B.Tech. DEGREE EXAMINATION, NOVEMBER 2023
Fourth Semester

18CEC206T – HYDRAULIC ENGINEERING AND DESIGN
(For the candidates admitted from the academic year 2020-2021 & 2021-2022)

Note:
(i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.
(ii) **Part - B & Part - C** should be answered in answer booklet.

Time: 3 hours

Max. Marks: 100

PART – A (20 × 1 = 20 Marks)
Answer ALL Questions

	Marks	BL	CO	PO

1. The dimension of pressure in MLT system is   1   1   1   3
   (A) MLT^{-2} (B) ML^2T^2
   (C) $ML^{-1}T^{-2}$ (D) $ML^{-1}T^{-3}$

2. Two equations are said to be dimensionally homogenous, if the fundamental dimensions have identical powers of   1   1   1   3
   (A) Mass, length, time   (B) Mass
   (C) Time   (D) Length

3. The structure of which model is prepared, is known as   1   1   1   3
   (A) Scale ratio   (B) Scale effect
   (C) Prototype   (D) Geometric similarity

4. In a model of scale ratio 1:25, the ratio discharges between the prototype and model is   1   1   1   3
   (A) $\dfrac{1}{25}$ (B) $\dfrac{1}{\sqrt{25}}$
   (C) $(25)^{1.5}$ (D) $(25)^{2.5}$

5. The gravity force (Fg) is the product of   1   1   2   3
   (A) Surface tensions and mass   (B) Shear stress and area of flow
   (C) Mass and acceleration   (D) Intensity of pressure and area of flow

6. Chezy's formula is given by   1   1   2   3
   (A) $V = C\sqrt{RS}$ (B) $V = CRS$
   (C) $V = \sqrt{RS}$ (D) $V = CS$

7. Depth of water is a channel, corresponding to the minimum specific energy is called   1   1   2   3
   (A) Maximum depth   (B) Critical depth
   (C) Virtual depth   (D) Hydraulic mean depth

8. The curve for kinetic energy will be a   1 1 2 3
   (A) Hyperbola   (B) Ellipse
   (C) Rectangular hyperbola (D) Parabola

9. The hydraulic jumps occurs during which of the following type of flows?   1 1 3 3
   (A) Critical flow   (B) Shooting flow
   (C) Streaming flow   (D) Any type of flow

10. Afflux refers to   1 1 3 3
    (A) Increase in water level   (B) Decrease in water level
    (C) Loss of friction   (D) Decrease in width of the channel

11. A notch is used to measure the _____ of liquids.   1 1 3 1
    (A) Pressure   (B) Temperature
    (C) Discharge   (D) Velocity

12. The cippoletti weir is a   1 1 3 3
    (A) Rectangular weir   (B) Downward weir
    (C) Ogee weir   (D) Trapezoidal weir

13. A flumed structure used for the measurement of quantity of water is called   1 1 4 3
    (A) Venturimeter   (B) Orifice meter
    (C) Venturiflume   (D) Rota meter

14. A simplex way of measuring the velocity of flow is by means of   1 1 4 3
    (A) Rota meter   (B) Floats
    (C) Venturimeter   (D) Current meter

15. In a centrifugal pump the liquid enters   1 1 4 3
    (A) At the centre   (B) At the top
    (C) At the bottom   (D) From sides

16. Air vessels are used in reciprocating pumps to   1 1 4 3
    (A) Increase the flow   (B) Smoothen the flow
    (C) Decrease the flow   (D) Reduce acceleration head

17. An impulse turbine is used for   1 1 5 3
    (A) Medium head of water   (B) Low head of water
    (C) High head of water   (D) Head of water from 0 to 25 m

18. The power produced by a reaction turbine is   1 1 5 3
    (A) Directly proportional to $\sqrt{H}$ (B) Directly proportional to H
    (C) Inversely proportional to H   (D) Inversely proportional to $\sqrt{H}$

19. The specific speed of turbine is given by the relation   1 1 5 3
    (A) $\dfrac{NP}{H}$ (B) $\dfrac{N\sqrt{P}}{H^{5/4}}$
    (C) $\dfrac{N\sqrt{P}}{H}$ (D) $\dfrac{NH}{\sqrt{P}}$

