Course Specifications

Course Title:	**Advanced Physical Chemistry**
Course Code:	**531CHEM-2**
Program:	**Master of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**King Khalid University**

Table of Contents

A. Course Identification

1. Credit hours:	2
2. Course type	
a.	University ☐ College ☐ Department ■ Others ☐
b.	Required ■ Elective ☐
3. Level/year at which this course is offered:	Level 1 / Year 1
4. Pre-requisites for this course (if any)**:**	No prerequisite
5. Co-requisites for this course (if any)**:**	No co-requisite

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	1	50%
2	**Blended**	0	0
3	**E-learning**	1	50%
4	**Correspondence**	0	0%
5	**Other**	0	0%

7. Actual Learning Hours (based on academic semester)

No	Activity	Learning Hours
Contact Hours		
1	**Lecture**	15
2	**Laboratory/Studio**	0
3	**Tutorial**	15
4	**Others** (specify)	0
	Total	30
Other Learning Hours*		
1	**Study**	45
2	**Assignments**	20
3	**Library**	15
	Total	80

* The length of time that a learner takes to complete learning activities that lead to achievement of course learning outcomes, such as study time, homework assignments, projects, preparing presentations, library times

B. Course Objectives and Learning Outcomes

This course covers key concepts in physical chemistry which underpin the understanding and ability to control chemical processes. The principal points include chemical kinetics (zero, 1st and 2nd order reactions, rate laws and half-lifes and the relationship of rate laws to reaction mechanisms), and basic principles of catalysis (heterogeneous and homogeneous) and reactions in solutions. A strong emphasis on calculations helps students get to grips with the course material and develops numeracy skills.

2. Course Main Objectives

Understand the concepts of chemical kinetics principles.

Determine the rate law parameters from the method of initial rates.
Determine the rate law parameters using the integrated rate laws and statistical method.
• Use the Arrhenius equation to statistically determine the activation energy and the preexponential factor for a given reaction.
• Relate a reaction mechanism to the stoichiometry of the balanced chemical equation.
• Differentiate between types of reaction mechanisms.
• Apply the steady-state hypothesis to predict rate equations.
• Determine the effects of a rate-determining step on the overall rate.
• Understand macroscopic properties, such as pressure and temperature on a microscopic level using kinetic model of gases.
• Understand the principles of the kinetics theories.
• Predict the reaction rate using the kinetics theories.
• Relate the rate constant to the terms of the Gibbs energy, entropy, and enthalpy of activation.
• Differentiate between the catalysis reaction types.
• Understand the mechanisms of enzyme catalysis and inhibition.
• Explain the mode of inhibition.
• Determine the adsorption parameters for a reaction at the solid surface.
• Understand the dynamics behind the liquid solutions and solid surfaces reactions.
• Understand the factors that control the molecular motions in the solutions and gases.
• Estimate the factors that control the diffusion-controlled reactions and activation controlled reaction.
• Determine the influence of the ionic strength on the reaction rates.

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge:**	
1.1	To determine the order of various types of reactions.	K1
1.2	To recognize the importance of the kinetics in industrial procedures	K1and K3
2	**Skills**	
2.1	To compare between different methods of determination of reaction order	S1 and S4
2.2	To connect between the theoretical studies and the industrial applications	S1and S3
2.2	To solve any problems in the industrial fields in the future	S1
3	**Competence**	
3.1	To demonstrate responsibility on the adoption of a research problem to be searched on.	C2, C3 and C4
3.2	To implement appropriate parameters properly in special environment	C2, C3 and C4
3.3	To determine the order of various types of reactions.	C1

