NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF CHEMICAL ENGINEERING

COURSE PLAN – PART I			
Name of the programme and specialization	M.Tech/Chemical Engineering		
Course Title	Advances in Fluidization Engineering		
Course Code	CL602	No. of Credits	3
Course Code of Pre-requisite subject(s)	NIL		
Session	January 2019	Section (if, applicable)	-
Name of Faculty	Dr.N.Anantharaman	Department	Chemical Engg
Official Email	naraman@nitt.edu	Telephone No.	04312503103
Name of Course Coordinator(s) (if, applicable)			
Official E-mail		Telephone No.	
Course Type (please tick appropriately)	☑ Core course	☐ Elective course	

Syllabus (approved in BoS)

Applications of fluidized beds: Introduction, Industrial application of fluidiz
ed 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. Cir–
culation systems.

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

REFERENCE BOOKS

1. Diazo Kunii and O. Levenspiel, *Fluidization Engg.*, 2nd Ed., Butterworth Heinemann,1991.
2. J. F. Davidson and Harrison, *Fluidization,* 10 Ed, Academic Press, London, 1994.
3. Jackson, R., *The Dynamics of Fluidized Particles,* Cambridge University Press, New York, 2000.
4. Fan, L.-S. and C. Zhu, *Principles of Gas-Solid Flows,* Cambridge University Press, New York (1998)

COURSE OBJECTIVES

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

MAPPING OF COs with POs	
Course Outcomes	**Programme Outcomes (PO)** (Enter Numbers only)
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 Umf	Chalk and talk
5	Week 2	Estimation Terminal velocity and mode of fluidization	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 Dp and Umf	Chalk and talk
11	Week 4	Problems on estimation of Ut and Mode of fluidisation	Chalk and talk
12	Week4	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	Week7	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 coeffts	Chalk and talk
37	Week 13	Heat and mass transfer in FBs and definitions of mass transfer coeffts	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	1	Assignment-1	3rd week	-
2	2	I Assessment – (Written)	5th week since commencement	1 hour
3	3	seminar	Starting from 8th week	
4	4	II Assessment- (Written)	9th week since commencement	1 hour
CPA	CPA	Compensation Assessmeent* (Written)	12th week	1 hour
5	Final Assessment *	Final Assessment *-(Written)	14th week since commencement	2 hour

***mandatory; refer to guidelines on page 4 (Will cover entire syllabus)**

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 (including compensation assessment to be specified)

The compensation assessment (for written test 1 and 2) will be conducted covering the portions of 1st and 2nd test topics. This is exclusively applicable only for those who are absent on valid reasons like, representing the Institute, Medical grounds etc.

ATTENDANCE POLICY (A uniform attendance policy as specified below shall be followed)

- At least 75% attendance in each course is mandatory.
- A maximum of 10% shall be allowed under On Duty (OD) category.
- Students with less than 65% of attendance shall be prevented from writing the final

assessment and shall be awarded 'V' grade.

ACADEMIC DISHONESTY & PLAGIARISM

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.
- The above policy against academic dishonesty shall be applicable for all the programmes.

ADDITIONAL INFORMATION, IF ANY

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 _____ **CC- Chairperson** _____ **HOD** _____

Guidelines

a) The number of assessments for any theory course shall range from 4 to 6.

b) Every theory course shall have a final assessment on the entire syllabus with at least 30% weightage.

c) One compensation assessment for absentees in assessments (other than final assessment) is mandatory. Only genuine cases of absence shall be considered.

d) The passing minimum shall be as per the regulations.

B.Tech. Admitted in				P.G.
2018	2017	2016	2015	
35% or (Class average/2) whichever is greater.		(Peak/3) or (Class Average/2) whichever is lower		40%

e) Attendance policy and the policy on academic dishonesty & plagiarism by students are uniform for all the courses.

f) Absolute grading policy shall be incorporated if the number of students per course is less than 10.

g) Necessary care shall be taken to ensure that the course plan is reasonable and is objective.