Course Specification
(Bachelor)

Course Title:	**Physical Chemistry (2)**
Course Code:	**CHM 1242**
Program:	**Bachelor of Science in Chemistry**
Department:	**Chemistry**
College:	**Science**
Institution:	**Imam Mohammed Ibn Saud Islamic University**
Version:	**1**
Last Revision Date:	*Pick Revision Date.*

Table of Contents

A. General information about the course:

-1. Course Identification

1. Credit hours: 3 (1,2, 3)					
4 (3 Lectures, 0 Tutorials, 3 Lab)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		

3. Level/year at which this course is offered: Level 4 / year 2

4. Course general Description:

Topics covered in the course include the description of the laws of phase transformations of pure substances followed by applications. Derivation and applications of phase rules on Two-Component Systems, vapor Pressure Diagrams. The Lever Rule. Temperature-Composition Diagrams. Distillation of Mixtures, Azeotropes, Immiscible Liquids. Distillation of Partially Miscible Liquids, Liquid-Solid Phase Diagrams, Eutectics. Three component systems. Quantitative chemical kinetics including definitions, types and rates of reactions, and methods for the determination of their partial and global orders, determination of reaction rate laws and constants along with the factor affecting them. The course was designed to operate laboratory instruments, diagram and illustrate experimentally obtained data.

5. Pre-requirements for this course (if any)**:**

Physical Chemistry (1) –CHM 1241

6. Co-requisites for this course (if any)**:**

None

7. Course Main Objective(s):

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

- **Improve the students' knowledge of the laws of phase transformations of pure substances followed by applications**
- **Use the typical phase diagrams of gases, liquids, and solids as well as to determine the eutectic and azeotropic mixtures solutions point.**
- **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 affecting 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	90	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	**45**
2.	**Laboratory/Studio**	**45**
3.	**Field**	**0**
4.	**Tutorial**	**0**
5.	**Others (specify)**	**0**
Total		**90**

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 phase transformations laws**	**K1; K2; K3;**	**Lectures**	**quizzes**
1.2	**To state the Phase Rule**	**K1; K3**	▪ **Lectures and laboratory experiments**	▪ **Quizzes and homework** ▪ **Group discussions**
1.3	**To define the dependence of Rates on Concentration First-Order Second-Order, Zero-Order, Nth-Order Reactions**	**K1; K2; K3;**	▪ **Lectures and group discussion** **Lectures and laboratory experiments**	▪ **Homework** **Exams and laboratory reports**
2.0	Skills			

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
2.1	To evaluate Rate Constants and the order of reactions	S1; S2; S3	• Group discussions • Homework • Mini reports Virtual labs and demonstrations	• Presentation marks • Oral tests and lab sheets • Assessments and homework • Laboratory performance Laboratory reports and sheet
2.2	To analyze data and results through analytical thinking, with evaluation of the gained information.	S1; S2; S3	Group discussions and laboratory experiments	Oral questions marks and laboratory reports
2.3	To demonstrate skills to participate in class by asking questions and giving answers.	S3	Brain storming	MCQs
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;	▪ Group discussion and assignments ▪ Demonstrations and laboratory manuals ▪ Presentations, demonstrations and virtual labs. • Encourage studens to use electronic mail to submit homeworks and assignments	▪ Oral tests and assignments marks ▪ Laboratory performance ▪ Laboratory performance and reports Assignments and homework
3.0	Values, autonomy, and responsibility			
3.1	To show effective awareness to maintain scientific integrity during different	V1;V2	• Group discussions • Homework • Mini reports	• Presentation marks • Oral tests • Assessments and homework

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
	assessments, projects, and mini reports			

