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
CHEMICAL ENGINEERING
(2020 SCHEME)

Course Code : 20CHT205

Course Name: Fluid and Particle Mechanics

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

Missing data may be assumed suitably.

PART A

(Answer all questions. Each question carries 3 marks)

1. A fluid that occupies a volume of 24 L weights 225 N at a location where the gravitational acceleration is 9.80 m/s^2. Determine the mass of this fluid and its density?
2. A capillary tube of 1.2 mm diameter is immersed vertically in water exposed to the atmosphere. Determine how high water will rise in the tube. Take the contact angle at the inner wall of the tube to be 6° and the surface tension to be 1.00 N/m.
3. Explain the significance of Reynold's Number? Calculate the critical velocity of water flowing through 25 mm I.D. pipe. Data: Density of water = 1000 kg/m^3 Viscosity of water = 0.0008 $(N.s)/m^2$, N_{Re}=2100.
4. Define stream line, path line and streak line.
5. Explain the significance of Prandtl one seventh power law.
6. Write down the relationship for friction factor and Reynold's number in laminar flow.
7. Differentiate between particulate fluidization and aggregate fluidization.
8. Define drag coefficient.
9. Explain the need for priming in centrifugal pump.
10. What is NPSH? Explain.

PART B

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

MODULE I

11. a) Derive the expression for position of liquid-liquid interface in terms of other variables in a continuous gravity decanter. (7)

    b) A continuous gravity decanter is to separate chlorobenzene with a density of 1109 kg/m3 from am aqueous wash liquid having a density of 1020 kg/m3. If the total depth in the separator is 1m (7)

and the interface is to be 0.6m from the vessel floor. What should be the height of the heavy liquid overflow leg? Neat figure of the problem statement is required.

OR

12. a) Explain about the rheological classification of fluids and their stress strain curve. (7)
    b) A thin plate moves between two parallel, horizontal, stationary flat surfaces at a constant velocity of 5 m/s. The two stationary surfaces are spaced 4 cm apart, and the medium between them is filled with oil whose viscosity is 0.9 N. s/m^2. The part of the plate immersed in oil at any given time is 2-m long and 0.5-m wide. If the plate moves through the mid-plane between the surfaces, determine the force required to maintain this motion. (7)

MODULE II

13. Derive Bernoulli's equation for an ideal fluid and modify it to account for frictional losses. (14)

OR

14. With neat sketch, explain the concept of boundary layer. How the layer formation happens in straight tubes? (14)

MODULE III

15. a) Derive Darcy-Weisbach's equation for head loss due to friction in pipe flow. (8)
    b) Derive the equation for shear stress distribution in pipe under laminar flow. (6)

OR

16. a) Crude oil of density 840 kg/m^3 is pumped at a rate of 3 l/s through a 52 mm i.d. steel pipe under a pressure drop of 550 kPa over a length of 600 m. Calculate the Fanning friction factor using the Hagen-Poiseuille equation. (7)
    b) Discuss on (i) Viscous sublayer (ii) Buffer layer and (iii) Turbulent core. (7)

MODULE IV

17. Explain about the different regimes of fluidization. Write the application of fluidization techniques in industry. (14)

OR

18. a) What is minimum fluidization velocity? How pressure drop in the bed varies if velocity is increased beyond this value? (4)
    b) A packed bed of 0.5 m in diameter and 0.6 m in height is filled with spherical particles with a specific gravity of 2.5 and a uniform size (10)

of 1500 μm. In case of the packed bed, the porosity is 0.4. if water is to be used as the minimum fluidization, the bed height will be 1 m. what is the porosity of the fluidized bed?

MODULE V

19. Discuss on (i) Gate Valve (ii) Butterfly valve (iii) Check valve with neat sketch. (14)

OR

20. Explain in detail on different types of pumps based on its application and operation. (14)

****