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

Course Specification

(Bachelor)

Course Title:	**Principles of Physical Chemistry**
Course Code:	**CHM 1240**
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 3/ Second year					
4. Course general Description:					
Topics covered in the course include the properties of ideal gas and some laws related to them and the real gas properties. Thermochemistry: First law of thermodynamics, Enthalpy of reactions. Properties of solutions. Colligative properties: boiling-point elevation and freezing point depression. chemical equilibrium and electrochemistry concepts.					
5. Pre-requirements for this course (if any)**:**					
General Chemistry 1 (CHM 1101)					
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:

- To familiarize students with basic knowledge of physical chemistry needed for higher level courses.
- To recognize the properties of gases, perfect gases laws and correlate the kinetic theory to gas laws.
- To improve the students' knowledge of the laws of classical thermodynamics and thermochemistry.
- To recognize the basic principles of electrochemistry.
- To develop the students' appreciation of chemistry as an experimental science supported by theory as an interpretive and predictive tool.

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	**0**	**0**

No	Mode of Instruction	Contact Hours	Percentage
	• E-learning		
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 define the concept of standard state and thermodynamic functions of pure substances due to change of temperature and state main gas laws and their applications.	K1; K2; K3;	Lectures	Short quizzes and exams
1.2	To list the thermodynamic concept of phase equilibrium, chemical equilibrium,	K1; K2; K3;	Lectures	Exams, homeworks and quizzes

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
	entropy, and Gibb's free energy.			
1.3	To recognize some principles of electrochemistry.	K1; K3	lectures and laboratory experiments	Laboratory reports Numerical problem solution grades
2.0	Skills			
2.1	To estimate the heat of reaction from tabulated bond energy values and evaluate the elevation in boiling point and depression in freezing point of solutions due to salt addition	S1, S3	Lectures and laboratory experiments	Solved problem marks Short quizzes and Laboratory reports Numerical problem
2.2	To evaluate the equilibrium constant from experimental data, and contrast kinetic data with Mathematical equations.	S1, S2	Lectures and laboratory experiments	Solved problem marks Short quizzes and Laboratory reports
2.3	To analyze data and results through analytical thinking, with evaluation of the gained information.	S1, S3	Brain storming and self-study	Work portfolio and homework
2.4	To illustrate and diagram experimentally obtained data during laboratory classes and field tasks, and to demonstrate oral and network communication and	S1, S3	• Oral participation • Group discussions and lab experiment and reports • Encourage students to use blackboard and email to submit homework and assignments.	• Oral tests • lab performance, reports and sheets Marks • Assignments and homework marks

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
	technical writing skills.			
3.0	Values, autonomy, and responsibility			
3.1	To show effective contribution in teamwork and raise Knowledge during various evaluations, initiatives, and Lab-reports to uphold scientific integrity.	V1; V2	• Group discussion and assignments • homework • Lab-reports • Virtual labs and demonstrations	• Oral tests and lab performance, reports and sheets Marks • Assignments and homework marks

C. Course Content

No	List of Topics	Contact Hours
1.	● **Nature of physical chemistry**. Classical mechanics and Properties of Gases, The Perfect Gas – States of gases ● Gas laws, Individual Gases, Boyle's Law, Charles's and Gay-Lussac's law, Avogadro's Principle, Graham's law, Perfect (Ideal) Gas Equation, Mixtures of Gases. ● Dalton's Law, Mole Fractions, Real Gases, Virial coefficients, Molecular Interactions, Compression factor Boyle's Temperature, CO_2 Phase Diagram, Condensation. ● Critical Constants, van der Waals Equations, Principle of Corresponding States, Kinetic Model of Gases.	9
2.	**Thermochemistry**: Introduction to Thermodynamics, Basic Concepts (Work, Heat and Energy), ZEROth Law. First Law: State functions, Standard Enthalpy Changes, Enthalpies of Physical Change, Enthalpies of Chemical Change, Hess' Law, Standard Enthalpies of Formation Changes, Reaction Enthalpy & Enthalpy of Formation, Group Contributions, Temperature Dependence of Reaction Enthalpies.	9
3.	**Properties of Solutions**, Mixtures, Colligative Properties, Boiling point elevation, Freezing point depression, Solubility, osmotic Pressure, Activities, Solvent Activity, Solute Activity, Regular Solutions.	9
4	**Chemical equilibrium**: Chemical equilibrium, Law of mass action, Equilibrium constant, Equilibrium concentration, Le Chatelier's principal.	6

5	**Electrochemistry**: Introduction / Fundamental Concepts: Electrochemistry and Redox reactions, Electrolytic cells, Galvanic Cell, Standard reduction potential, spontaneities of Redox reactions, Cell Emf.	9
6	**Physical Properties of Solutions**: Type of solutions, A molecular view of the solution process, Concentration units, Effect of temperature on solubility, Effect of pressure on the solubility of gases.	3
Topics to be covered (Laboratories)		
1	Safety and Laboratory equipment and measurements and How to make a report ,	3
2	Calorimeter calibration	
3	measurements and reports Boyle and Mariette's law (P, V), Amontons' law (P,T)	3
4	Gay-Lussac's law (V, T), Avogadro' s law (V, n)	3
5	Determination of heat of solution(endothermic-exothermic reaction)	3
6	Determination of specific heat of metals & Determination of heat of Neutralization	3
7	Determination of heat of Dilution	3
8	Chemical equilibrium: Effect of concentration & Chemical equilibrium: Effect of Temperature	3
9	Part I: Determination of the Effect of Various Influences on the Position of Equilibrium	3
10	Part II: Determination of the Effect of Various Influences on the Position of Equilibrium	3
11	Colligative properties (Boiling point Elevation)	3
12	Colligative properties (Melting point Depression)	3
13	Viscosity of liquids	3
14	Daniel Cell	3
15	Revision	3
Total		**90**

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	

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
			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	Keith J. Laidler, John H. Meiser, Bryan C. Sanctuary, **Physical Chemistry**, Houghton Mifflin College Div; 4th edition (January 1, 2003), ISBN-10 : 0618403744, ISBN-13 : 978-0618403745
Supportive References	1. Peter Atkins, Julio de Paula, **Physical Chemistry**, W. H. Freeman; 8th edition (March 10, 2006), ISBN-10 : 0716787598, ISBN-13 : 978-0716787594. 2. Robert J. Silbey , Robert A. Alberty, Moungi G. Bawendi, **Physical Chemistry**, Wiley; 4th edition (July 1, 2004), ISBN-10 : 047121504X, ISBN-13 : 978-0471215042
Electronic Materials	• Blackboard • www. Elesevier.com
Other Learning Materials	An Introduction for Students of Physical Chemistry, Atoms and Molecules: Karplus, M., and R. Porter. Reading, MA: Addison Wesley, 1970 (ISBN: 9780805352184).

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**

Items	Resources
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. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, 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