Course Specification
(Bachelor)

Course Title:	Physical Chemistry
Course Code:	CHM 1341
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: 4 (3, 3, 0)					
4 (3 Lectures, 3 Lab, 0 Tutorials)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: Level 6/ third year					
4. Course general Description:					
Topics covered in the course include second and third laws of thermodynamics, the equilibrium states, Application of the Gibbs function. It covered also the phase rule for phase transformation of one and two component systems. The principles of chemical kinetic and surface chemistry principles such as adsorption process were studied as well as some topics related to Electrochemistry and the Environment.					
5. Pre-requirements for this course (if any)**:**					
Principles of Physical Chemistry (CHM 1240)					
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:

- ✓ recall the second and third law of thermodynamics
- ✓ recall the phase rule and phase transformations laws
- ✓ interpret the equilibrium state or direction on variation operational conditions.
- ✓ determine reaction rate laws and constants along with the factor affecting them.
- ✓ operate laboratory instruments, diagram and illustrate experimentally obtained data.
- ✓ Define surface chemistry and adsorption-desorption process.
- ✓ Introduce corrosion and wear occurring to metals under different conditions and technologies used to prevent or minimize it.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	**90**	**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**	**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 describe the basic principles of chemical equilibria related to thermodynamic functions and recall phase transformations laws**	**K1; K2; K4**	• Six hours weekly, containing lectures and laboratory activities • A Private study, including a Homework	**Direct:** • exams, Quizzes • Homework Laboratory Reports • Participation
1.2	**To define surface chemistry and adsorption-desorption process, and list techniques for measurement of adsorption .**	**K1; K2**	• Two hours weekly, containing lectures • A Private study, including a Homework	**Direct:** • exams, Quizzes • Oral Discussion • Laboratory Reports • Participation
1.3	**To state the factors affecting reaction rate and the laws of chemical kinetics**	**K2; K3**	• Lectures • laboratory experiments • Group discussion .	**Direct:** • Participation, • Quizzes and MCQs, • Laboratory reports and performance
1.4	**To define corrosion and its impact upon metal integrity, and list**	**K2; K3**	• Lectures • Group discussion	**Direct:** • exams, Quizzes

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
	methods of corrosion prevention		• A Private study, including a Homework	• Homework Laboratory Reports • Participation
2.0	**Skills**			
2.1	**To calculate Adsorption parameters using problems and their solutions, and estimate kinetic, physical and optical parameters of colloidal systems.**	**S1; S2; S3**	• Lecturing, • group discussion Laboratory experiments performance	**Direct;** • Short quizzes Exams, • Solved problems marks • Homework assignment • Laboratory reports
2.2	**To analyze data and results through analytical thinking, with evaluation of the gained information.**	**S1; S3**	• Lecturing, • group discussion Laboratory experiments performance	**Direct;** • Short quizzes Exams, • Solved problems marks • Homework assignment • Laboratory reports
2.3	**To demonstrate skills to participate in class by asking questions and giving answers.**	**S3**	• Brain storming • self-study	**Direct;** • Quizzes • Oral discussion • aboratory reports
2.4	**To diagram and explain experimentally obtained data during laboratory classes and field tasks, and to demonstrate oral and network communication and technical writing skills.**	**S2; S4**	• Group discussion • Laboratory experiments. • Brain storming	**Direct;** • Homework assignment, • Examination • Laboratory report
3.0	**Values, autonomy, and responsibility**			
3.1	**To appraise teamwork, and create awareness to maintain scientific**	**V2**	• Group discussions • Homework • Mini reports	Direct: • Presentation marks

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
	integrity during different assessments, projects, and mini reports.			• Oral tests and lab sheets • Assessments and homework
3.2	**Show personal values and attributes such as honesty, empathy and respect for others**	**V1, V2**	• Teamwork and class discussions	**Direct** ✓ lab reports ✓ Mini projects