20. The efficiency of conical draft tubes is as large as

    (A) 75%   (B) 80%

    (C) 90%   (D) 60%

| | 1 | 1 | 5 | 3 |

PART – B (5 × 4 = 20 Marks)
Answer ANY FIVE Questions

	Marks	BL	CO	PO
21. Differentiate clearly between undistorted and distorted model.	4	1	1	3
22. Write short notes on types of channels.	4	1	2	3
23. What are the advantages of a triangular notch over a rectangular notch?	4	1	3	3
24. Define 'Velocity of approach' and 'End contraction'.	4	1	3	3
25. Draw a neat sketch of a centrifugal pump and mention the components on it.	4	1	4	3
26. What is an air vessel? Why is it necessary?	4	1	4	3
27. How turbine are classified?	4	1	5	3

PART – C (5 × 12 = 60 Marks)
Answer ALL Questions

	Marks	BL	CO	PO
28. a. The resisting force (F) of a supersonic plane during flight can be considered as dependent upon the length of the air craft (l), velocity (v), air viscosity (μ), air density (ρ) and bulk modulus of air (k). Express the functional relationship between these variables and the resisting force. Use Buckingham's π-theorem.	12	2	1	3

(OR)

b.i. A model of an open channel is made in a laboratory. If the actual discharge of the prototype is 102.4 m³/s and corresponding discharge over the model is 100 lps, find the scale of the model.	6	2	1	3
ii. Explain the use of model in the design of hydraulic structures.	6	1	1	3
29. a.i. Compare pipe flow and channel flow.	6	1	2	3
ii. A rectangular channel has a cross-section of 8 m². Find its size and discharge through the most economical section, if the bed slope is 1 in 1000. Take C = 55.	6	2	2	3

(OR)

b. Design a most economical earthen channel with velocity of flow as 1 m/s, and to discharge 3 m³/s having side slope 1 in 2. Take C = 55.	12	2	2	3

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30. a.i. Calculate the possible depth of flow an which a discharge of 25 m³/s be carried in a rectangular channel 4 m wide with a specific energy equal to 2.5 m.   6 2 3 3

    ii. How are Weirs classified?   6 1 3 3

<center>(OR)</center>

    b.i. During an experiment 50 lps of water flowers a 90° V-notch was collected in measuring tank in one second. Calculate the coefficient of discharge for the notch if the head of water is 200 mm.   6 2 3 3

    ii. Water flows over a rectangular weir 1.2 m wide at a depth of 0.15 m and afterwards passes through a 90° triangular weir. The values of C_d for rectangular and triangular weir are 0.62 and 0.59 respectively. What is the head on the triangular weir?   6 2 3 3

31. a. The diameter and width of a centrifugal pump impeller are 400 mm and 80 mm respectively. The pump is delivering 0.175 m³/s with a manometric efficiency 80%. The effective outlet vane angle is 45°. If the speed of rotation is 950 rpm. Calculate specific speed of the pump.   12 2 4 3

<center>(OR)</center>

    b. A single acting reciprocating pump runs at 60 rpm delivers 54 m³ of water per minute. The diameter of the piston is 200 mm and the stroke length is 300 mm. the suction and delivery heads are 4 m and 12 m respectively. Determine   12 2 4 2
        (i)   Theoretical discharge
        (ii) C_d
        (iii)   Percentage of slip
        (iv)   Power required to rate the pump

32. a. Design a pelton wheel to develop 750 kW working under a head of 250 m running at 800 rpm. The speed is 800 rpm with an overall efficiency of 85%. Take speed ratio as 0.45 and $C_V = 0.98$. The ratio of jet diameter to wheel diameter is 1/10. Find   12 2 5 3
        (i)   Wheel diameter
        (ii)   Jet diameter
        (iii)   Number of jets

<center>(OR)</center>

    b. A Kaplan turbine develops 9000 kW under a net head of 7.5 m and speed ratio and flow ratio are 2.2 and 6.6 respectively dia of boss is 0.35 times the external diameter of the wheel. The overall efficiency of the turbine is 86%. Determine diameters of runner and boss, synchronous speed and specific speed of the runner.   12 2 5 3

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