هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission
اعتماد
NCAAA
2024
TP-153

Course Specification

(Bachelor)

Course Title:	Chemical Kinetics
Course Code:	CHM 1448
Program:	Bachelor of Science in Chemical Laboratories
Department:	Chemistry
College:	Science
Institution:	Imam Mohammed Ibn Saud Islamic University
Version:	1446-10-v1
Last Revision Date:	1446-10-v1

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: 3 (2, 3,0)					
3 (2 Lectures, 3 Lab and 0 Tutorials)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☐ Required		☒ Elective		
3. Level/year at which this course is offered: Level 7/ Fourth year					
4. Course general Description:					
Topics covered in the course include the description of the Response of Chemical Equilibria to Conditions, Quantitative chemical kinetics, Kinetics of complex multistep reactions.					
5. Pre-requirements for this course (if any)**:**					
Physical Chemistry- CHM 1346					
6. Co-requisites for this course (if any)**:**					
None					
7. Course Main Objective(s): Industrial Catalysis, Reactions					

At the end of the course, Students should be able to:

- ✓ To provide students with vocabulary and concepts of chemical kinetics and an introduction to catalysis.
- ✓ This includes definitions, types and rates of reactions, and methods for the determination of the their partial and global orders, initiation to catalysis specifically acid-base and enzymatic catalysis .
- ✓ The course is designed to provide theoretical, practical, methodological and technical knowledge of kinetic in solution chemistry and physical chemistry.
- ✓ determine reaction rate laws and constants along with the factor effecting them.
- ✓ operate laboratory instruments.
- ✓ diagram and illustrate experimentally obtained data.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	**75**	**100%**
2	E-learning	**0**	**0**
3	Hybrid • Traditional classroom • E-learning	**0**	**0**
4	Distance learning	**0**	**0**

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	**30**
2.	**Laboratory/Studio**	**45**
3.	**Field**	**0**
4.	**Tutorial**	**0**
5.	**Others (specify)**	**0**
Total		75

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**To define the dependence of Rates on Concentration First-Order Second-Order, Zero-Order, N^{th}-Order Reactions**	**K1; K3; K4**	**Lecture**	**Homework assignment marks and lab reports**
1.2	**To describe the Third-Order Reactions. Parallel Reactions. Series First-Order Reactions. Series Reactions with Two Intermediates. Reversible Reactions. Autocatalysis Effect of Temperature.**	**K1; K3; K4**	**Lecture**	**Short quizzes**
1.3	**To state the factors affecting reaction rate and the laws of chemical kinetics**	**K1; K4**	**Lecture and group discussions**	**Oral tests and MCQs, Homework**

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
2.0	**Skills**			
2.1	**To evaluate Rate Constants**	**S1; S2; S3**	Lectures laboratory experiments	**Direct:** Solved problem marks Short quizzes and Laboratory reports
2.2	**To analyze data and results through analytical thinking, with evaluation of the gained information.**	**S1; S2; S3**	Brain storming and self-study	**Direct:** Work portfolio and homework
2.3	**To demonstrate skills to participate in class by asking questions and giving answers.**	**S3**	Motivate students to ask questions and to give response.	**Direct:** Participation marks
2.4	**To illustrate and diagram experimentally obtained data during laboratory classes and field tasks, and to demonstrate oral and network communication and technical writing skills.**	**S2; S4**	• Seminars • Group discussions and lab experiment • Encourage students to use electronic mail and blackboard to submit works and assessments.	• **Direct:** • Presentation marks • Oral tests and lab sheets • Assignments and homework • Laboratory performance • Laboratory reports and sheet
3.0	**Values, autonomy, and responsibility**			
3.1	**To appraise coordination and raise knowledge during**	**V1; V2**	• Group discussions • Homework	• Presentation marks • Oral tests and lab sheets

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
	various evaluations, initiatives, and mini reports to uphold scientific integrity.		• Mini report Virtual labs and demonstrations	• Assessments and homework • Laboratory reports and sheet