C. Course Content

No	List of Topics	Contact Hours
1	Mathematical Background Review	3
2	Coordinate Systems	
3	Logarithms and Exponentials	
4	Differentiation and Integration	
	The Rates of Chemical Reactions	10
6	Introduction	
7	Rates of Chemical Reactions	
8	Linear Regression Demonstration	
9	Differential and Integrated Rate Laws	
10	Zero-Order Reaction	
11	First-Order Reaction	
12	Second-Order Reaction	
13	Temperature Dependence of Rate Constants	
14	Examples of Reaction Mechanisms	
15	Opposing Reactions	
16	Parallel Reactions	
17	Consecutive Reactions	
18	Unimolecular Reactions	
	Theories of Reaction Rates	7
	Introduction	
	The Kinetic Theory of Gases	
	The Kinetic Model of Gases	

	Collisions with Walls and Surfaces	
	Reaction Encounters	
	Collision Theory	
	Transition State Theory (TST)	
	Catalysis	5
	Introduction	
	Homogeneous Catalysis	
	Enzymes	
	Heterogeneous Catalysis	
	The Nature of Catalytic Sites on Solid Surfaces	
	Adsorption and Desorption	
	The Adsorption Isotherms	
	Heats of Adsorption	
	Reactions in Solutions	5
	The Cage Effect and Friction	
	Diffusion-Controlled Reactions	
	Reaction Rates and Ionic Strength	
Total		30

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge**		
1.1	To determine the order of various types of reactions.	Lectures, Interactive teaching sessions	Written exams, electronic quizzes
1.2	To recognize the importance of the kinetics in industrial procedures	Lectures, Interactive teaching sessions	Written exams, electronic quizzes
2.0	Skills		
2.1	To compare between different methods of determination of reaction order	Lectures, problem solving sessions	Written and oral exams
2.2	To connect between the theoretical studies and the industrial applications	Tutorials, problem solving sessions	Oral discussion, written examinations
	To solve any problems in the industrial fields in the future	Tutorials, problem solving sessions	Oral discussion, written examinations
3.0	Competence		
3.1	To demonstrate responsibility on the adoption of a research problem to be searched on.	Open essays on selected topics	Discussion within a group
3.2	To implement appropriate parameters properly in special environment	Interactive teaching sessions	Oral presentation on a group report

2. Assessment Tasks for Students

#	*Assessment task	Week Due	Percentage of Total Assessment Score
1	Homework 1, Quiz -1	4th	5
2	Oral discussion (exam)	5th	5
3	Presentation	7th	5
4	Homework 2, Quiz -2	9th	5
5	Mid-1	6th	15
6	Mid-2	10th	15
7	Final exam	16th	50

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :

10 office hours are offered for students for individual consultations. Communications are available on-site, phone conversations, and chatting by social media. In addition, each student has a scientific guide presents the required counseling

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	E. House, Principles of Chemical Kinetics, 2nd ed. Elsevier 2007.
Essential References Materials	P. Atkins, J. dePaula, Physical Chemistry Oxford University Press, 9th ed. 2009. P. L. Houston, Chemical Kinetics and Reaction Dynamics, Dover Publications, 1st ed. 2006.
Electronic Materials	Saudi Digital Library
Other Learning Materials	No other learning materials.

2. Facilities Required

Item	Resources
Accommodation Classrooms, laboratories, demonstration) (.rooms/labs, etc	A classroom containing at least 20 seats and equipped with projector and Internet access (scheduled for 2 hour twice a week). A help session classroom containing at least 20 seats and equipped with projector and Internet access (scheduled for 1 hour every week).
Technology Resources (.AV, data show, Smart Board, software, etc)	Common computer lab containing at least 25 computer sets.

	High speed internet access.
Other Resources Specify, e.g. if specific laboratory) equipment is required, list requirements or (attach a list	Colored Printers.

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Course delivering	Student	Questionnaire
Course contents (update)	Plan and curriculum committee	Report
Teaching materials	Faculty	Meeting
Learning materials	Student	Discussion
Assignment	Program instructor and Faculty	Report
Exams	Program instructor and Faculty	Report

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	**Chemistry Department Council**
Reference No.	**Session number 22**
Date	**27/04/2021M / 15/09/1442H**