هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	Physical Chemistry of Solution
Course Code:	**CHEM336**
Program:	**Baccalaureate**
Department:	**Chemistry department**
College:	**Science**
Institution:	**King Saud University**

Table of Contents

A. Course Identification

1. Credit hours: (2 + 1)
2. Course type **a.** University ☐ College ☐ Department ■ Others ☐ **b.** Required ■ Elective ☐
3. Level/year at which this course is offered: *Junior level 3th year*
4. Pre-requisites for this course (if any)**:** *Chem 101 and Chem 102 (General Chemistry 1 and 2); Chem 231(Chemical Thermodynamic); Math 111*
5. Co-requisites for this course (if any)**:**

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	3	10
2	**Blended**	9	30
3	**E-learning**	9	30
4	**Distance learning**	9	30
5	**Other**	-	-

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	30
2	**Laboratory/Studio**	15
3	**Tutorial**	-
4	**Others** (specify)	-
	Total	45

B. Course Objectives and Learning Outcomes

1. Course Description

CHEM336 is a program which relates to the description of solutions and the thermodynamic relations which characterize them. It deals with ideal and real solutions in all their states(gas, liquid and solids) where the phase diagrams will be presented and discussed. This course also deals with real ionic solutions and their thermodynamic properties.

2. Course Main Objective

- knowing the physical chemical properties of different mixtures and solutions,
- Knowing the phase diagrams of solutions (liquid-vapor, liquid-liquid and solid-liquid),
- Know the different methods used in the separation of components (distillation at atmospheric pressure, distillation at reduced pressure, solid-liquid filtration, liquid-liquid decantation, settling),
- Knowing ionic solutions and the relationships that govern them,

3. Course Learning Outcomes

	CLOs	Aligned-PLOs
1	**Knowledge and Understanding**	

CLOs		Aligned-PLOs
1.1	*Define the different solutions (ideal, real, and ionic) and recognize the relationships between them*	*Understand, resolution and application*
1.2	*Describe the properties of solutions (ideal and real);*	
1.3	*Recognize and describe the phase diagrams (liquid-vapor, liquid-liquid and solid-liquid*	
1...		
2	**Skills :**	
	Cognitive Skills	
2.1	*Interpret the phase diagrams and evaluate the critical points.*	*Calculate, evaluate, interpret and Comment*
2.2	*Calculate and analyze the thermodynamic parameter of mixtures such as the partial molar parameters (volume, free enthalpy, enthalpy and entropy)*	
2.3	*Estimate the changes in the enthalpy, entropy and the Gibbs energy changes.*	
2.4	*Estimate colligative properties of solutions.*	
2.5	*Derive the thermodynamic function of mixture and determine the different molar parameters such as molar volume, free enthalpy expressions and calculate the partial molar volume of each constituent.*	
2.6	*Represent and interpret the experimental data*	
	Interpersonal Skills & Responsibility	
2.7	*-Work independently and as in groups including leadership responsibilities;* *- Act responsibly in a personal manner;* *-Display of ethical and high moral standards in both private and public environments.*	*Master, Empower, educate*
2.8	*-Use sta- Manage resources, time and other members of the group* *- Communicate results of work to other*	
	Communication, Information Technology, Numerical	
2.9	*- Utilizing university electronic resources of learning.* *-Interpretation of numerical, chemical and general scientific information*	*Mastery of electronic means and communications*
	Psychomotor	
2.10	*Prepare solutions, manipulate the analytic instruments, draw the curves for determining different parameters such as molecular weight and critical points*	*Handle, analyze, criticize*

C. Course Content

No	List of Topics	Contact Hours
1.	**1. NON IONIC SOLUTIONS**	14
	1.1 Some notions on the liquid properties ***1.2.* The simple mixtures** 1.2.1 The thermodynamic description of mixtures 1.2.2 The Partial molar quantities *a) Partial molar volume Vp* *b) Partial molar Gibbs energies* *c) The wider significance of the chemical potential* *d) The Gibbs Duhem equation* **1.3 The Chemical potential of liquids** *1.3.1* Ideal solutions 1.3.2 Ideal-dilute solutions *Exercises* **1.4 Ideal and non ideal solutions of non-electrolyte** 1.4.1 Ideal solutions 1.4.2 Excess functions and regular solutions *Exercises* **1.5 Colligative properties** 1.5.1 The commun features of colligative properties 1.5.2 The elevation of boiling point 1.5.3 The depression of freezing point 1.5.4 The solubility 1.5.5 The Osmosis *Exercises* **1.6 Activities of solvent and solute** 1.6.1 Ideal-dilute solutions 1.6.2 Real solutes 1.6.3 Activities in terms of molalities 1.6.4 The biological standard state *Exercises* **1. 7 Activities coefficient** 1.7.1 The activities of regular solutions 1.7.2 Mean activity coefficients *Exercises*	
2	**Phase Diagrams**	8
	2.1 Vapor pressure diagrams *2. 1.1* The composition of the vapor 2. 1.2 The interpretation of the diagrams 2.1.3 The level rule Exercises **2.2 Liquid- vapor phase diagrams** *2.2.1* The distillation of mixtures	

