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

CHEMICAL ENGINEERING

(2020 SCHEME)

Course Code: **20CHT205**

Course Name: **Fluid and Particle Mechanics**

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

Assume any missing data suitably

PART A

(Answer all questions. Each question carries 3 marks)

1. Derive an expression for capillary rise of a liquid.
2. Differentiate between absolute viscosity and apparent viscosity.
3. Derive the continuity equation of fluid flow.
4. State Bernoulli's theorem for steady flow of an incompressible fluid.
5. Write friction factor (f) vs N_{Re} relationship in turbulent flow.
6. Derive Hagen Poiseuille equation
7. What are the assumptions for deriving the Ergun equation?
8. Differentiate between dense fluidization and lean fluidization.
9. Define priming in a centrifugal pump.
10. Reciprocating pumps are called positive displacement pump. Why?

PART B

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

MODULE I

11. a) Define Newton's law of viscosity. Two plates are placed at a distance of 0.15 mm apart. The lower plate is fixed while upper plate having surface area 1 m^2 is pulled at 0.3 m/s. Find the force required to maintain this speed, if the fluid separating them is having viscosity 1.5 poise. (7)

    b) Calculate the pressure and density of air at a height of 4000 m from sea level where pressure and temperature of the air are 10.143 N/cm^2 and 15^0C respectively. The temperature lapse rate is given as $0.00065^0C/m$. Take density of air at sea level equal to 1.285 kg/m^3. (7)

OR

12. a) Derive the expression for hydrostatic equilibrium in centrifugal field. (7)

    b) A pressure gauge read 107 kN/m^2 at an elevation of 4m on the side of a tank containing a liquid. Another gauge read 88kN/m^2 at an elevation of 6m. (7)

Calculate the density, specific gravity, specific volume of liquid and total height of liquid.

MODULE II

13. a) With a neat diagram explain the formation of boundary layer separation and wake formation in flat plates. (7)

b) It is planned to install a steel pipe with an inside dia of 20 cm to transfer 1000 kg/minute, molasses having a viscosity of 500 cP and a density of 1.6 gm/cc. The line is to be 1000 m long and the delivery end is to be 5 m higher than the intake. Calculate (7)

1. Pressure drop due to friction.

2. If the overall efficiency of the pump is 60%, what will be the H.P required.

OR

14. a) Derive Bernoulli's equation and state all assumptions. (10)

b) Write the significance of Navier Stokes equation. (4)

MODULE III

15. a) Derive the expression for expansion loss coefficient in a pipeline having sudden expansion. (8)

b) With a neat diagram of friction factor chart, discuss the applications of friction factor chart (6)

OR

16. a) Derive the Universal velocity distribution equation. (10)6

b) What are the limitations of Universal velocity distribution equation. (4)

MODULE IV

17. a) From the Ergun equation derive the equation for minimum fluidization velocity. (7)

b) A 0.5 m high bed made up of a 1mm diameter glass sphere of density 2500 kg/m^3 is to be fluidized by water. If at the point of incipient fluidization, the bed voidage is 40%. Calculate the pressure drop across the bed in N/m^2. (7)

OR

18. a) A partial oxidation is carried out by passing air with 1.2 mol% hydrocarbons through 40mm tubes packed with length 4mm and diameter 5mm cylindrical catalyst pellets. The air enters at 36^0C and 3 atm with a superficial velocity of 1m/s. What is the pressure drop in the packed bed? How much would be the pressure drop reduced by using 6mm diameter pellets? Consider viscosity of air to be $1.81x10^{-5}$ kg/m.s . Assume porosity is 0.4. (10)

b) Discuss about pneumatic conveyence and slurry transport. (4)

MODULE V

19. a) A pump draws benzene at 25 ^0C from a tank, whose level is 2.6 m above the (10)

pump inlet. The suction line has a head loss of 0.8m. The atmospheric pressure is measured to be 98.5 kPa (abs). Calculate the available NPSH. The vapor pressure of benzene is 13.3 kPa (abs).

b) Differentiate between positive displacement pumps and centrifugal pumps. (4)

OR

20. a) Write briefly on various types of check valves with neat sketches and application in the process industry. (7)

b) Discuss about different types of expansion joints in the piping network. With neat diagram explain any one of them in detail. (7)

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