Register No.: .... Name: ....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION (R), DECEMBER 2023
CHEMICAL ENGINEERING
(2020 SCHEME)

Course Code: **20CHT471**

Course Name: **Fluidization Engineering**

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

PART A

(Answer all questions. Each question carries 3 marks)

1. State incipient fluidization velocity and how it is important.
2. List any two applications of fluidized bed in process industry.
3. A shot of gas is injected into a 40 cm ID incipiently fluidized bed of 400 μm sand for which u_{mf} = 3 cm/s and e_{mf} = 0.5. Find the rise velocity (u_{br}), if the size of the bubble is 6 cm.
4. Write down the equation for pumping power requirement in fluidized beds.
5. Draw the graphical representation relating pressure drop and velocity in fluidization.
6. Multimetal oxide catalyst particles are preferable in industrial fluidized beds. Why?
7. Case studies are very useful in scaleup and design of fluidized bed reactors. Justify.
8. Define Sherwood number and its significance.
9. Mention the optimum size ratio equation of reactor and regenerator.
10. List the factors affecting the design of catalytic reactors.

PART B

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

MODULE I

11. Predict the mode of fluidization for particles of density ρ_s = 2.5 g/cm^3 at superficial gas velocities of u_0 = 50 and 70 cm/s (14)
(a) d_p = 70 μm, ρ_g = 1.5 × 10^{-3} g /cm^3, μ = 2 × 10^{-4} g/cm s.
(b) d_p = 480 μm, ρ_g = 1 × 10^{-3} g /cm^3, μ = 2.5 × 10^{-4} g/cm s.

OR

12. Explain Fischer-Tropsch synthesis with the help of a neat diagram. (14)

MODULE II

13. Explain the Geldart classification of particles and extension of Geldart fluidization. (14)

OR

14. Calculate the terminal velocity of (14)
(i) 10 μm spheres

(ii) 1 mm spheres
(iii) 10 μm irregular particles, $\Phi_s = 0.67$
(iv) 1-mm irregular particles, $\Phi_s = 0.67$
for $\rho_s = 2.5$ g/cm^3, $\rho_g = 1.2 \times 10^{-3}$ g /cm^3, $\mu = 1.8 \times 10^{-4}$ g/cm s.

MODULE III

15. Explain the Davidson model for the gas flow at bubbles using neat diagrams. (14)

OR

16. Explain in detail about fluidized bed catalytic cracking with a neat sketch. (14)

MODULE IV

17. Derive an expression for dimensionless heat transfer coefficient in bubbling fluidized bed. Also explain the effect of Reynolds number of gas flow on heat transfer rate. (14)

OR

18. Derive an expression for inter-exchange coefficient in bubbling fluidized bed with adsorption kinetics. (14)

MODULE V

19. Discuss in detail the design considerations employed in fluidized bed catalytic cracker. (14)

OR

20. Design a reactor to produce 30 kilo tons of acrylonitrile per year. We would like to operate at the same conversion of propylene, $X_A = 85\%$, and with a product selectivity of at least SR = 50%. Thus, determine the superficial gas velocity, bed diameter and height. (14)

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