	2..2.2 Azeotropes 2. 2.3 Immiscible liquids *Exercises* 2.3 **Liquid-liquid phase diagrams** 2.3.1 Phase separation 2.3.2 Critical solution temperatures 2.3.3 The distillation of partially miscible liquids *Exercises* **2.4 Liquid-solid phase diagrams** 2.4.1 Eutectics 2.4.2 Reacting systems 2.4.3 Incongruent melting *Exercises*	
4	**IONIC SOLUTIONS**	8
	4.1 Ideal ionic solutions	
	4.1.1 Definitions	
	4.1.2 Colligative properties	
	4.2 Chemical potential and activity coefficients	
	4.2.1 Chemical potential	
	4.2.2 Excess chemical potentials for real ionic solutions	
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 and Understanding**		
1.1	*-Define the different solutions (ideal, real, and ionic) and recognize the relationships between them*	*Use interactive method (question-answer),* *Incorporation of the IT to develop the knowledge and particularly (the smart board, internet),* *Proposing stimulation questions*	*Homework assignments,* *Using active learning techniques,* *-Major final and two segmented midterm exams*
1.2	*-Describe the properties of solutions (ideal and real);*		
…	*-Recognize and describe the phase diagrams (liquid-vapor, liquid-liquid and solid-liquid*		
2.0	**Skills**		
2.1	*Interpret the phase diagrams and evaluate the critical points.*	*- Solving examples,*	*Following up students*
2.2	*Calculate and analyze the thermodynamic parameter of mixtures such as the partial molar parameters*		

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	(volume, free enthalpy, enthalpy and entropy) .	*- Class discussions,* *- Using modern methods of teaching such as the IT ways,*	*participations in class discussion activities.* *Major and final exams* *Problem solving by students on board*
2.3	*Estimate the changes in the enthalpy, entropy and the Gibbs energy changes*		
2.4	*Estimate colligative properties of solutions.*		
2.5	*Derive the thermodynamic function of mixture and determine the different molar parameters such as molar volume, free enthalpy expressions and calculate the partial molar volume of each constituent.*		
2.6	*Represent and interpret the experimental data*		
3.0	**Values**		
3.1	*Resolution of problems*	*Give more exercises and problems to solve in group work.*	*MED: 1 and 2* *Final exam* *Quizzes + noted interactive questions*
3.2	Exploitation of results	*Provide tables from experimental data and let the student draw the curves and deduce the important parameters.*	*Labs exam*
3.3	Communication of results	*Make the links between the results obtained and the translators.*	*MED: 1 and 2* *Final exam* *Quizzes + noted interactive questions*

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	*Class activities (in-class quizzes, homework)*	*Weekly*	*10%*
2	*Major Exam I*	*Week 6*	*25%*
3	*Major Exam II*	*Week 12*	*25%*
4	*Revision*	*Week 13*	-
5	*Final Exam*	*Week 16*	*40%*
8			

***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 :

Daily individual consultations of students which takes place according to a program drawn up

by the teacher according to his availability.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	Physical Chemistry, 9 Ed. Peter Atkins and Julio de Paula, Publisher : W.H. Freeman and Company, 2010
Essential References Materials	N.A.
Electronic Materials	N.A.
Other Learning Materials	*Software*: *Word, Excel, Power-Point presentations, Chemdraw, etc.*

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	*Laboratory (10 experimentations)*
Technology Resources (AV, data show, Smart Board, software, etc.)	*Using Smart board*
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	*N.A.*

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Faculty	*Administrators*	*Feed back*
Department	*Administrators*	*Feed back*
	Students	Feed back

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	
Reference No.	
Date	25- janvier-2023