COURSE COMPACT FOR CHE 326

Course

Course code: CHE 326
Course title: Chemical Reactions Engineering (3 units)
Course status: Compulsory

Course Duration

Three (3) hours per week for 15 weeks (45hours)

Lecturer Data

Name: Dr. M.S. Olakunle
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Consultation Hours: Tuesday – Thursday, 10:00 – 12:00p.m.

Course Content:

Introduction: definition and reaction rates, variables affecting reaction rates; Classification of reactions; Homogeneous reactions (elementary and non-elementary reactions), molecularity and reaction order, rate constant, temperature dependency theories, activation energy, Constant-volume batch reactor (irreversible reactions of zero, 1st, 2nd and nth order; series and parallel reactions, Overall order from half-life data; reversible reactions of 1st and 2nd order); Variable-volume batch reactor (irreversible reactions of zero, 1st, 2nd and nth order), Analysis of total-pressure data; Homogeneous and autocatalytic reactions; Introduction to catalysis and catalyst deactivation

Course Description:

Chemical Reaction Engineering I is an introduction to chemical reaction engineering. It deals with definition and classification of reaction. It also deals with homogeneous systems and defines the parameters that influence its kinetics: temperature and concentration. Furthermore, methods of derivation of kinetic expressions using batch reactor experimental data are treated.

Course Justification:

Homogeneous reactions are common and continue to be very important in the chemical process industry. For purposes of design, kinetic models are usually very important. The course exposes students to typical reactions and parameters and methods considered in deriving their rate expressions.

Course objectives

At the end of this course, students should be able to:

i. understand the concept of homogeneous reactions
ii. know the parameters of the parameters that affects their kinetics
iii. understand how to develop kinetic models for homogeneous reactions

Course Requirement:

Method of Grading- An example below

S/N	**Grading**	**Score** (%)
1	Test	20
2	Assignment	10
3	Final Examination	70
	Total	**100**

Course Delivery Strategies – Illustration below:
Lecture and Collaboration method complimented with tutorials will be adopted. In the tutorials, practice questions will be treated by the students guided by the course instructor. Students may sometimes be grouped for the tutorial classes and group assignment will also be given to students.

LECTURE CONTENT

Week	Topic	Objectives	Description
1	Chemical Reaction and Classification	At the end of this topic, students should be able to: • Define the rate of chemical reaction. • Apply the mole balance equations to a batch reactor, CSTR, PFR, and PBR. • know what a chemical reaction is • Understand the basis for the various ways in which reactions are classified	First hour: General description of chemical reactions and their importance to the chemical process industry. Second hour: Types of chemical reactions Third Hour: Study Question: List and discuss the various ways in which chemical reactions are classified
2	Rate of Reaction of Homogeneous Reaction	At the end of this topic, students should be able to: Understand what is meant by reaction kinetics and the parameters that affect the kinetics of a homogeneous reaction	First hour: Reaction rate of various species from stoichiometric equation Second hour: Factors that affect the rate of reaction Third Hour: Study Question: Calculation of the rate of reaction of reactants and products and the significance of the negative (-ve) sign in the rate expression
3	Variables affecting reaction rates; molecularity and reaction order, rate constant	At the end of this topic, students should be able to: Understand the generalised form of rate law	First hour: Elementary and non-elementary reactions Second hour: The rate law and the significance of each term Third hour: Study Question: Class assignment
4	Variable affecting reaction rate:	At the end of this topic, students should be able to:	First hour: The Arrhenius theory Second hour: Solution for

	temperature dependency theories, activation energy	Understand the temperature dependent term and the Arrhenius theory	frequency factor and activation energy for typical problems Third Hour: Study Question:
5	Constant-volume batch reactor: irreversible reactions	At the end of this topic, students should be able to: Develop the kinetic expression for irreversible reactions using the integral method of analysis	First hour: Integral method of analysis Second hour: Derivation of kinetic parameters Third hour: Study Question: Find the kinetic parameters for a zero order reaction, parallel reaction, series reaction
6	Constant-volume batch reactor: irreversible reactions continued…	At the end of this topic, students should be able to: Develop the kinetic expression for irreversible reactions using the integral method of analysis	First hour: Derivation of kinetic parameter Second hour: Derivation of kinetic parameter Third Hour: Study Question:
7	Revision on topics covered so far		
8	Mid-Semester Continuous Assessment/Test		
9	Constant-volume batch reactor: reversible reactions	At the end of this topic, students should be able to: Understand the use of the integral method of analysis in generating kinetic parameters for reversible reactions	First hour: 1^{st} order reversible reactions Second hour: 2^{nd} order reversible reactions Third hour: Study Question: Development of kinetic parameters for typical reactions
10	Constant-volume batch reactor: differential method of analysis	At the end of this topic, students should be able to: understand how to determine the values of kinetic parameters for irreversible reactions using the differential method of analysis	First hour: Differential method of analysis: zero and 1^{st} order reactions Second hour: 2^{nd} and nth order reactions Study Question: Determine kinetics parameters given experimental reactor data
11	Autocatalytic reactions	At the end of this topic, students should be able to: Explain what autocatalytic reactions are Illustrate Method of analysis such reactions to obtain kinetic parameters	First hour: Autocatalytic reaction rate description Second hour: solving for kinetic parameters Third hour: Study Question: show how the model to be tested is developed
12	Variable Volume Reactor	At the end of this topic, students should be able to: Understand the significance of fractional volume change on complete conversion Differential method of	First hour: significance of fractional volume change ($\square_A$) Second hour: theory of solving for kinetic parameters Third hour: Study Question: show the effect

		analysis with variable volume reactors	of stoichiometry on the value of $x_{A.}$
13	Variable Volume Reactor continued…	At the end of this topic, students should be able to: Explain and apply the Integral method of analysis with variable volume reactors	First hour: Integral method of analysis Second hour: Integral method of analysis Third hour: Study Question: Tutorial: solution of typical problems
14	General Revision	At the end of this topic, students should be able to:	First Hour: Second Hour: Third Hour: Study Question:
15	Examination	To examine the students on all that has been taught during the semester.	

Reading List - Books and materials students can read:

1. Chemical Reaction Engineering, 3rd Edition, Octave Levenspiel
2. Elements of Chemical Reaction Engineering, 3rd Edition, H. Scott Fogler