



UNIVERSIDAD DE GUADALAJARA

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Secretaría Académica / Coordinación de la Licenciatura en Química
Comité de Innovación Curricular de la Licenciatura en Química

1.- INFORMACIÓN GENERAL

Learning unit Physical Chemistry II		Department Chemistry		Format Lecture
Prerequisites(P) Physical Chemistry I	Corequisites (CO) Physical Chemistry lab	Ascribed Academy Physical Chemistry	Module M1: Structure of Matter	
Type Basic Particular Mandatory	Lecture Hours 68 hrs.	Practice Hours 0	Total hours 68 hrs.	Credits 9

2.- GENERIC COMPETENCIES

Students...

...review systems in thermodynamic equilibrium, with a brief introduction of non-equilibrium systems.
...recognize, interpret and apply thermodynamic terms to understand chemical reactions and physical phenomena that occurs in different processes carried out in equilibrium, with matter and energy exchange. This way, they will help to make decisions based on the analysis, synthesis and evaluation of the system.
...determine the different factors that interfere in the equilibrium of a homogeneous or heterogeneous chemical reaction.

3.- SPECIFIC CHARACTERISTICS OF THE COMPETENCY

Knowledge	Students... ...Use research methods. ...Know the thermodynamic properties that result from the laws of thermodynamic and understand their role in the description of physicochemical equilibria. ...Apply the laws of thermodynamics to the study of chemical equilibria and phase equilibria ...Describe the ideal and real behavior of solutions.
Skills	...Search and understand information. ...Use digital resources. ...Are able to identify and solve problems. ...Remember basic and computer knowledge. ...Are able to analyze, synthesize and assess.
Aptitudes	...Interrelate the use of mathematical models with physicochemical systems. ...Identify problems state questions and hypotheses to solve them.



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	<p>...Enunciate knowledge from different fields and establish relationships among them and their daily life.</p> <p>...Develop efficient and continuous study habits.</p> <p>...Self-learning.</p> <p>...Professional development and realization.</p> <p>...Creativity.</p>
Values	<p>...Ability to determine if a system can be submitted to a physical or chemical change.</p> <p>Consistency, perseverance, honesty, responsibility, respect, tolerance.</p>

4.- TRANSVERSAL COMPETENCIES

Foreign Language (English)
Critical, analytical and synthetic thinking.
Oral and written expression
Professional ethics
Administration of human and material resources
Leadership and sustainability
Creativity, innovation and entrepreneurship
Others: algebra, and differential and integral calculus.

5.- COURSE CONTENT OF THE LEARNING UNIT

UNIT 1. FUGACITY AND ACTIVITY

- 1.1 Chemical potential
- 1.2 Fugacity
- 1.3 Changes in fugacity
- 1.4 Fugacity calculation methods
- 1.5 Activity
- 1.6 Activity Coefficients

UNIT 2 PHASE EQUILIBRIUM: COMPONENT SYSTEM

- 2.1 Gibbs' phase rule
- 2.2 Equilibrium diagram
- 2.3 Clapeyron equation
- 2.4 Liquid-Vapor, Liquid-solid, Solid-Vapor and triple point equilibrium

UNIT 3 PHASE EQUILIBRIUM: TWO OR MORE COMPONENT SYSTEM



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- 3.1 Ideal solutions
- 3.2 Ideal solutions of nonelectrolytes.
- 3.3 Henry's Law
- 3.4 Colligative properties of real solutions
- 3.5 Nernst Distribution Law
- 3.6 Phase equilibrium
- 3.7 Liquid-Vapor equilibrium
- 3.8 Solid-liquid equilibrium
- 3.9 Liquid-liquid equilibrium
- 3.10 Solid-liquid-vapor equilibrium

UNIT 4 IONIC EQUILIBRIUM

- 4.1 Thermodynamics of ions in solution.
- 4.2 Determination of electrolyte activity coefficients.
- 4.3 Debye-Hückel theory of electrolytes.
- 4.4 Ionic association.
- 4.5 Colligative properties of electrolytic solutions.

