1. Module identification code.	
Name of the institution:	Universidad Autónoma de Nuevo León
Name of the school:	School of Medicine
Name of the degree program:	Clinical Chemistry
Name of the course (learning unit):	Physicochemistry
Total number of class hours-theory and practice:	140 h
Class hours per week:	7 h
Independent study:	70 h
Course modality:	Face-to-face instruction
Module level:	Second semester
Core/elective module:	Core
Curriculum area:	ACFB
UANL credit points:	7
Create date:	11/15/2019
Date of last amendment made:	01/25/2023
Person(s) responsible for the design and amendment of the module:	Dr. Q. Juan Ricardo Lucio Gutiérrez

2. Presentation:

The Physicochemistry Learning Unit (LU) is located in the second semester of the Bachelor's degree in Clinical Biology Chemistry and was developed considering the characteristics of the new educational model of the UANL; which incorporates trends such as curricular flexibility, a learning-based approach and competency-based education. The LU is divided into three stages where three of the fundamental branches of Physicochemistry are reviewed: Thermodynamics, Spectroscopy and Kinetics. In stage 1, the concepts and applications of thermodynamics and thermochemistry are analyzed, mainly to the study of biochemical reactions and equilibrium. The behavior of solutions and their colligative properties are also reviewed, as well as colloidal systems. Thus, the student will be able to relate the physical-chemical properties of substances with the analytical processes of importance for the Clinical Chemist. In stage 2, the properties of electromagnetic radiation and its interaction with matter, the concepts used in spectroscopy and its application in analysis techniques are examined. In the learning process, students will be able to obtain absorption spectra, identify the relevant signals and the wavelength of maximum absorption and use the latter to quantify an analyte. In stage 3, the topics of chemical and enzymatic kinetics are reviewed, which aim to provide the student with the basis for the interpretation of reaction mechanisms in chemistry and biochemistry. The student will be able to determine the order of a reaction and identify the types of enzymatic inhibition. During the development of the three stages, the student is directed to remember and apply the acquired knowledge, by following the learning activities contained in this analytical program. Regarding the evaluation system, the LU requires compliance with evidence, accredited activities and culminates with the course integrative project/product (CIP), which consists of a written evaluation with theoretical - practical resolution to application problems and evaluation of concepts of thermodynamics, spectroscopy and kinetics.

3. Purpose:

The purpose of this LU is to encourage students to develop skills that will help them interpret and predict the physicochemical behavior of substances of biochemical interest. This will allow them, as future graduates, to base the design and selection of biochemical analysis tests.

Regarding general skills, during the development of this LU, the student will be able to use logical and mathematical language to interpret and apply universal physical-chemical theories. Likewise, he/she undertakes to respect the working conditions in different contexts and thus contribute to consolidating the general well-being of himself/herself and his/her colleagues. In addition, he/she adapts to the conditions and regulations to work in harmony both in the classroom and in the laboratory.

During the course of the LU, the student also develops specific skills both in the classroom and in the laboratory, as he or she solves problems by applying knowledge of the chemical composition of matter and its physicochemical properties, which will be useful for the determination of analytes in different matrices. Likewise, by complying with the department's safety regulations, observing the safety data sheets of reagents and the Mexican Official Standards (NOMs), the competence to handle chemical and biological materials is developed following the NOMs and/or international standards that guarantee their correct use and disposal to preserve health and the environment.

The Physicochemistry LU is located in the second semester of the Academic Program of Clinical Chemist, for its development it uses the skills acquired in the General Chemistry LU, applying the knowledge of nomenclature, properties of radiation and matter, as well as the management of solutions. In addition, it makes use of the knowledge acquired in the Advanced Mathematics LU such as algebraic equations, management of logarithmic functions and elaboration of graphs, among others, which it uses in the present LU, for the resolution of problems of thermodynamics, kinetics and spectroscopy. On the other hand, it provides the student with the thermodynamic bases, for the understanding of the equilibrium processes that are taught in the Fundamentals of Analytical Chemistry LU. Likewise, the principles of thermodynamics and kinetics reviewed in Physicochemistry, help to understand the reaction mechanisms that are studied in the Basic Organic Chemistry LU. Also, through the study of the colligative and osmotic properties of solutions and colloids, Physicochemistry underpins many phenomena related to homeostasis in the organism, which are examined in depth in the LU of Medical Physiology.

4. Competencies of the graduate profile:

General competences to which this module (learning unit) contributes:

Instrumental skills:

2. To use logical, formal, mathematical, iconic, verbal and non-verbal languages according to their stage of life, to understand, interpret and express ideas, feelings, theories and currents of thought with an ecumenical approach.

Personal and social interaction skills:

10. To intervene in the face of the challenges of contemporary society at the local and global level with a critical attitude and human, academic and professional commitment to contribute to consolidating general well-being and sustainable development.

