Register No.: …… Name: ……

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

THIRD SEMESTER B.TECH DEGREE EXAMINATION (R,S), DECEMBER 2023
CIVIL ENGINEERING
(2020 SCHEME)

Course Code : 20CET203

Course Name: Fluid Mechanics and Hydraulics

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

Assume any missing data if necessary

PART A

(Answer all questions. Each question carries 3 marks)

1. Differentiate simple and differential manometers.
2. Explain the method of estimation of hydrostatic force on curved surfaces.
3. State the stability conditions of floating bodies.
4. Differentiate Eulerian and Lagrangian methods of representing fluid flow.
5. Define and explain the terms hydraulic gradient line and total energy line with a sketch.
6. List all the minor losses associated with the flow of a fluid through a closed conduit specifying their equations.
7. Explain the characteristics of velocity distribution in open channels.
8. Find an expression for the discharge over a rectangular weir in terms of head of water over the crest of weir.
9. Derive the condition for maximum discharge for a given value of specific energy.
10. Show the flow profile variation through neat sketches in case of steep sloped channel in various zones.

PART B

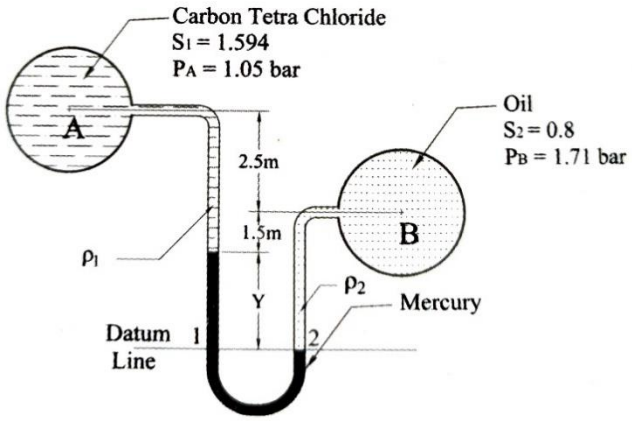
(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Derive an expression for total pressure and centre of pressure on a vertically submerged plane surface. (7)

    b) A differential manometer is connected to two pipes whose centres are at 2.5 m difference in height. Higher level pipe is carrying carbon tetrachloride of specific gravity 1.594 under a pressure of 1.05 bar and another pipe is carrying oil of specific gravity 0.8 under a pressure of 1.71 bar. The centre of pipe low pressure liquid is 4 m above the higher level of mercury in the manometer. The manometer fluid is mercury. Find out the difference in mercury (7)

level in the manometer.



OR

12. a) Show that the intensity of pressure at a point in a fluid at rest is equal in all directions. (6)

b) A cylinder of 3 m diameter is placed across a channel of 5 m width. Water is retained on one side of the cylinder for a depth of 3 m and on the other side, it retains oil of specific gravity 0.8 for a depth of 1.5 m. Determine the resultant force acting on the cylinder and the direction of resultant force. (8)

MODULE II

13. a) A solid cylinder of diameter 4 m has a height of 3 m. Find the metacentric height of cylinder when it is floating in water with its axis vertical. The specific gravity of cylinder is 0.6. State whether the equilibrium is stable or unstable. (5)

b) 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=1. (9)

OR

14. a) Derive continuity equation in three dimensional Cartesian coordinates. (7)

b) A wooden cylinder of circular section and uniform density having specific gravity 0.6 is required to float in oil of specific gravity 0.8. If the diameter of the cylinder is D and its length is L, show that L cannot exceed about 0.817D for cylinder to float with its longitudinal axis vertical. (7)

MODULE III

15. a) State and derive Bernoulli's theorem. (7)

b) A venturimeter having a diameter of 7.5 cm at the throat and 15 cm at the enlarged end is installed in a horizontal pipeline of 15 cm diameter. Rate of flow of fluid in the pipeline is 30 litres per second. (7)

The difference of pressure head measured between the enlarged section and the throat section is 2.45 m. Find the coefficient of discharge of the venturimeter.

OR

16. Three pipes of diameters 400 mm, 200 mm and 300 mm have lengths of 400 m, 200 m and 300 m respectively. They are connected in series to make a compound pipe. The ends of this compound pipe are connected with two tanks whose difference of water levels is 16 m. If the coefficient of friction for these pipes is same and is equal to 0.005, determine the discharge through the compound pipe (i) neglecting the minor losses (ii) including the minor losses. (14)

MODULE IV

17. a) Find the diameter of a circular sewer pipe which is laid at a slope of 1 in 8000 and carries a discharge of 8000 litres/s when flowing half full. Take the value of Manning's N= 0.020. (7)

b) Water is flowing in a rectangular channel of 1 m wide and 0.75 m deep. Find the discharge over a rectangular weir of crest length 60 cm, if the head of water above crest of weir is 20 cm and water from channel flows over the weir. Take C_d = 0.62. Neglect end contractions. Take velocity of approach into consideration. (7)

OR

18. a) Obtain the condition for maximum velocity through circular channels. (7)

b) Define 'end contraction' of a weir. What is the effect of end contraction on the discharge through a weir? (7)

MODULE V

19. a) Explain the classification of channel bottom slopes. (4)

b) Derive the dynamic equation for a gradually varied flow, stating the underlying assumptions. (10)

OR

20. a) Determine the length of the back water curve caused by an afflux of 2.0 m in a rectangular channel of width 40 m and depth 2.5 m. The slope of the bed is given as 1 in 11000. Take Manning's N = 0.03. (7)

b) The discharge of water through a rectangular channel of width 8 m, is 15 m^3/s, when depth of flow of water is 1.2 m. Calculate : (i) Specific energy of the flowing water (ii) Critical depth and critical velocity (iii) Value of minimum specific energy (7)

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