UNIT 5 CHEMICAL EQUILIBRIUM

- 5.1 Equilibrium constants of homogeneous and heterogeneous systems.
- 5.2 Equilibrium classification.
- 5.3 Gas phase equilibrium.
- 5.4 Liquid solutions equilibria.
- 5.5 Elements that affect the equilibrium constant.

6.- ASSESSMENT

	Numeric grade
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7.- GRADING CRITERIA OF THE LEARNING UNIT

Indicator of Evaluation	Percentage
Departmental exams	30
Partial exam	40
Homework	20
Research activities	10



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Practice reports	0
Class participation	0
Other	0

8.- REQUIRED MATERIAL (for students)

Calculator Periodic table Lab coat Text book Workbook Other Formula chart, Atkins physical chemistry charts
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9.-SPECIFIC CONTENT BY LEARNING UNITS

Content unit	Generic competency of the content unit	Topics	Class hours	Professor activities	Student activities	Bibliography
UNIT 1. FUGACITY AND ACTIVITY	Students know and distinguish the following terms: activity, fugacity and fugacity coefficient.	Chemical potential	1	-Professor lectures: Mathematic definitions, conclusions and terms for this unit. - uses the approach of exercise solving based learning.	Students... DURING -Do the activities assigned for this unit in order to understand the concepts and ask questions of those aspects they do not understand. AFTER -Answer homework exercises related to this unit.	BASIC: - Smith JM, Van Ness HC, Abbott MM (2007); <i>Introducción a la Termodinámica en Ingeniería Química.</i> - (7th. edition). Mc Graw-Hill. - Cengel YA, Boles MA (2009); <i>Termodinámica.</i> Mc Graw-Hill. - Sandler SI (2006); <i>Chemical, Biochemical and Engineering Thermodynamics.</i> John Wiley. COMPLEMENTARY: - Raymond Chang (2008) <i>Fisicoquímica.</i> 3 rd edition, McGraw-Hill. - Levine IN (2009) <i>Fisicoquímica,</i> McGraw-Hill.
		Fugacity	2			
		Changes in fugacity	2			
		Fugacity calculation methods	3			
		Activity	1			
		Activity Coefficients	1			



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						- Atkins P, de Paula J (2008) <i>Fisicoquímica</i> , Ed. Medica Panamericana.
UNIT 2 PHASE EQUILIBRIUM: COMPONENT SYSTEM	Students -Create phase diagrams of different substances.	Gibbs' phase rule	1	Professor lectures: Mathematic definitions, conclusions and terms for this unit. Professor uses the approach of exercise solving based learning	DURING: Students... -Do the activities assigned for this unit in order to understand the concepts and ask questions of those aspects they do not understand. -Draw phase diagrams of different compounds.	BASIC: - Smith JM, Van Ness HC, Abbott MM (2007); <i>Introducción a la Termodinámica en Ingeniería Química</i> . - (7th. edition). Mc Graw-Hill. - Cengel YA, Boles MA (2009); <i>Termodinámica</i> . Mc Graw-Hill. - Sandler SI (2006); <i>Chemical, Biochemical and Engineering Thermodynamics</i> . John Wiley. COMPLEMENTARY: - Raymond Chang (2008) <i>Fisicoquímica</i> . 3 rd edition, McGraw-Hill. - Levine IN (2009) <i>Fisicoquímica</i> , McGraw-Hill.
		Equilibrium diagram	2			
	Clapeyron equation	3				
	Liquid-Vapor, Liquid-solid, Solid-Vapor and triple point equilibrium	2				
	-Know and apply the phase rule and the Clapeyron equation in different systems		2			



