GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (30)

FLUIDIZATION ENGINEERING
SUBJECT CODE:3713016

SEMESTER: I

Type of course: Chemical Engineering (Elective-I (c))

Rationale:
Fluidization finds extensive application today in Process Industry and also in combustion. Objective of this course is to make the student aware of fundamentals of Fluidization and understand the design aspects of fluidized bed systems.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Contents:

Sr. No.	Content	Hrs	% weightage
1	**Introduction to fluidization and applications** Phenomenon of fluidization, behavior of fluidized bed, contacting modes, advantages and disadvantages of fluidization, fluidization quality, selection of contacting mode, Beds for Industrial applications, coal gasification, synthesis reactions, physical operations, cracking of hydrocarbons	6	10
2	**Mapping of fluidization regimes** characterization of particles, mechanics of flow around single particles, minimum fluidization velocity, pressure drop versus velocity diagram, The Geldart classification of solids, fluidization with carryover of particles, terminal velocity of particles, distributor types, gas entry region of bed, pressure drop requirements, design of gas distributor, power consumption	8	15
3	**Bubbling fluidized beds** Davidson model for bubble in a fluidized bed, and its implications, the wake region and movement of solids at bubbles, coalescence and splitting of bubbles, bubble formation above a distributor, slug flow, Turbulent and fast fluidization - mechanics, flow regimes and design equations, Emulsion movement, estimation of bed properties, bubble	10	25

	rise velocity, scale up aspects, flow models, two phase model, K-L model		
4	**Solids movement and Gas dispersion** Vertical and horizontal movement of solids, Dispersion model, large solids in beds of smaller particles, staging of fluidized beds Gas dispersion in beds, gas interchange between bubble and emulsion, estimation of gas interchange coefficient, Heat and mass transfer in fluidized systems, Mixing in fluidized systems - measurements and models.	12	25
5	**Fluidized bed reactors** Entrainment and elutriation, Freeboard behavior, gas outlet, entrainment from tall vessel, freeboard entrainment model, high velocity fluidization, pressure drop in turbulent and fast fluidization, Slugging, Spouted beds, Circulating Fluidized Beds. Mathematical model of a homogeneous fluidized bed, Design of catalytic reactors, pilot plant reactors, information for design, bench scale reactors, design decisions, deactivating catalysts, Design of noncatalytic reactors, kinetic models for conversion of solids, models for shrinking particles, conversion of solids of unchanging size	16	25

List of Practicals:

1. Determination of minimum fluidization velocity in circular bed
2. Determination of minimum fluidization velocity in rectangular bed
3. Calculation of entrainment in fluidized bed
4. Classification of particles as per the Geldart classification scheme.
5. Estimation of gas interchange coefficient in fluidized bed
6. Performance evaluation of fluidized bed using K-L model
7. Performance evaluation of fluidized bed using Davidson model
8. Modelling and simulation of Fluidized Catalytic Cracker
9. Design study of iron-coke smelting furnace
10. Design study of fluidized bed drying using FBD model.
11. Application study of fluidized bed in pharmaceuticals industries
12. Fluidization performance study using various fluids to fluidize sand particles.

References:

1. Levenspiel O. and Kunnii D., "Fluidization Engineering", John Wiley, 1972
2. Liang-Shih Fan, "Gas-Liquid-Solid Fluidization Engineering", Butterworths, 1989

Course Outcomes:

At the end of the course, the student will be able to:

1. Performing and understanding the behavior fluidization in fluidized bed
2. Evaluate the characterization of particles and power consumption in fluidization regimes
3. Understanding the applicability of the fluidized beds in chemical industries