C. Course Content

No	List of Topics	Contact Hours
1.	**Thermodynamics:** The second law of thermodynamics. **Entropy, free energy and equilibrium**: Spontaneous reactions, Entropy, State function, Entropy change of a system, Gibbs free energy, phase transition, Gibbs free energy and chemical equilibrium. Carnot Cycle, Third law.	9
2.	**Physical Transformations** Phase rule, Phase Diagrams, **one component systems**, Stabilities of Phases, Phase Boundaries, Phase Stability and Phase Transitions, Thermodynamic Criterion of Equilibrium, Dependence of Stability on the Conditions, Location of Phase Boundaries. **Two-Component Systems,** ideal solutions, Raoul's law and Henry's law. Mixing of ideal gases, Vapor Pressure Diagrams, Composition of the Vapor, Interpretation of the Diagrams. The Lever Rule. Temperature-Composition Diagrams. Distillation of Mixtures, Azeotropes, Immiscible Liquids Liquid-Liquid Phase Diagrams, Critical Solution Temperatures, Liquid-Solid Phase Diagrams, Eutectics.	9
3.	**Surface chemistry**: surface, Bulk, Surface Tension and Contact Angle. Adsorption, adsorbate, adsorbent, Desorption, Occlusion, absorption, Physisorption, Chemisorption, Temperature, pressure, Applications Adsorption at Solid Liquid interface Adsorption at Solid Gas interface, Adsorption isotherm, thermodynamic consideration, equilibrium, Adsorption models: Freundlich isotherm, and Langmuir isotherm, specific surface area, BET theory, Capillary condensation, Pores classification	9
4.	**Chemical kinetics**	9

	Rate of reactions, rate equations, zero, first, second order cases, rate constant. Graphical analysis of rate data for rate constant and half-life determination for each case. Dependence of rate on temperature. Arrhenius equation and activation energy, Kinetics of complex multistep reactions. Consecutive reactions. Concept of rate determining step and reaction intermediate.	
5.	**Electrochemistry and the Environment** Corrosion: introduction, Electrode Potential in Electrochemical Cells, Types of Electrochemical Corrosion, Protection Against Electrochemical Corrosion, inhibitors, mechanism.	9
	Laboratory Topics	
1	Mutual Solubility Curve for Phenol – Water system	3
2	The Melting point of a binary system (Eutectic point)	3
3	Determination of partition coefficient of Iodine between water and CCl_4	3
4	Determination of equilibrium constant of KI_3 formation	3
5	Determination of coordination number of copper-ammonia complex	3
6	Three component system (Ethyl Acetate-Ethanol-water)	3
7	Determination of the adsorption isotherm of oxalic acid on bone charcoal.	3
8	Determination of Heat of Adsorption of Acetic Acid on Charcoal	3
9	Determination of the adsorption isotherm of methylene blue dye on bone charcoal.	3
10	Chemical Kinetics (The Iodine Clock Reaction)	3
11	Chemical Kinetics (The Oxalic acid-Potassium permanganate Clock Reaction)	3
12	Kinetics of first order reactions (Hydrolysis of ethyl acetate in acidic solution)	3
13	Pseudo first order reaction ($K_2S_2O_8$-KI) reaction	3
14	Decomposition of H_2O_2 by MnO_2	3
15	Revision and Lab Reports overview	3
Total		**86**

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.			

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
	Laboratory	All the semester	30 %
5.	Final Exam	16th week	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	1. Keith J. Laidler, John H. Meiser, Bryan C. Sanctuary, ***Physical Chemistry***, Brooks Cole; 4th edition (May 6, 2002), ISBN-10:0618123415, ISBN-13: 978-0618123414 2. Vladimir S. Bagotsky, **Fundamentals of Electrochemistry**, Wiley-Interscience; 2nd edition (November 18, 2005), ISBN-10 : 0471700584, ISBN-13 : 978-0471700586
Supportive References	1. Volkan Cicek, Bayan Al-Numan, **Corrosion Chemistry**, Wiley-Scrivener; 1st edition (November 15, 2011), ISBN-10 : 0470943076, ISBN-13 : 978-0470943076 2. J. N. Gurtu, Amit Gurtu, **Adv. Physical Chemistry Experiments**, Pragati Prakashan (1 January 2011, ISBN-10 : 9350063980, ISBN-13 : 978-9350063989
Electronic Materials	
Other Learning Materials	**Advanced Physical Chemistry Experiments**, J. N Gurtu, Amit Gurtu (2008) Meerut, India, Pragati Prakashan, ISBN:978-81-8398-527-7

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**

Items	Resources
	• **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.
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.

Assessment Areas/Issues	Assessor	Assessment Methods
	Program Leaders	**Indirect:** Second examiner checklist-Course report. **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**