

DEPARTMENT OF CHEMICAL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN – PART I			
Course Title	CHEMICAL REACTOR ANALYSIS AND DESIGN		
Course Code	CL 605	No. of Credits	3
Course Code of Pre-requisite subject(s)	Chemical Reaction Engineering, Mass Transfer		
Session	July 2018	Section (if, applicable)	NA
Name of Faculty	Dr K Muthukumar	Department	Chemical Engineering
Email	kmkumar@nitt.edu	Telephone No.	91-431-2503105
Name of Course Coordinator(s) (if, applicable)	Dr P Sivashanmugam		
E-mail		Telephone No.	
Course Type	<input checked="" type="checkbox"/> Core course <input type="checkbox"/> Elective course		
Syllabus (approved in BoS)			
<p>Analysis of Non-catalytic fluid solid reaction: Kinetics of non-catalytic fluid-particle reactions various models, application to design.</p> <p>Catalyst preparation and characterization: Catalysis - Nature of catalyses, methods of evaluation of catalysis, factors affecting the choice of catalysts, promoters, inhibitors, and supports, catalyst specifications, preparation and characterization of catalysts, surface area measurement by BET method, pore size distribution, catalyst, poison, mechanism and kinetics of catalyst, deactivation.</p> <p>Physical adsorption and chemical adsorption: Fluid-fluid reactions different regimes, identification reaction regime, application to design. Physical absorption with chemical reaction, simultaneous absorption of two reacting cases consecutive reversible reactions between gas and liquid, irreversible reactions, estimation of effective interfacial area in absorption equipment.</p> <p>Reaction kinetics, accounting porous nature of catalyst: Heterogeneous catalytic reactions - effectiveness factor, internal and external transport processes, non-isothermal reacting systems, uniqueness and multiplicity of steady states, stability analysis.</p> <p>Modeling of chemical reactors: Modeling of multiphase reactors -Fixed, fluidized, trickle bed, and slurry reactors.</p>			
COURSE OBJECTIVES			
<ol style="list-style-type: none"> 1. To understand the kinetics of non-catalytic chemical reaction and reactor design. 2. To understand the catalyst physical characterisation of surface area, pore volume, and pore size. 3. To understand the kinetics of catalytic chemical reaction and reactor design. 4. To understand the kinetics of fluid - fluid Chemical reaction and reactor design. 5. To understand the operation and troubleshooting of heterogeneous reactors. 			

COURSE OUTCOMES (CO)	
Course Outcomes	Aligned Programme Outcomes (PO)
1. Have awareness on catalyst physical properties and catalyst characterization.	1, 2, 3
2. Acquire awareness on kinetics of catalytic and non-catalytic chemical reaction.	1,2,3,4,6,8,9,10
3. Familiarize with the design of catalytic and non-catalytic reactor	1,2,3,4,5,6,7,9,10,11
4. Familiarize with operation and troubleshooting of heterogeneous reactors.	1,2,3,4,5,6,7,8,9,10,11

COURSE PLAN – PART II			
COURSE OVERVIEW			
<p>This course imparts knowledge on basics of heterogeneous reactions, mass transfer aspects, nature of catalysts and their characterization, and design of reactors. At the end of the course, students will be in a position to select and model the reactors for heterogeneous reactions. Importantly, most of the reactions in chemical industries employ catalyst and hence, this course is very vital for the chemical engineering students.</p>			
COURSE TEACHING AND LEARNING ACTIVITIES			
S.No.	Week/ Contact Hours	Topic	Mode of Delivery
1	Week 1	Introduction to Heterogeneous Reactions, Catalyst types, Steps involved in Heterogeneous reactions, development of rate of equation	C & T
2	Week 2	Discussion on deducing rate equation using experimental data and based on mechanism, Estimation of rate parameters, Design of reactor, Pressure drop calculations	C & T
3	Week 3	Catalyst deactivation Intra particle diffusion	C & T
4	Week 4	External Mass Transfer	C & T
5	Week 5	non-isothermal reacting systems, uniqueness and multiplicity of steady states, stability analysis	C & T
6	Week 6	Catalysts, Factors affecting the choice of catalysts, promoters, inhibitors, and supports, catalyst specifications, surface area measurement by BET method, pore size distribution, catalyst, poison, mechanism	C & T, PPT
7	Week 7	Physical adsorption and chemical adsorption: Fluid-fluid reactions different regimes, identification reaction regime	C & T, PPT
8	Week 8	Physical absorption with chemical reaction, simultaneous absorption of two reacting cases consecutive reversible reactions between gas and liquid	C & T, PPT

9	Week 9	Irreversible reactions, estimation of effective interfacial area in absorption equipment	C & T, PPT
10	Week 10	Analysis of Non-catalytic fluid solid reaction	C & T
11	Week 11	Kinetics of non-catalytic fluid-particle reactions	C & T
12	Week 12	Design of non-catalytic reactors	C & T
13	Week 13	Modeling of Fixed and fluidized bed reactors	C & T
14	Week 14	Modeling of slurry and trickle bed reactor	C & T
15	Week 15	Slurry reactors	C & T

COURSE ASSESSMENT METHODS (shall range from 4 to 6)

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Test 1	Week 6	1 h	20
2	Two Assignments	As per the schedule given by the faculty	-	5% each
3	Test 2	Week 12	1h	20
CPA	Compensation Assessment*	Week 14	1 h	20
4	Final Assessment *	As per schedule	3 h	50

***mandatory; refer to guidelines on page 4**

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

Students indirect feedback will be collected twice during the course-one in the mid of the course and one at the end of the course on course contents, delivery etc. The academic performance of the students will be assessed based on 2 cycle tests (each 20 marks), one final examination (50 marks) and assignments (10 marks).

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

MODE OF CORRESPONDENCE (email/ phone etc)

The students can contact the course instructor through Email/Phone as given above.

ATTENDANCE

- **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.**

COMPENSATION ASSESSMENT

A Student who is absent from a cycle test due to a valid reason only will be allowed to attend the compensation test. The syllabus for the compensation test include both Cycle Test 1 & 2 portion. No compensation assessment for final assessment

ACADEMIC HONESTY & 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

1. All the students are expected to attend all the classes and Tests without fail.
2. The passing minimum will be fixed as per the Rules and Regulations of the Institute.

FOR APPROVAL


Dr K MUTHUKUMAR
Course Faculty


Dr P SIVASHANMUGAM
CC-Chairperson


Dr P SIVASHANMUGAM
HOD

Guidelines:

- a) The number of assessments for a course shall range from 4 to 6.
- b) **Every 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. This is not applicable for project work/industrial lectures/internship.**
- d) **The passing minimum for all the courses shall be the maximum of 35% or class average/2.**
- e) **Absolute grading policy shall be incorporated if the number of students per course is less than 10.**
- f) Necessary care shall be taken to ensure that the course plan is reasonable and is objective.

References:

1. Minutes of 37th Senate Meeting held on 6th July 2017, Page No.17 – 20.
2. Minutes of 39th Senate meeting held on 15th May 2018, Annexure A.