C. Course Content

No	List of Topics	Contact Hours
1.	• **Physical Transformations of Pure Substances,** Phase Diagrams, Stabilities of Phases, Phase Boundaries, Three Typical Phase Diagrams, Phase Stability and Phase Transitions, • Thermodynamic Criterion of Equilibrium, Dependence of Stability on the Conditions, Location of Phase Boundaries, Ehrenfest Classification of Phase Transitions	**12**
2.	• **Phase Transformations:** Phases, Components and Degrees of Freedom, Definitions. • The Phase Rule, Two-Component Systems, Vapor Pressure Diagrams, Composition of the Vapor, Interpretation of the Diagrams. • The Lever Rule. Temperature-Composition Diagrams. • Distillation of Mixtures, Azeotropes. • Liquid-Liquid Phase Diagrams, Phase Separations, Critical Solution Temperatures, Distillation of Partially Miscible Liquids, Liquid-Solid Phase Diagrams, Eutectics. Three component systems.	**15**
3	• **Rates of Reactions,** Factors affecting on the rate of reactions, Expression of rate of reactions, Rate law, Zero-Order, First-Order, Second-Order, Nth-Order Reactions, Effect of Temperature, determination of activation energy.	**9**
4	• **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. Collision Theory. The Potential Energy Surface, Transition State Theory.	**9**
Total		**45**

No	List of Experiments	Contact hours
1	**Introduction and Safety**	**3**
2	**Water-Phenol Miscibility Diagram (two components system)**	**3**
3	**The melting point of a binary system (Eutectic mixture)**	**3**
4	**A study of the ternary system:benzene-acetic acid-water**	**3**

5	Determination of the distribution coefficient of acetic acid between water and butanol or (water and diethyl ether)	3
6	To find out the equilibrium constant for the tri-iodide formation, $1_2 + 1^- = I_3$	3
7	Catalytic decomposition of H_2O_2 over MnO_2	3
8	Determination of the Kinetic and thermodynamic parameters of catalytic decomposition of H_2O_2 over MnO_2 (Effect of temperature)	3
9	Hydrolysis of ethyl acetate ester in acidic medium	3
10	Determination of rate constant of Pseudo-First order reaction of ($K_2S_2O_8$-KI)	3
11	Determination of rate constant of second order reaction of ($K_2S_2O_8$-KI)	3
12	The clock reaction of ($KMnO_4$-Oxalic acid)	3
13	The Iodine Clock Reaction	3
14	The clock reaction of (HCl-$Na_2S_2O_3$)	3
15	Revision	3
Total		45

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm Exam 1	Around 6th & 7th week	10 %
2.	Midterm Exam 2	Around 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	Around -16 17th week	40 %
6.	Total		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	• ***Physical Chemistry***, K. J. Laidler, J. H. Meiser, B. C. Sanctuary, 4th Ed, 2003,Houghton Mifflin Company [ISBN: 0618123415 • ***Chemical Kinetics and Reaction Dynamics***, Santosh K. Upadhyay, Co-published by Springer 233 Spring Street, New York 10013, USA with Anamaya Publishers, New Delhi, India (2006)
Supportive References	• **Physical Chemistry,** Ira N. Levine, 5th Edition, McGraw-Hill (ISBN: 0-07-231808-2). • **Physical Chemistry**, R.Silbey, R. Alberty, and M. Bawendi. 4th ed. 2004, New York, NY: John Wiley & Sons, ISBN: 9780471215042. • **Advanced Physical** Chemistry Experiments, J. N Gurtu, Amit Gurtu (2008) Meerut, India, Pragati Prakashan, ISBN:978-81-8398-527-7 • ***Principles of Chemical Kinetics,*** James E. House, Academic Academic Press; 2nd edition, ASIN : B0018C7KS4
Electronic Materials	• Blackboard • www. Elesevier.com•
Other Learning Materials	Chemical Thermodynamics Basic Concepts and Methods, Irving M. Klotz, Robert M. Rosenberg, - 7th edition-Wiley (2008). ISBN-10: 471780154.

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 (large test tubes, conical**

Items	Resources
	flasks, beakers, measuring cylinders, dishes, funnels) • Appropriate fine chemicals and solvents (Phenol, Biphenyl, naphthalene, glacial acetic acid, absolut ethanol, chloroform, sodium chloride, diethyl ether, benzene, potassium iodide, iodine, copper sulphate, ammonia solution) • Analytical balance (3 digits), thermometer, water path, separating funnel, density flusk. • 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.
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.
Lab Performance	Students	**Direct:** Lab reports, Final Lab exam, Course e-Portfolio.
	Course Responsible	

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.	7 (NO. 2/3)
DATE	29/3/1446 - 2/10/2024