Course Specifications

Course Title:	Chemistry of Surfaces, Catalysis and Phase Rule
Course Code:	335CHEM-3
Program:	Bachelor of Science in Chemistry
Department:	Chemistry
College:	Science
Institution:	King Khalid University

Table of Contents

A. Course Identification

1. Credit hours: 3
2. Course type **a.** University ☐ College ☐ Department ■ Others ☐ **b.** Required ■ Elective ☐
3. Level/year at which this course is offered: 5th level / 3rd year
4. Pre-requisites for this course (if any)**: 232 Chem-2**
5. Co-requisites for this course (if any)**: No co-requisites**

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	3	100%
2	**Blended**	0	0%
3	**E-learning**	0	0%
4	**Correspondence**	0	0%
5	**Other**	-	-

7. Actual Learning Hours (based on academic semester)

No	Activity	Learning Hours
Contact Hours		
1	**Lecture**	45
2	**Laboratory/Studio**	0
3	**Tutorial**	0
4	**Others** (specify)	0
	Total	45
Other Learning Hours*		
1	**Study**	15
2	**Assignments**	15
3	**Library**	5
4	**Projects/Research Essays/Theses**	5
5	**Others (presentations)**	5
	Total	45

* 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

1. Course Description

The current course introduces four major topics: surface chemistry, catalysis, colloid chemistry, and phase equilibrium chemistry. In general, the course discusses the following topics: surface structure, adsorption behavior, physical properties of surfaces, homogeneous catalysis, heterogeneous catalysis, enzymatic catalysis, techniques of preparation and purification of colloids, applications of the use of colloids and finally, phase equilibrium in a single phase system such as water and sulphur.

2. Course Main Objective

The current course introduces the basic knowledge and principles of four different -but connected- topics mainly, surface chemistry, catalytic chemistry, colloid chemistry, and phase equilibrium chemistry. Moreover, the course links the abstract theories and the physical meaning of various phenomena of daily life such as the phenomenon of liquid and gas adsorption, the phenomenon of wetness, the phenomenon of surface tension, catalysis in the field of petrochemicals, water phase conversion, detergents, and the manufacture of solids. Moreover, the course introduces the historical development of modern equations and the efforts made by scientists to realize them such as adsorption equations, and the relationship between temperature and surface tension. The course contains several equations that train students to convert physical behaviors into mathematical expressions such as conversion calculations, selectivity, and molecular size calculations.

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge:**	
1.1	Gain knowledge of basic concepts and principles of catalysis - surface chemistry - colloid chemistry and phase equilibrium chemistry	K1 and K3
1.2	Deep understanding of abstract theories and then applying them to physical phenomena in everyday life	K2 and K3
1.3	Understand the efforts of scientists in developing many physical theories	K1 and K3
1.4	Realizing the different industrial applications based on the different course theories	K1
2	**Skills :**	
2.1	Analyzing, interpreting and explaining daily physical phenomena based on course topics	S4
2.2	The use of various mathematical equations to explain a particular physical phenomenon	S4
2.3	Being able to solve problems and mathematical exercises in the various subjects of the course	S4
2.4	An oral presentation to explain the physical phenomena in the course topics	S4
3	**Competence:**	
3.1	Effective communication between students and professor, and between students themselves	C2 and C4
3.2	Commitment to hand over duties and carry out activities on time	C2 and C4
3.3	Teamwork in small groups	C2 and C4

C. Course Content

No	List of Topics	Contact Hours
1	An introduction to the definition of surface chemistry Surface separation between liquid and gas - the phenomenon of liquid surface tension, laboratory experiments to determine the surface tension parameter - forces acting on the surface	3
2	The separating surface between liquids and solids Surface Free Energy - the phenomenon of wetness and determination of the angle of contact and its effect on the phenomenon of wetness	3
3	Relationship between temperature, surface tension, adhesion and cohesion occupancy - Sudgen's equation and determination of the parachor constant	3
4	The separating surface between two liquids - the diffusion phenomenon - the gypsum equation - the solute and its relationship to the surface tension of the solvent - the adsorption work and the trop base	3
5	Surface separating solid and gas - Physical and chemical adsorption - Gas adsorption curves on solid surfaces - Adsorption temperature and thermodynamic functions	3
6	Adsorption theories – Friendelsh's equation – Langmuir's equation - BET theory - surface active substances	3
7	An introduction to the definition of catalysis	3

