



UNIVERSIDAD DE GUADALAJARA

Centro Universitario de Ciencias Exactas e Ingenierías
Secretaría Académica / Coordinación de la Licenciatura en Química
Comité de Innovación Curricular de la Licenciatura en Química

1.- GENERAL INFORMATION

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

2.- GENERIC COMPETENCIES

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- Problem solving
- Synthesis and analysis.
- Behavioral abilities
- Value consolidation
- Teamwork.
- Computer skills
- Information managing
- Oral and written production
- Discerning and decision-making
- Ability to be critical towards others and towards themselves
- Communicate their ideas through chemical language
- Analyze situations using basic concepts of physical chemistry
- Judge based on experience and knowledge.
- Solve problems in different contexts.
- Do research on scientific and technological innovations to develop and solve problems.
- Offer solutions to problems.
- Utilize information and communication technologies to process and interpret information.

3.- SPECIFIC CHARACTERISTICS OF THE COMPETENCIES

Knowledge	Students...
	... know the basic concepts of physical chemistry. ... understand the concepts of energy involved in chemical reactions. ... apply the relationship pressure-temperature-volume and the thermodynamic principles in order to predict physicochemical properties.



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	... develop oral and written skills by making reports about different topics in the class.
Skills	Students... ...learn autonomously. ...distinguish ideal systems from non-ideal systems. ...understand thermodynamic concepts and their importance in physical and chemical processes. ...create solution paths of physical and chemical problems using reported thermodynamic data. ...observe and/or propose situations or problems related to energy and design resolution strategies. ...reason, conceptualize, and express critical opinions using physicochemical tools. ...work collaboratively, expressing their point of views with an open mind and considering those of others with a critical approach.
Aptitudes	...observe and/or propose situations or problems related to energy and design resolution strategies. ...reason, conceptualize, and express critical opinions using physicochemical tools. ...identify and solve problems based on the formulation of hypotheses and the application of essential principles analytically. ... relate knowledge from different fields and apply it in ordinary situations. ...develop study habits and manage their learning
Values	✓ Students develop and reaffirm values such as responsibility, honesty, tolerance, respect, solidarity, disposition, positive attitude towards individual and teamwork.



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4.- TRANSVERSAL COMPETENCIES

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|-------------------------------------|--|
| ☒ | 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 |
| ☐ | Other |

5.- COURSE CONTENT OF THE LEARNING UNIT

UNIT 1 Pressure, Volume, Temperature relationships

- 1.1 Zero law of thermodynamics
- 1.2. State equations
 - 1.2.1 Compressibility coefficient
 - 1.2.2. Coefficient of volumetric expansion
 - 1.2.3. Ideal Gases
 - 1.2.4 Real Gases
 - 1.2.5 Liquids and Solids

UNIT II First law of thermodynamics

- 2.1. Energy, work and heat
- 2.2 First law of thermodynamics
- 2.3 Reversible and irreversible processes
- 2.4 Enthalpy and heat capacity
- 2.5 q , w , ΔU , ΔH calculations in physical processes.
- 2.6 Thermochemistry

UNIT III Second law of thermodynamics

- 3.1. Spontaneous and non-spontaneous processes
- 3.2 Carnot cycle
- 3.3 Second law of thermodynamics
- 3.4 Entropy changes in physical processes.

UNIT IV Third law of thermodynamics



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- 4.1. Entropy and molecular disorder.
- 4.2. Absolute entropy calculation.
- 4.3. Entropy changes in chemical reactions

UNIT V Functions of free energy

- 5.1 Gibbs free energy
- 5.2 Helmholtz free energy
- 5.3 Free energy changes in physical and chemical processes.
- 5.4 Spontaneity of a reaction.

6.- ASSESSMENT

- | | |
|-------------------------------------|---------------|
| ☒ | Numeric grade |
|-------------------------------------|---------------|

7.- GRADING CRITERIA OF THE LEARNING UNIT

Indicator of evaluation	Percentage
Departmental exams	30
Partial exam	40
Homework	20
Research activities	5
Practice reports	5
Class participation	0
Other: Presentations	0

8.- REQUIRED MATERIAL (for students)

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| ☒ | Calculator |
| ☒ | Periodic table |
| ☐ | Lab coat |
| ☒ | Text book |
| ☐ | Workbook |
| ☒ | Other: Thermodynamic tables, tablet, computer. |



