BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus
Instruction Division

FIRST SEMESTER 2016-2017
Course Handout Part II

Date: 02/August/2016

In addition to Part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : **CHE F311**
Course Title : **Kinetics & Reactor Design**
Instructor-in-charge : **ARVIND KUMAR SHARMA**
Instructor (Tutorial) : **Arvind Kumar Sharma, P. Chattopadhyay & Vijayan, S.**

1. **Course Description**:
   Kinetics of homogeneous, heterogeneous reactions; ideal reactors, non-ideal flow; selectivity; analysis and design of chemical reactors [*Kinetics Reaction rate, order, rate constant; Batch reactors Design + basics; Kinetic constants from batch reactor data; Ideal flow reactors Mass and Energy balances; Isothermal, adiabatic and non-isothermal operation; Catalysts, Catalytic rates, Reaction mechanisms; Internal/External transport in catalysts; Non-catalytic solid-gas reactions; Reactor design for ideal flow reactors; Kinetics of Solid Catalyzed Reactions; Yield and Selectivity; Concept of RTD; Segregation and Maximum Mixedness models.*]

2. **Scope and Objective of the Course**:
   This course is an introduction to the chemical reaction kinetics, design and performance of various types of chemical reactors for chemically reacting systems which yield industrially important products. The emphasis in this course will be to understand the fundamentals of kinetics of homogeneous reactions, design and analysis of ideal reactors; and non-ideal flow.

3. **Text Book**:
   Fogler, H. Scott "Elements of Chemical Reaction Engineering", Pearson Education, Inc., 4th Ed, 2006.

4. **Reference Books:**
   (a) Levenspiel O., "Chemical Reaction Engineering", John Wiley, 3rd Ed., 1999.
   (b) Schmidt Lanny D., "The Engineering of Chemical Reactions", Oxford University Press, 2nd Ed., 2005.
   (c) *More references will be shared dynamically. Pls remain updated … !*

5. **Course Plan**:

Lecture No.	Learning Objectives	Topics to be covered	Ref./Ch./ Sec
1	Introduction	Scope and objectives of the course, methodology, concept of mole balances	1.1-1.2
2-3	Mole balances	Different types of reactors, mole balances	1.3-1.5

4	Design equations	Conversion and reactor sizing	2.1-2.3
5-7	Applications of design equations	Reactor sizing for batch and flow systems	2.4-2.6
8-10	Rate laws and stoichiometric	Basic definitions and stoichiometric tables	3.1-3.6
11-12	Isothermal reactor design	Design structure, design of batch and flow reactors	4.1-4.4
13	Effect of pressure	Pressure drop in reactors	4.5
14	Mole balances in terms of concentration and molar flow rates	Mole balance on CSTRs, PFRs, PBRs and Batch reactors	4.7
15-17	Collection and analysis of rate data	Differential and integral methods of analysis, examples	5.1-5.5
18	Evaluation of laboratory reactors	Differential reactors, comparison of experimental reactors	5.6-5.7
19-21	Multiple reactions	Maximizing desired product in parallel and series reactions	6.1-6.3
22-24	Non isothermal reactor design	Energy balance	8.1-8.2
25	Flow reactors	Steady state reactor design of CSTR and PFR	8.3
26-28	Additional topics	Equilibrium conversion, nonadiabatic operation, multiple study states, multiple reactions	8.4, 8.6
29	Unsteady state reactor design	Batch reactors	9.1-9.2
30-31	Catalysis	Catalysts and mechanism of catalytic reactions	10.1-10.2
32	Finding the rate law	Mechanism, rate-limiting step and rate law	10.3
33	Reactor design	Design of reactors for Gas-solid reactions	10.4
34-35	Reactions in porous catalysts	Diffusion and reaction in porous catalysts	11.1-11.3
36-38	Non ideal reactors	RTD, measurement and characteristics, RTD in ideal reactors	13.1-13.4
39	Reactor modeling with RTD	Zero-parameter models	13.6-13.7
40-41	Analysis of non-ideal reactors	One-parameter models	14.1-14.2
42	Complex models	Two-parameter models	14.7

Self-Study : Sections 4.6; 4.8-4.10; 6.4; 7.1-7.4; 8.5; 8.7; 10.5-10.6; 11.4-11.5; 12.1-12.5;13.5; 13.8-13.9; 14.3 | **Not to be included for evaluation** (Mid Sem. , Tut. & Surprise Tests / Quizzes and Comre') … but **Assignment(s)** and **Project(s) may be there … !**

Rest of the Text & Ref. Books : At the **earliest** in your professional life … !

6. Evaluation Scheme*

Components		Duration	Weightage (%)	Marks	Date & Time	Nature **
1	Mid Sem. Test	1.5 hr.	30	90	5/10 2:00 - 3:30 PM	CB + OB
2#	Tutorial Tests / Surprise Quizzes / Assignments / Projects … *etc.*	-	30	90	-	CB/OB
3	Comprehensive Exam.	3 hr.	40	120	7/12 FN.	CB + OB

* **If any change in this / rest of the handout : it will be communicated in Classes / Tutorials – pls follow them.**

** **CB** = Close Book **OB** = Open Book

A judicious blend of these components will spread over class and tutorial hours. There will not be "best of option" in assignments and / or projects. In case of tutorial tests and/or surprise quizzes, all possible efforts will be made so that "best of option" may be exercised.

- **Chamber consultation hour** will be announced in the class.
- The **notices,** if any**,** concerning the course, will be displayed on the notice board of the Department of Chemical Engineering / Nalanda (http://nalanda.bits-pilani.ac.in).
- **Make-up** will be granted for **genuine cases only**. Certificate from authenticated doctor, say from the Medical Center, must accompany make-up application (*only prescription or vouchers for medicines will not be sufficient*). Prior permission of IC is compulsory.

Instructor-in-charge
CHE F311