	Reaction activation energy - types of catalysts - importance of the catalysis process in industry - catalysis and the national economy - requirements for a good catalyst	
8	Homogeneous catalysis Examples of homogeneous catalysis - Homogeneous catalysis in gas reactions - Homogeneous catalysis in liquid reactions - Intermediate compound formation's theory	3
9	Heterogeneous catalysis Examples of heterogeneous catalysis - Catalyzing gaseous reactions on solid surfaces - Catalyzing liquid reactions on solid surfaces - Haber method - Touching theory - Poisoning of heterogeneous catalysts	3
10	Enzymatic catalysis Examples of enzymatic catalysis - key-lock's theory - Industrial use of enzymatic catalysis - Determination of selectivity and conversion ratio	3
11	Introduction and definition of colloids Colloidal state and particle size - mixtures, solutions and colloids - colloidal states and different phases of matter	3
12	Methods for preparing colloidal solutions - Methods of purification of colloidal solutions - Properties of colloidal solutions – Brown's movement - Electrophoresis - Tindal phenomenon	3
13	Charges on colloidal particles - the phenomenon of coagulation - applications of colloids in food industry - applications of colloids in the pharmaceutical industry - applications of colloids in the control of water and air pollution / Phase equilibrium chemistry Phase equilibrium and phase base / examples and problems on phase base	3
14	phase diagram for single phase systems - phase curve for water - phase diagram for sulfur Phase diagram of biphasic systems - Phase diagram between water and phenol - Phase diagram between water and nicotine - Distillation phenomenon	3
15	Midterm Exams	3
Total		45

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	Gain knowledge of basic concepts and principles of catalysis - surface chemistry - colloid chemistry and phase equilibrium chemistry	Lectures - interactive teaching sessions - recorded scientific presentations	Written exams – Oral quizzes – regular homework
1.2	Deep understanding of abstract theories and then applying them to physical phenomena in everyday life	Lectures - interactive teaching sessions - recorded scientific presentations	Written exams – Oral quizzes – regular homework
1.3	Understand the efforts of scientists in developing many physical theories	Lectures - interactive teaching sessions -	Written exams – Oral quizzes –

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
		recorded scientific presentations	regular homework
1.4	Realizing the different industrial applications based on the different course theories	Lectures - interactive teaching sessions - recorded scientific presentations	Written exams – Oral quizzes – regular homework
2.0	**Skills**		
2.1	Analyzing, interpreting and explaining daily physical phenomena based on course topics	Lectures - interactive teaching sessions - recorded scientific presentations	Written exams – Oral quizzes – regular homework
2.2	The use of various mathematical equations to explain a particular physical phenomenon	Lectures - interactive teaching sessions - recorded scientific presentations	Written exams – Oral quizzes – regular homework
2.3	Being able to solve problems and mathematical exercises in the various subjects of the course	Lectures - interactive teaching sessions - recorded scientific presentations	Written exams – Oral quizzes – regular homework
2.4	An oral presentation to explain the physical phenomena in the course topics	Lectures - interactive teaching sessions - recorded scientific presentations	Written exams – Oral quizzes – regular homework
3.0	**Competence**		
3.1	Effective communication between students and professor, and between students themselves	Lectures - interactive teaching sessions	Scientific presentations - reports
3.2	Commitment to hand over duties and carry out activities on time	Lectures - interactive teaching sessions	Scientific presentations - reports
3.3	Teamwork in small groups	Lectures - interactive teaching sessions	Scientific presentations - reports

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Electronic homework	5 and 9	10%
2	Oral quiz	7 and 11	5%
3	Presentation and reports	8 and 13	5%
4	Mid-term exam 1	6	15%
5	Mid-term exam 2	12	15%
6	Final exam	15	50%

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)
& *separated from theory lecture with independent lecturer*

E. Student Academic Counseling and Support

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

The faculty member supervising the course has 10 office hours distributed over the days of the week by two hours per day in order to guide students and support them and answer all questions related to the course and re-explain what is difficult to understand during the lectures.

F. Learning Resources and Facilities

1. Learning Resources

Required Textbooks	Surface Chemistry and Catalysis – Prof. Muhammad Magdy Wasel - Al-Azhar University, 2004
Essential References Materials	The tenth and eleventh chapters (phases equilibrium) and the fourteenth chapter (colloidal state) from the book Principles of Physical Chemistry by Dr. Al-Sayed Ali Hassan and others - Dar Al-Ma'arif – Egypt. Book No. 513.3 HB, the University Central Library. Chapter Twenty-first (Surfaces and Heterogeneous Catalysis) from the book Physical Chemistry - authored by Jordi Barrow - Fourth Edition - University Central Library. Chapter Four (The Base of the Phase) - Chapter Twelve (The Colloidal State) - and Chapter Fourteen (Catalysis) from the book The Physical Chemistry by Dr. Ahmed Medhat Islam and Dr. Mustafa Mahmoud Emara - House of Arab Thought - The Central Library of the University. The Principles of Catalyst Evolution by James T Richardson - translated by Dr. Laila Abdul Karim - Scientific Publication and Presses, King Saud University 2010 - Book No. 541.395 RM - The University's Central Library.
Electronic Materials	Scientific short demonstrations from Youtube
Other Learning Materials	

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Air-conditioned rooms (45 seats)
Technology Resources (AV, data show, Smart Board, software, etc.)	Computer and projector
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	Wireless internet

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Course delivery (teaching methods and assessment methods)	Students	Questionnaire
	Departmental plan and curriculum committee; external reviewers.	Reports and workshops
	Program leader	Meeting
Course contents (update)	Departmental plan and curriculum committee; external reviewers.	Reports and workshops
Quality of learning resources	external reviewers.	Reports

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	Department counsel
Reference No.	1/22/142
Date	15-9-1442