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						- Atkins P, de Paula J (2008) <i>Fisicoquímica</i> , Ed. Medica Panamericana.
UNIT 3 PHASE EQUILIBRIUM: TWO OR MORE COMPONENT SYSTEM	Students identify different types of solutions and apply the acquired knowledge to determine the different colligative properties as well as the different existing equilibria.	Ideal solutions	1	Professor ... - Lectures: Mathematic definitions, conclusions and terms for this unit. - Uses the approach of exercise solving based learning	Students... DURING: -Do the activities assigned for this unit in order to understand the concepts and ask questions of those aspects they do not understand. AFTER: -Answer homework exercises related to this unit.	BASIC: - Smith JM, Van Ness HC, Abbott MM (2007); <i>Introducción a la Termodinámica en Ingeniería Química</i> . - (7th. edition). Mc Graw-Hill. - Cengel YA, Boles MA (2009); <i>Termodinámica</i> . Mc Graw-Hill. - Sandler SI (2006); <i>Chemical, Biochemical and Engineering Thermodynamics</i> . John Wiley. COMPLEMENTARY: - Raymond Chang (2008) <i>Fisicoquímica</i> . 3 rd edition, McGraw-Hill.
		Ideal solutions of nonelectrolytes.	1			
		Henry's Law	1			
		Colligative properties of real solutions	3			
		Nernst Distribution Law	2			
		Phase equilibrium	2			
		Liquid-Vapor equilibrium	2			
		Solid-liquid equilibrium	2			
		Liquid-liquid equilibrium	2			
Solid-liquid-vapor equilibrium	2					



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						<p>- Levine IN (2009) <i>Fisicoquímica</i>, McGraw-Hill.</p> <p>- Atkins P, de Paula J (2008) <i>Fisicoquímica</i>, Ed. Medica Panamericana.</p>
<p>UNIT IV IONIC EQUILIBRIUM</p>	<p>Students... -Apply the foundations of ionization, acid-base and pH in the solution of real problems, developing experimental abilities by using substances used in daily life.</p>	<p>Thermodynamics of ions in solution.</p>	2	<p>Professor lectures: Mathematic definitions, conclusions and terms for this unit.</p> <p>-Professor uses the approach of exercise solving based learning</p>	<p>Students... BEFORE:</p> <p>-Do previous research. - Write a report of the reading about states of matter and equilibria diagrams.</p> <p>DURING:</p> <p>-Bring the required material to solve problems in class and get data from them.</p>	<p>BASIC:</p> <p>- Chang, R.; College, W. (2002) <i>Química</i>. (7th. ed). Mexico: Mc Graw-Hill Interamericana Editores S.A.</p> <p>COMPLEMENTARY:</p> <p>- Raymond Chang (2008) <i>Fisicoquímica</i>. 3rd edition, McGraw-Hill.</p> <p>- Levine IN (2009) <i>Fisicoquímica</i>, McGraw-Hill.</p> <p>- Atkins P, de Paula J (2008) <i>Fisicoquímica</i>, Ed. Medica Panamericana.</p>
		<p>Determination of electrolyte activity coefficients.</p>	2			
		<p>Debye-Hückel theory of electrolytes.</p>	2			
		<p>Ionic association.</p>	2			
		<p>Colligative properties of electrolytic solutions.</p>	2			



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UNIT V CHEMICAL EQUILIBRIUM	Students... - Explain the principles of chemical kinetics, identifying the factors that modify the reaction speed and the causes that contribute to chemical equilibrium.	Equilibrium constants of homogeneous and heterogeneous systems.	2	Professor lectures: Mathematic definitions, conclusions and terms for this unit. -Professor uses the approach of exercise solving based learning	Students... BEFORE: -Do previous research. - Write a report of the reading about states of matter and equilibria diagrams. DURING: -Bring the required material to solve problems in class and get data from them.	BASIC: - Chang, R.; College, W. (2002) <i>Química</i> . (7th. ed). Mexico: Mc Graw-Hill Interamericana Editores S.A - Moog R and Farrel J (2002) <i>Chemistry A Guided Inquiry.</i> , 2nd edition. New York: John Wiley & sons, 2002. COMPLEMENTARY: - Raymond Chang (2008) <i>Fisicoquímica</i> . 3 rd edition, McGraw-Hill. - Levine IN (2009) <i>Fisicoquímica</i> , McGraw-Hill. - Atkins P, de Paula J (2008) <i>Fisicoquímica</i> , Ed. Medica Panamericana.
		Equilibrium classification.	2			
		Gas phase equilibrium.				
		Liquid solutions equilibria.	3			
		Elements that affect the equilibrium constant.	3			



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COURSE EVIDENCE

(Deliverables)

- 1) Summaries or data sheets of the investigations of each learning unit.
- 2) Diagrams and questionnaires of different learning units.
- 3) Homework exercises of each unit.
- 4) Exams.
- 5) Self-evaluations.

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