**Chemical Engineering Department**

CHE 402: Kinetics and Reactor Design

Term 151

**Instructors**: **Dr. Zuhair, O. Malaibari** (Coordinator) and Dr. Nabeel S. Abo-Ghandar

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**Office Hours: UTR (11:00 – 11:50 am.)**

**Prerequisites**: CHE 303, CHEM 311, Senior Standing

**Objectives**:

1. Apply the fundamental principles of chemical kinetics to problems involving mass and energy balances with reactions.
2. Assess the basics of homogenous reaction kinetics and design different types of isothermal and non-isothermal chemical reactors (BR, PFR, PBR, CSTR).
3. Analyze experimental kinetic data to determine rate equations and mechanisms.
4. Use different methods to analyze rate data.
5. Define catalysis and different types of catalytic reactors.

**Outcomes**:

1. Interpret batch and differential reactors data to obtain reaction rate expressions.
2. Calculate volume of batch and flow reactors in constant- and variable-volume systems.
3. Calculate yield and selectivity in multiple reactions.
4. Analyze heat effects in non-isothermal reactors.
5. Define catalysis, classify catalytic reaction and describe its steps.
6. Calculate catalyst weight and reactor volume in isothermal PBRs.

**Textbook**: Fogler, H. S., "Elements of Chemical Reaction Engineering", 4th ed., Prentice Hall (2005).

**Key Reference**: Levenspiel, O., "Chemical Reaction Engineering", 3rd ed., John Wiley & Sons (1999).

Carberry, J. J., “Chemical and Catalytic Reaction Engineering”, 2nd ed., Dover Publocations (2001).

**Topics**

**I. Rate Laws, Stoichiometry and Mole Balances (Chapter 1 & 3)**

Definition of reaction rate

Reaction order, reaction rate constant and rate law

Reversible and irreversible reactions

Elementary and non-elementary reactions

Batch and continuous flow reactors

Stoichiometry in batch and flow systems

Industrial reactors

**II.Conversion and Reactor Sizing (Chapter 2)**

Conversion

Design equations for batch and continuous flow reactors

Application of the design equations

Reactor staging

**III. Isothermal Reactor Design (Chapter 4)**

Reactor sizing and design

Design structure for isothermal reactors.

Design of batch reactor

Design of CSTRs

Tubular reactors

Semi-batch reactors

Packed bed reactors

**IV. Collection and Analysis of Rate Data (Chapter 5)**

Batch Reactor design

Differential method of analysis

Integral method of analysis

Differential reactors

**V. Multiple Reactions (Chapter 6)**

Yield and selectivity

Parallel, series and complex reactions

Conditions for maximizing the desired product

Mole balances for multiple reactions

Temperature effects

**VI. Non-Isothermal Reactor Design (Chapter 8)**

The energy balance

Adiabatic operations

Non-isothermal flow reactors with heat exchange

Equilibrium conversion and adiabatic temperature

Optimum feed temperature

**VII. Catalysis and Catalytic Reactors (Chapter 10)**

Definition of catalysis and catalytic processes

Catalysts properties and classification

Steps in a catalytic reaction and adsorption isotherms

Grading:

Homework 5%

Attendance 5%

Computer Assignments 10%

Quizzes 6%

Four Major Quizzes 4%

 Two major exams 40%

Final exam. 30%

Exam Dates:

1. First Major Exam will be on **Monday, Oct 19th, 2015 at 6:00 pm.**
2. Second Major Exam will be on **Monday, Nov 23rd, 2015 at 6:45 pm.**
3. Final Exam will be on **Sunday, Dec 27th 2015 at 7:00 pm (Evening).**

**Important Notes:**

* Attending classes is very important for understanding the material and passing the course, according to University regulations unexcused absence in 20% of the course lectures (**9 unexcused absences**) will result in an automatic **DN** grade.
* If you have an excuse for an absence, it will be accepted only within **two weeks** after the absence. There will be no makeup quizzes. If you are excused from a quiz, I will simply double the grade of the next one.
* All course material and exam schedules as well as announcements will be posted on WebCT/Black Board. It is your responsibility to check it before and after each lecture, and to check your e-mail for any announcements