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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 Pressure, Volume, Temperature relationships	-Problem solving -Synthesis and analysis -Behavioral abilities -Value consolidation - Teamwork -Computer skills - Information managing -Oral and written production -Discerning and decision-making -Ability to be critical towards others and towards themselves -Communicate	1.1 Zero law of thermodynamics	2 h	Professor... -Proposes an ice breaker to get to know the group -Applies a diagnostic test to determine previous knowledge. -Lectures -Leads an activity to analyze the importance of using real gas formulas and the difference from liquids and solids.	Students... BEFORE: -Read their scientific calculator instruction manual. -Investigate and remember concepts involving the properties of pressure, temperature and volume to be used in class. -Gather tables of constants for the state equations to be used in class.	Gilbert W. Castellan <i>Fisicoquímica</i> 2nd Edition Addison Wesley Samuel H. Maron. <i>Fundamentos de fisicoquímica</i> Limusa Raymond Chang <i>Fisicoquímica</i> 3rd Edition Mc Graw Hill Ira N. Levine <i>Fisicoquímica</i> Volume I 5th Edition Mc Graw Hill
		1.2. State equations 1.2.1 Compressibility coefficient 1.2.2. Coefficient of volumetric expansion 1.2.3. Ideal Gases 1.2.4 Real Gases 1.2.5 Liquids and Solids	12 h			



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	their ideas through chemical language - Relate physicochemical concepts and their application.			-Assigns exercises to solve problems about the unit. -Assesses the unit	- Gather tables of integration and derivation. DURING: -Solve exercises and problems after the explanation, and applying what was seen. AFTER: -Solve homework exercises related to the learning unit.	
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UNIT 2 First law of thermodynamics	-Problem solving -Synthesis and analysis. -Behavioral abilities -Value consolidation - Teamwork. -Computer skills - Information managing -Discerning and decision-making -Ability to be critical towards others and towards themselves -Communicate their ideas through chemical language - Analyze situations using basic concepts of physical	2.1. Energy, work and heat	4 h	Professor... -Leads a discussion on the importance of energy. -Lectures -Assigns problem and exercises solution about the unit. -Leads a discussion on the greenhouse effect and its relationship to the first law of thermodynamics. -Leads a discussion on thermochemistry. -Assesses the unit.	Students... BEFORE: -Read the chapter about the Zero and First Laws of thermodynamics. -Gather tables of heat capacity to be used in class. -Gather tables of formulas for integration and derivation. DURING: -Discuss the importance of energy identifying each type. -Identify why some depend on a trajectory and why others do not.	Gilbert W. Castellan <i>Fisicoquímica</i> 2nd Edition Addison Wesley Samuel H. Maron. <i>Fundamentos de fisicoquímica</i> Limusa Raymond Chang <i>Fisicoquímica</i> 3rd Edition Mc Graw Hill Ira N. Levine <i>Fisicoquímica</i> Volume I 5th Edition Mc Graw Hill
		2.2 First law of thermodynamics	4 h			
		2.3 Reversible and irreversible processes	4 h			
		2.4 Enthalpy and heat capacity	2 h			
		2.5 q, w, DU, DH calculations in physical processes.	4 h			
		2.6 Thermochemistry	2 h			



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	chemistry - Judge based on experience and knowledge. -Solve problems in different contexts. -Do research on scientific and technological innovations to develop and solve problems. - Offer solutions to problems.				-Solve exercises and problems after the explanation of the topic. -Gather tables of updated thermodynamic properties. -Investigate the greenhouse effect and its relationship to the first law of thermodynamics. -Read about thermochemistry. -Discuss the concepts of exothermic and endothermic reactions. (Thermochemistry). AFTER:	
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					-Solve homework exercises related to the learning unit.	
UNIT 3 Second law of thermodynamics	- Problem solving -Synthesis and analysis. -Behavioral abilities -Value consolidation - Teamwork. -Computer skills - Information managing -Oral and written production -Discerning and decision-making -Ability to be critical towards others and towards themselves -Communicate their ideas	3.1. Spontaneous and non-spontaneous processes	2 h	Professor... -Leads a discussion on the second law of thermodynamics. -Lectures	Students: BEFORE: -Read the chapter about the second law of thermodynamics. DURING: -Discuss the second law of thermodynamics. -Analyze why it has different statements. -Discuss the difference between ideal processes and real processes.	Gilbert W. Castellan <i>Fisicoquímica</i> 2nd Edition Addison Wesley Samuel H. Maron. <i>Fundamentos de fisicoquímica</i> Limusa Raymond Chang <i>Fisicoquímica</i> 3rd Edition Mc Graw Hill Ira N. Levine <i>Fisicoquímica Volume I</i> 5th Edition Mc Graw Hill
		3.2 Carnot Cycle	6 h			
		3.3 Second law of thermodynamics	4 h			
		3.4 Entropy changes in physical processes.	2 h	- Assigns problems and exercises solution about the unit. -Assesses the unit		



