Register No.: …… Name: ……..

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

THIRD SEMESTER B.TECH DEGREE EXAMINATION (S), MAY 2022

CIVIL ENGINEERING

(2020 SCHEME)

Course Code : **20CET203**

Course Name: **Fluid Mechanics and Hydraulics**

Max. Marks : **100** **Duration: 3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

1. Differentiate between piezometer and U-tube manometer.
2. A cylinder contains a fluid at a gauge pressure of 300kN/m^2. Express the pressure in terms of head of (a) water (b) mercury. What would be the absolute pressure in the cylinder if the atmospheric pressure is 101.3kN/m^2.
3. Define metacentre and metacentric height with figure.
4. Differentiate between the Eulerian and Lagrangian methods of representing fluid flow.
5. Define kinetic energy correction factor.
6. Explain how a pitot tube can be used to find out velocity at any point in a pipeline.
7. What is meant by most economical section of an open channel? Enumerate the conditions for trapezoidal channel to be most economical.
8. What is a cipoletti weir?
9. Differentiate between backwater curve and drawdown curve.
10. What are the applications of hydraulic jump?

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) A circular plate of 0.3m diameter is immersed in water at an inclination 60^0 to the free surface with its top edge at 1.5m below the water surface. Find the total pressure and centre of pressure on the plate. (6)

    b) A U-tube manometer has been employed to measure the pressure of water in a pipe line which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in the level of mercury in the limb of a U-tube is 15cm and the height of fluid in the left limb from the centre of pipe is 10cm below. If the pressure of water in the pipe line reduces to 9kN/m^2, calculate the new difference in the level of mercury. (8)

OR

12. a) Prove that centre of pressure of a lamina placed in vertical position lies below the centre of gravity. (7)

b) An annular ring cut in a sheet metal has 2m outer diameter and 1m inner diameter. It is inserted vertically in a liquid of relative density 0.9 with its centre 1.5m below the surface. Calculate the total force on one side of this ring and the location of the centre of pressure. (7)

MODULE II

13. a) A solid cylinder of diameter 20cm and height 10cm is to float in water with its axis vertical in sea water(specific gravity=1.03). If the relative density of the cylinder material is 0.9, examine the stability of cylinder. (8)

b) Derive the continuity equation for two dimensional flow. (6)

OR

14. a) The velocity vector in an incompressible flow is given by $V = (6xt + yz^2)i + (3t + xy^2)j + (xy - 2xyz - 6tz)k$. (i) Verify whether continuity equation is satisfied. (ii) Determine the acceleration and velocity at point A (1, 1, 1,) at t=2. (7)

b) A ship 65m long and 15m wide displaces 20000kN of water. A weight of 200kN is displaced across the deck through a distance of 5m and the ship is tilted through 5^0. The moment of inertia of the ship about the fore-and-aft axis is 80% of the circumscribing rectangle. The centre of buoyancy is 8m below the water surface. Determine the metacentric height and the position of the centre of gravity of the ship. Take specific gravity of sea water as 1.03. (7)

MODULE III

15. a) State Bernoulli's theorem for a steady flow of an incompressible fluid. Derive an expression for Bernoulli's theorem from the first principle and state the assumptions made for such a derivation. (10)

b) A piping system consists of three pipes arranged in series; the length of the pipes are 1500m, 800m, 600m and diameters 800mm, 600mm and 400mm respectively. (i) Transform the system to an equivalent 400mm diameter pipe, and (ii) Determine an equivalent diameter for the pipe, 2900m long. (4)

OR

16. a) A horizontal pipeline 60m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the first 40m of its length from the tank, the pipe is 300mm diameter and its diameter is suddenly enlarged to 400mm. The height of water level in the tank is 10m above the centre of the pipe. Considering all minor losses, determine the rate of flow. Take friction factor as 0.01 for both sections. Also draw the hydraulic gradient line and total energy line. (14)

MODULE IV

17. a) A trapezoidal irrigation channel, having side slopes 3 horizontal to 2 vertical, is to carry a flow of 15 cumecs on a longitudinal slope of 1 in 4000. The (8)

channel is to be lined for which the value of Manning's coefficient is 0.012. Find the dimensions of the most economic section of the channel.

b) A submerged weir 1.8m long has height of water on the upstream 0.12m and downstream 0.075m above the top of the weir. Find the discharge over the weir, if the coefficient of discharge for free and drowned portions is 0.6 and 0.8 respectively. (6)

OR

18. a) Compare open channel flow and pipe flow. (4)

b) Water flows first over a 1.2m wide trapezoidal weir at a depth of 0.2m with water surface width of 1.8m and then through a right angled triangular weir installed in a channel. Find the depth of water over the triangular weir if the coefficient of discharge of trapezoidal and triangular weir is 0.62 and 0.6 respectively. (10)

MODULE V

19. a) A rectangular channel has a width of 2m and carries a discharge of $1.8m^3/s$ at a depth of 0.18m. Calculate i) specific energy ii) depth alternate to the existing depth and iii) Froude numbers at the alternate depths. (6)

b) Derive the dynamic equation for gradually varied flow, stating the assumptions involved. (8)

OR

20. a) A trapezoidal channel with 8m bottom width and side slope 2 horizontal to 1 vertical having a bed slope of 0.0018 carries $15m^3/s$ of water. The dam along the way of the channel raises the water depth by 2m behind the dam. Decide the nature of channel and type of profile of water. Take Manning's coefficient as 0.025. (8)

b) A horizontal rectangular channel 3m wide carries discharge of $12m^3/s$. Check whether a jump may occur at an initial depth of 0.6m or not. If a jump occurs, determine the sequent depth to this initial depth. Also calculate the energy loss in the jump. (6)

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