# CBCS SCHEME

USN

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

1 a. Discuss the stability of floating bodies with sketches. **(06 Marks)**

b. What is dimensional analysis? Explain Rayleigh's method of dimensional analysis. **(06 Marks)**

c. 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

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

**OR**

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

b. What is buoyancy? Explain how metacentric height is determined by theoretical method. **(10 Marks)**

c. Define the following terms:
(i) Model (ii) Prototype
(iii) Model analysis (iv) Hydraulic similitude **(04 Marks)**

### Module-2

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

b. With neat sketches, differentiate between flow through pipes and flow through open channels. **(05 Marks)**

c. 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**

4 a. Define specific energy. Draw and explain specific energy curve. Also derive an expression for critical depth and critical velocity in rectangular channels. **(09 Marks)**

b. 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 = $\frac{1}{2} \times$ depth of flow. **(07 Marks)**

c. Find the critical depth and critical velocity of the water flowing through a rectangular channel of width 5m, when discharge is 15 $m^3$/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 $m^3$/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 excreted 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° 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)**

## 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° 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 $m^2$. The angles made by absolute and relative velocities at inlet are 20° and 60° 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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