

DEPARTMENT OF CHEMICAL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN – PART I			
Course Title	CHEMICAL REACTOR ANALYSIS AND DESIGN		
Course Code	CL 602	No. of Credits	3
Course Code of Pre-requisite subject(s)	Chemical Reaction Engineering, Mass Transfer		
Session	Jan 2021	Section (if, applicable)	NA
Name of Faculty	K Muthukumar	Department	Chemical Engineering
Email	kmkumar@nitt.edu	Telephone No.	9444951977
Name of Course Coordinator(s) (if, applicable)			
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	
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			
This course imparts knowledge on the basics of heterogeneous reactions, mass transfer aspects, catalysts preparation 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.			
COURSE TEACHING AND LEARNING ACTIVITIES			
S.No.	Week/Contact Hours	Topic	Mode of Delivery
1	Week 1	Analysis of Non-catalytic fluid solid reaction	PPT/Document Camera
2	Week 2	Kinetics of non-catalytic fluid-particle reactions	PPT/Document Camera
3	Week 3	Design of non-catalytic reactors	PPT/Document Camera
4	Week 4	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	PPT/Document Camera
5	Week 5	Introduction to Heterogeneous Reactions, Catalyst types, Steps involved in Heterogeneous reactions, development of rate of equation	PPT/Document Camera

6	Week 6	Discussion on deducing rate equation using experimental data and based on mechanism, Estimation of rate parameters, Design of reactor, Pressure drop calculations	PPT/Document Camera
7	Week 7	Catalyst deactivation Intraparticle diffusion	PPT/Document Camera
8	Week 8	External Mass Transfer	PPT/Document Camera
9	Week 9	non-isothermal reacting systems, uniqueness and multiplicity of steady states, stability analysis	PPT/Document Camera
10	Week 10	Physical adsorption and chemical adsorption: Fluid-fluid reactions different regimes, identification reaction regime	PPT/Document Camera
11	Week 11	Physical absorption with chemical reaction, simultaneous absorption of two reacting cases consecutive reversible reactions between gas and liquid	PPT/Document Camera
12	Week 12	Irreversible reactions, estimation of effective interfacial area in absorption equipment	PPT/Document Camera
13	Week 13	Modeling of Fixed and fluidized bed reactors	PPT/Document Camera
14	Week 14	Modeling of slurry and trickle bed reactor	PPT/Document Camera
15	Week 15	Slurry reactors	PPT/Document Camera

COURSE ASSESSMENT METHODS (shall range from 4 to 6)

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Online Test 1	February Last Week	1 h	20
2	Three Assignments (Online Submission)	As per the schedule given by the faculty	-	10% each = 30
3	Online Test 2	March Last Week	1h	20

CPA	Online Compensation Assessment*	May First Week	1 h	20
4	Online Final Assessment *	As schedule by O/o Dean (Academic)	2 h	30

***mandatory; refer to guidelines**

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 (30 marks) and assignments (30 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

- A uniform attendance policy for all courses is recommended. **At least 75% attendance in each course is mandatory.**
- The students with less than 75% in any course by the end of 9th week will be identified and complementary assignments will be given to them to be done during 10th week.
- **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. Please note that 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 constituted with the 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 policy against academic dishonesty shall be applicable for the current batches also.

ADDITIONAL INFORMATION

1. All the students are expected to attend all the classes and Tests without fail.
2. It is advised to maintain the attendance above 75%. On Duty claims to attend the Institute approved co-curricular and extra-curricular activities should be forwarded by the competent authorities.
3. Students absenting from cycle tests, on genuine reason, may appear for retest only once.
4. Dishonesty will be penalized severely.
5. The passing minimum will be fixed as per the Rules and Regulations of the Institute.

FOR APPROVAL**Course Faculty****Dr K Muthukumar
8th February 2021****Dr T Sivasankar
CC-Chairperson****Dr P Kalaihelvi
HoD**