Department: Chemistry Dept.

College: Education College

University: Salahaddin University

Subject: Phase & Equilibrium

Course Book: *Stage* 2**; Second semester**

Lecturer's name: Lecturer Dr. Khozan A. Haji

Academic Year: 2022/2023

Course Book

1. Course name	Phase and Equilibrium
2. Lecturer in charge	Dr.Khozan A. Haji
3. Department/ College	Chemistry/ Education
4. Contact	e-mail:khozan.haji@su.edu.krd
5. Time (in hours) per week	Theory: 4 Practical: 9
6. Office hours	Thursday 10.5am – 12.5 pm or by appointment
7. Course code	
8. Teacher's academic profile	I graduated from the College of Education, Department of Chemistry in 1997 and got a bachelor's degree BSc in chemistry. After that. I then started to study MSc/Analytical Chemistry in 1998 at Salahaddin University. After finishing my MSc study in 2000, I worked in Collage of Education / Chemistry department, as an assistant lecturer. The teaching experience is practical in the analytical Physical, Industrial &Organic Chemistry. Finally, I received my PhD-Physical Chemistry in the same University in 2015. My academic and research program interest focus on Kinetic study; I have more than 4 published articles and going to publish some other articles.
9. Keywords	**Colligative properties, equilibrium state, phase rule**

10. Course overview:

Dilute solutions containing non-volatile solute exhibit the following properties:

(1) Lowering of the Vapour Pressure

(2) Elevation of the Boiling Point

(3) Depression of the Freezing Point

(4) Osmotic Pressure

The essential feature of these properties is that they depend only on the number of solute particles present in solution. Being closely related to each other through a common explanation, these have been grouped together under the class name Colligative Properties (Greek colligatus = Collected together).

11. Course objective:

It tells whether a particular physical or chemical change can occur under a given set of conditions of temperature, pressure and concentration. It also helps in predicting how far a physical or chemical change can proceed, until the equilibrium conditions are established.

12. Student's obligation

The student attendance in class two hours a week, preparation of the home works examinations and participate in the discussion in the classroom.

13. Forms of teaching

Different forms of teaching will be used to reach the objectives of the course: Direct questions, Quizzes, Discussion and conclusions. Power point presentations

14. Assessment scheme

Exams: There will be two closed book exams given throughout the semester.
Each test will be to take 90 minutes. Each exam carry out 7.5 degrees, they considered = 15%.

Final Exam: The Final Exam is Comprehensive in all course outlines. Carry out 50% degrees of the grade.

Theoretical grade = 65%

Practical grade = 35%

15. Student learning outcome:

The student will learn the phase rules, chemical equilibrium, finding the equilibrium constant for different reactions, in addition to learning the colligative properties of a mixtures

16. Course Reading List and References:

1- P.Atkins, and J.DE Paula. " ATKINS Physical Chemistry "6th edition.
2- IRA N. Levine. "Physical Chemistry" 6th edition.
3- A. Bahl, B.S. Bahl, and G.D. Tuli " Essential of physical Chemistry" .
4- R.A. Alberty, and R.J. Silbey."Physical Chemistry" 2nd edition.

17. The Topics:	Lecturer's name
First week Phase rule. Degree of freedom. Second week Phase diagrams, one-component system. Third week Two-component systems. Fourth week Solutions. Henry's law, miscible liquids, partially miscible liquids.	Dr.Khozan A. Haji **2 hours**

Fifth week Colligative properties. Lowering of vapor pressure, Raoult's law. Sixth week Boiling point elevation, freezing point depression. Seventh week Osmotic pressure Eighth week Chemical equilibrium. Equilibrium constant, equilibrium law. Ninth week Units of equilibrium constant. Le-Chatelier's principle, heterogeneous equilibria. Tenth week van't Hoff's Equation and its applications Eleventh week Equilibrium Constant Expression Twelfth week Changing the concentration of a reactant or product. Thirteenth week Changing the pressure (or volume) of the system. Changing the temperature. Fourteenth week Distribution Law Fifteenth week Distribution law helps in determining the equilibrium constant of	

a reaction.	

19. Exams:

First Example

Q1// The vapor pressure of benzene (C_6H_6) is 53.3 kPa at 60.6°C, but it fell to 51.5 kPa when 19.0 g of an involatile organic compound was dissolved in 500 g of benzene. Calculate the molar mass of the compound.

(10M)

Q2// The osmotic pressure of an aqueous solution 5%(w/v) at 300 K is 4atm. Calculate the freezing point of the solution (if the density of solution≈1g/ml, and the compound is non electrolyte, k_f of water= 1.86).

(**20M)**

Q3// When 36.0 g of a solute having the empirical formula CH_2O is dissolved in 1.20 kg of water, the solution freezes at −0.372°C. What is the molecular formula of the solute? (K_f = 1.86°C kg mol^{-1}) **(10M)**

Q4// An aqueous solution containing 0.25 moles of anon-volatile but strong electrolyte solute A in 500 g water freezes at −2.79°C. Calculate the number of ions produced by A, if the strong electrolyte 100% dissociated. (K_f = 1.86). **(10M)**

Q5// Calculate the freezing point of the following aqueous solution of glucose ($C_6H_{12}O_6$), (K_f = 1.86) **(10M)**

1- 0.2777 mol/L (density=1.0175 g/ml)
2- 10% (w/v) (density=1.0375 g/ml)

Second Example

Q1: A sample weighing (4 g) containing compound A and B only, dissolved in 2 liters at 25°C. It was found that the osmotic pressure of this mixture is 0.4384 atm. Calculate the weight of A and B in the sample.
Molecular weight of A=120g/mol and for B=100g/mol.

Q2: A compound XY (its molecular mass is 150 g/mol) associated in water by 80%, if its observed (practical) molecular mass is 187.15 g/mol. Calculate the number of moles (a) of compound XY associated.

$$aXY \rightleftharpoons (XY)_a$$

Q3: The degree of dissociation of $Ca(NO_3)_2$ in a dilute aqueous solution, containing 7.0 g of the salt per 100 g water at 100°C is 70%. If the vapor pressure of water at 100°C is 760 mm Hg, calculate vapor pressure of the solution.
Atomic weights: Ca=40, N=14, O=16

20. Extra notes:

21. Peer review