. (10 Marks)  
 b. A jet of water having a velocity of 20 m/sec strikes a curved vane which is moving with velocity of 10 m/sec. The jet makes an angle of  $20^\circ$  with the direction of motion of vane at inlet and leaves at an angle of  $130^\circ$  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)

**Module-5**

- 9 a. Draw neat sketch of Kaplan turbine and explain its different parts. (06 Marks)  
 b. Derive an expression for minimum speed for starting a centrifugal pump. (06 Marks)  
 c. The impeller of a centrifugal pump having external and internal diameters 500 mm and 250 mm respectively, width at outlet 50 mm and running at 1200 rpm works against a head of 48 m. The velocity of flow through the impeller is constant and equal to 3 m/sec. The vanes are set back at an angle of  $40^\circ$  at outlet. Determine:  
 (i) Inlet vane angle  
 (ii) Work done by the impeller on water per second  
 (iii) Manometric efficiency (08 Marks)

OR

- 10 a. Explain different types of draft tubes with neat sketches. (06 Marks)  
 b. Explain heads and efficiencies of centrifugal pump. (07 Marks)  
 c. A reaction turbine works at 450 rpm under a head of 120 m. Its diameter at inlet is 1.2 m and the flow area is  $0.4 \text{ m}^2$ . The angles made by absolute and relative velocities at inlet are  $20^\circ$  and  $60^\circ$  respectively with the tangential velocity. Determine:  
 (i) The volume flow rate  
 (ii) The power developed  
 (iii) The hydraulic efficiency (07 Marks)

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