

**DEPARTMENT OF CHEMICAL ENGINEERING**  
**NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI**

COURSE PLAN - PART I				
Course Title	Advances in Fluidization Engineering			
Course Code	CL 602 (M.Tech-Chemical Engg)	No. of Credits	L	T
Course Code of Pre-requisite subject(s)	NIL		P	C
Session	Jan. 2018	Section (if, applicable)	3	0
Name of Faculty	Dr.N.Anantharaman	Department	0	3
Email	naraman@nitt.edu	Telephone No.	Chemical Engg R.No.: 102	
Name of Course Coordinator(s) (if, applicable)	Dr. P. Sivashanmugam			
E-mail	psiva@nitt.edu	Telephone No.	0431-2503103	
Course Type	<input checked="" type="checkbox"/> Core course	<input type="checkbox"/> Elective course	2503106	

**Syllabus (approved in BoS)**

Applications of fluidized beds: Introduction, Industrial application of fluidized beds, Physical operations and reactions.

Fluidization and analysis of different phases: Gross behavior of fluidized beds. Bubbles in dense beds. The emulsion phase in dense bubbling beds. Flow pattern of gas through fluidized beds.

Heat and Mass transfer in fluidized bed systems: Mass and heat transfer between fluid and solid. Gas conversion in bubbling beds. Heat transfer between fluidized bed and surfaces.

Elutriation and entrainment: TD and also distribution of solid in a fluidized bed. Circulation systems.

Design of fluidized bed systems: design of fluidization columns for physical operations, catalytic and non-catalytic reactions, three phase fluidization

**COURSE OBJECTIVES**

To learn the principle, technical concepts involved in the analysis and design of Fluidized bed systems.

COURSE OUTCOMES (CO)	
Course Outcomes	Aligned Programme Outcomes (PO)
1. Evaluate the fluidization behavior	PO1, PO4
2. Estimate pressure drop, bubble size, TDH, voidage, heat and mass transfer rates for the fluidized beds.	PO1, PO2, and PO4
3. Develop model equations for fluidized beds	PO1, PO2, PO3, PO4 and PO5
4. Design of gas-solid fluidized bed reactors.	PO1,PO2,PO3,PO4, PO5, PO6,PO7, PO8,PO9,PO10 and PO11

COURSE PLAN – PART II			
COURSE OVERVIEW			
To learn the principle, technical concepts involved in the analysis and design of Fluidized bed systems			
COURSE TEACHING AND LEARNING ACTIVITIES			
S.No.	Week/Contact Hours	Topic	Mode of Delivery
1	Week 1	Introduction	Chalk and talk
2	Week 1	Types of contacting- their features	Chalk and talk
3	Week 1	Classification of particles and beds	Chalk and talk
4	Week2	Pressure drop estimation and use of ergun's equation in estimating $U_{mf}$	Chalk and talk
5	Week 2	Estimation Terminal velocity and mode of fluidisation	Chalk and talk

6	Week 2	Distributors and their features	Chalk and talk
7	Week 3	Design of distributors	Chalk and talk
8	Week 3	Power requirements estimation	Chalk and talk
9	Week 3	Particle size determination	Chalk and talk
10	Week 4	Problems on estimation of $D_p$ and $U_{mf}$	Chalk and talk
11	Week 4	Problems on estimation of $U_t$ and Mode of fluidisation	Chalk and talk
12	Week 4	Problems on design of distributors and power estimation	Chalk and talk
13	Week 5	Assessment 1	
14	Week 5	Elutriation and entrainment, Effects of parameters on entrainment	Chalk and talk
15	Week 5	Problem on elutriation constant estimation	Chalk and talk
16	Week 6	Model for Entrainment	Chalk and talk
17	Week 6	Problems on entrainment estimation	Chalk and talk
18	Week 6	Salient features of Davidson's model	Chalk and talk

19	Week 7	Evaluation of Bubbling bed model	Chalk and talk
20	Week 7	Problem solving and interpretation of results on bubbling bed model	Chalk and talk
21	Week 7	Bubble growth and coalescence and problem solving on this topic	Chalk and talk
22	Week 8	Analysis of emulsion phase and Us estimation	Chalk and talk
23	Week 8	Dispersion of solids and application of model and problem solving	Chalk and talk
24	Week 8	Analysis of Gas interchange	Chalk and talk
25	Week 9	Estimation of dispersion of gas and solving problems	Chalk and talk
26	Week 9	An overview of Bubbling bed model	Chalk and talk
27	Week 9	Assessment 2	
28	Week 10	Applications of Fluidisation: Transportation/Heat exchange/Drying	Chalk and talk
29	Week 10	Applications of Fluidisation: Synthesis reactions/cracking/carbonisation	Chalk and talk & PPT
30	Week 10	Applications of Fluidisation: Gasification and calcination	Chalk and talk & PPT
31	Week 11	Conversion of gas in Fluidised beds	Chalk and talk & PPT

32	Week 11	Models on Conversion of gas in FBs	Chalk and talk & PPT
33	Week 11	Flow of high bulk density mixtures and circulation rates	Chalk and talk & PPT
34	Week 12	Flow of low bulk density mixtures, Assembly of circuit and Practical considerations	Chalk and talk & PPT
35	Week 12	Heat transfer between FBs and surfaces	Chalk and talk & PPT
36	Week 12	Definitions of mass transfer coeffs.	Chalk and talk
37	Week 13	Heat and mass transfer in FBs and definitions of mass transfer coeffs	Chalk and talk
38	Week 13	Design for Physical operations	Chalk and talk
39	Week 13	Design of catalytic reactors	Chalk and talk
40	Week 14	Design of non catalytic reactors	Chalk and talk
41	Week 14	Three Phase fluidisation	Chalk and Talk
42	Week 14	Overview	Chalk and talk
		FINAL ASSESSMENT	

## COURSE ASSESSMENT METHODS (shall range from 4 to 6)

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Assignment-1	3rd week		10%
2	I Assessment - (Written)	5 <sup>th</sup> week since commencement	1 hour	20%
3	seminar	Starting from 8 <sup>th</sup> week		10%
4	II Assessment- (Written)	9 <sup>th</sup> week since commencement	1 hour	20%
CPA	Compensation Assessment* (Written)	12 <sup>th</sup> week	1 hour	20%
5	Final Assessment *-( Written)	14 <sup>th</sup> week since commencement	3 hour	40%

**\*mandatory; refer to guidelines on page 4 (Will cover both I and II assessments)**

### COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)

Feedback is planned to be collected twice: once in the mid semester and one at the end of course as soon as classes are over.

### COURSE POLICY (preferred mode of correspondence with students, policy on attendance, compensation assessment, , academic honesty and plagiarism etc.)

#### MODE OF CORRESPONDENCE (email/ phone etc) :

Through Phone/email with Class representative

#### ATTENDANCE :

- 1) Attendance of 75% and above is expected. The 25% allowance is given for absence due to illness/institute related activities(sports/competitions/seminars etc)

#### COMPENSATION ASSESSMENT :

Will cover both I and II assessments for those who have missed either I or II or both, on genuine grounds

#### ACADEMIC HONESTY & PLAGIARISM

- 1) It is expected that the students will not copy from his/her friends/batch mates and if found that they have copied, both /all of them will loose all the marks in that test/examination/assignment. Reappearance / additional assignment will not be given.

#### ADDITIONAL INFORMATION

For those missing final assessment, a supplementary examination will be conducted for 100marks covering the entire syllabus, as directed Dean (academic) office.

#### FOR APPROVAL

Course Faculty N.A.A.      CC-Chairperson [Signature]      HOD [Signature]  
16/1/2016