C. Course Content

No	List of Topics	Contact Hours
1.	**Rates of Reactions,** Dependence of Rates on Concentration First-Order Second-Order, Zero-Order, Nth-Order Reactions, Cautions on Treating Kinetic Data, Effect of Temperature, Some Common Reaction Mechanisms, Direct Combination, Chain Mechanisms, Substitution Reactions	6
2.	**Second-Order Reaction**, First-Order in Two Components. Third-Order Reactions. Parallel Reactions. Series First-Order Reactions. Series Reactions with Two Intermediates. Reversible Reactions. Autocatalysis Effect of Temperature.	8
3.	**Calculating Rate Constants**, The Method of Half-Lives, Initial Rates, Using Large Excess of a Reactant (Flooding), The Logarithmic Method Effects of Pressure, Flow Techniques, Relaxation Techniques, Tracer Methods, Kinetic Isotope Effects. Collision Theory. The Potential Energy Surface, Transition State Theory, Unimolecular Decomposition of Gases, Free Radical or Chain Mechanisms, Adsorption of Gases on Solids, Langmuir Adsorption Isotherm, B–E–T Isotherm.	10
4.	**Catalyst and catalysis, Types of catalysis, Classification of catalysis. Characteristics of catalytic reactions,** Catalytic promoters, Catalytic poisons. Theories of catalysis. Biochemical or enzyme catalysis. Acid-base catalysis. Heterogeneous Catalysis. Industrial applications of catalysts	6
	Laboratories Topics	
1	Safety and Laboratory equipment's and measurements and reports	3
2	Factors affecting reaction rate. Part I (Concentration), Factors affecting reaction rate.	3
3	Part II (Temperature), Factors affecting reaction rate.	3
4	Part III (Catalyst), Factors affecting reaction rate. Part III (Surface area),	3
5	Chemical kinetics: second order reaction iodination of aniline	3
6	Determination the rate constant and order for H_2O_2 decomposition	3
7	Determination of rate constant of $S_2O_3^{-2}$ and I^{-1}	3
8	The Iodine Clock Reaction	3
9	Hydrolysis of ethyl acetate ester in acidic medium,	3

10	Hydrolysis of ethyl acetate ester in basic medium,	3
11	Determination of the activation energy of a reaction	3
12	Determination of the order and rate constant for the $MnO_4^-/C_2O_4^{2-}$ reaction	3
13	Effect of ionic strength on the $K_2S_2O_4$-KI reaction (With and without KCl)	3
14 15	Revison and Lab Reports overview	3
Total		75

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm 1	6th/ 7th week	10 %
2.	Midterm 2	11th/ 12th week	10 %
3.	Quizzes, Home Works, class participation, and mini projects	During the semester	10 %
4.	Laboratory	All the semester	30 %
5.	Final Exam	16thweek	40 %
6.	Total	All weeks	100 %

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	James E. House, ***Principles of Chemical Kinetics*** , Academic Press; 2nd edition (September 13, 2007), ISBN-10 : 0123567874, ISBN-13 : 978-0123567871
Supportive References	1. Santosh K. Upadhyay, ***Chemical Kinetics and Reaction Dynamics***, Springer; Softcover reprint of hardcover 1st ed. 2006 edition (October 19, 2010), ISBN-10 : 9048171466, ISBN-13 : 978-9048171460 2. R.A. van Santen , Hans (J.)W. Niemantsverdriet , *Chemical Kinetics and Catalysis (Fundamental and Applied Catalysis)*, Springer; 1995th edition (September 30, 1995), ISBN-10 : 0306450275, ISBN-13 : 978-0306450273
Electronic Materials	• **Blackboard**

	• www. Elesevier.com
Other Learning Materials	None

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• Each of the class room should be equipped with a whiteboard and a projector, with a maximum of 20 students. • In each laboratory, a list of safety and precautions are provided. • In each lab has proper ventilation, and well equipped with instruments. • In each lab, containers for solid waste, liquid waste, and crushed glasses. • Each lab has a small pharmacy for first aid in case of an accident • In each lab, the rules, conditions, and safety mechanism as well list of Risk, Safety precautions according to Merck Catalogue are hanging in the labs
Technology equipment (projector, smart board, software)	The rooms are equipped with data show, Smart Board, WI-FI access.
Other equipment (depending on the nature of the specialty)	• Appropriate Glasswares for carrying the requested experiments (conical flasks, beakers, measuring cylinders) • Appropriate fine chemicals and solvents (distilled Water ammonium nitrate) • Analytical balance (3 digits), Set gas laws with the glass jacket Data acquisition set for gas laws with glass jacket, PC, Windows® 95 or higher, calorimeter, thermometer, Filter papers , clamps, stands

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	**Students**	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of students assessment	**Program Leaders**	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Quality of learning resources	**Students**	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
The extent to which CLOs have been achieved	**Course Responsible**	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**COUNCIL OF DEPARTMENT OF CHEMISTRY**
REFERENCE NO.	**3 (NO. 1/3)**
DATE	**5/3/1446- 8/09/2024**