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	through chemical language - Judge based on experience and knowledge. -Solve problems in different contexts. -Do research on scientific and technological innovations to develop and solve problems. -Utilizes information and communication technologies to process and interpret information. - Relate concepts of physical chemistry and their application.				-Solve exercises and problems after the explanation of the topic. AFTER: -Solve homework exercises related to the learning unit.	
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UNIT 4 Third law of thermodynamics	-Problem solving -Synthesis and analysis. -Behavioral abilities -Value consolidation - Teamwork. -Computer skills - Information managing -Oral and written production -Discerning and decision-making -Ability to be critical towards others and towards themselves -Communicate their ideas through chemical language - Analyze situations using basic concepts of	4.1. Entropy and molecular disorder	2 h	Professor... -Leads a discussion about absolute entropy. -Lectures - Assigns problem and exercises solution about the unit. -Assesses the unit	Students... BEFORE: -Read the third chapter about the third law of thermodynamics. -Make an integration of concepts of the zero, first and second law of thermodynamics. DURING: -Discuss the importance of having entropy as a property with absolute value in a specific temperature. -Solve exercises and problems after the explanation and applying what was seen.	Gilbert W. Castellan <i>Fisicoquímica</i> 2nd Edition Addison Wesley Samuel H. Maron. <i>Fundamentos de fisicoquímica</i> Limusa Raymond Chang <i>Fisicoquímica</i> 3rd Edition Mc Graw Hill Ira N. Levine <i>Fisicoquímica</i> Volume I 5th Edition Mc Graw Hill
		4.2 Absolute entropy calculation	2 h			
		4.3 Entropy changes in chemical reactions	2 h			



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	physical chemistry - Judge based on experience and knowledge. -Solve problems in different contexts. -Do research on scientific and technological innovations to develop and solve problems. -Relates chemical concepts to their application.				AFTER: -Solve homework exercises related to the learning unit.	
UNIT V Gibbs Functions of free energy	-Problem solving -Synthesis and analysis. -Behavioral abilities -Value consolidation - Teamwork.	5.1 Gibbs free energy	4 h	Professor... -Lectures - Assigns problem and exercises solution about the unit. - Assesses the unit	Students... BEFORE: -Read the chapter about equilibrium, remember, and understand the concepts of physical	Gilbert W. Castellan <i>Fisicoquímica</i> 2nd Edition Addison Wesley Samuel H. Maron.
		5.2 Helmholtz free energy	2 h			
		5.3 Free energy changes in physical and chemical processes.	4 h			



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	-Computer skills - Information managing -Oral and written production -Discerning and decision-making -Ability to be critical towards others and towards themselves -Communicate their ideas through chemical language - Analyze situations using basic concepts of physical chemistry - Judge based on experience and knowledge. -Solve problems in different contexts.	5.4 Spontaneity of a reaction.	4 h		equilibrium seen in General Chemistry. DURING: -Investigate about the applications of Gibbs and Helmholtz' energies. in teams. -Discuss the applications of Gibbs and Helmholtz' energies in class. -Solve exercises and problems after the explanation and applying what was seen. AFTER: - Solve homework exercises related to the learning unit. -Discuss the impact of Gibbs and	<i>Fundamentos de fisicoquímica</i> Limusa Raymond Chang <i>Fisicoquímica</i> 3rd Edition Mc Graw Hill Ira N. Levine <i>Fisicoquímica</i> Volume I 5th Edition Mc Graw Hill
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	-Do research on scientific and technological innovations to develop and solve problems. -Relates chemical concepts to their application.				Helmholtz's equations in nature and in their careers. - Analyze the problem of global warming in teams and its repercussions of the new equilibria in our environment. - Offer solutions in the short, middle and long run.	
COURSE EVIDENCE (Deliverables) - Partial Exam - Departmental exam - Practice reports - Homework						

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