Integrative skills:

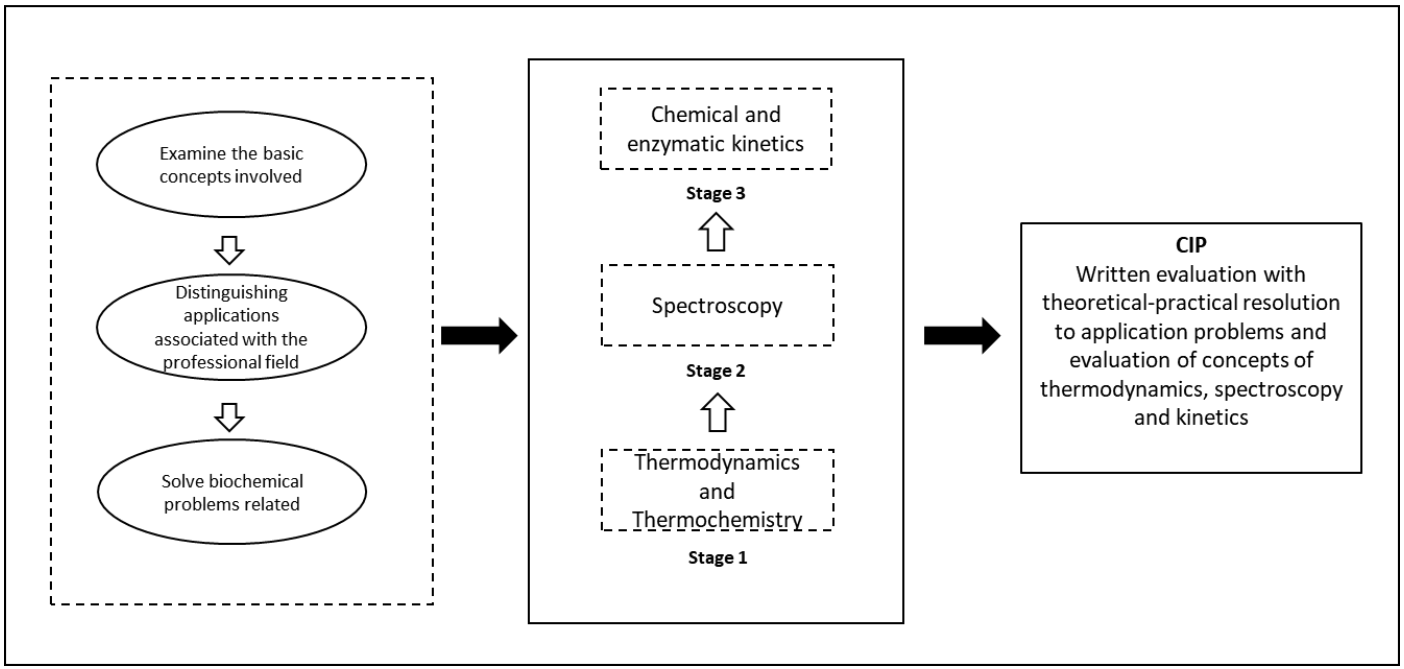
15. To achieve the adaptability required by the uncertain social and professional environments of our time to create better living conditions.

Specific competences of the graduate profile to which this module (learning unit) contributes:

1. To solve problems by applying knowledge of the chemical composition of matter as well as its physicochemical properties to determine analytes in biological, environmental and food matrices.

3. To handle chemical and biological materials following official Mexican and/or international standards that guarantee their correct use and disposal to preserve health and the environment.

5. Course roadmap:



6. Structuring in stages or phases:

Stage 1. Thermodynamics and Thermochemistry.

Stage 2. Spectroscopy.

Stage 3. Chemical and Enzymatic Kinetics.

6.1. Stage 1. Thermodynamics and Thermochemistry.				
Component(s) of the competence: Examine the foundations of thermodynamics in a biochemical context, using the laws that govern it to interpret, predict and justify the physicochemical behavior of substances, separation techniques and analysis methods based on its principles.				
Evidence of student learning	Performance criteria	Learning activities	Content	Resources
Evidence 1. Three theoretical and practical written assessments with application problems and evaluation of concepts on the foundations of thermodynamics and thermochemistry.	• Submit on the date, place and time indicated. • Includes identification data. • Solve problems individually. • Write your answers and the procedures you followed to obtain the result in good handwriting. • Clearly state the result or answer. • It includes fundamentals of thermodynamics and equilibrium,	The professor explains, using electronic presentations, infographics and/or multimedia material, the framework of the LU, presenting the objectives it pursues and making analogies. The student, outside the classroom, in collaborative work, uses electronic programs and builds two comparative tables: one on the areas into which Physicochemistry is divided (accredited	**a) Introduction to Physicochemistry (FQ) and chemical thermodynamics:** - Intuitive concept of Physicochemistry and field of study. - International System (SI) units commonly used in CF. - First law of thermodynamics. - Endothermic and exothermic processes. - State functions. - Enthalpy and enthalpy of reaction. - Calorimetry at constant pressure and volume. - Hess's law. - Enthalpies of formation.	Microsoft Teams platform . Faculty of Medicine Platform (Moodle). Forms Platform . Examsoft Platform . Computer with internet access. MS Office 365 programs. University Email Account.

	properties of gases, liquids and solutions, analysis techniques and separations based on thermodynamic principles.	**activity 1a-1**) and another on the applications it has in various professional fields (**accredited activity 1a-2**). Delivery in PDF format via digital platforms or in physical form. The student, inside and outside the classroom, through individual and collaborative work Perform the correct interpretation of SI units and practice their conversion (accredited **activity 1a-3**). Delivery in PDF format via digital platforms or in physical. The student individually and prior to the face-to-face session reads and analyzes the materials indicated by the professor and applies the prior organizer provided by him. the teacher explains, using electronic presentations, infographics and/or	- Applications of the laws of thermodynamics to biochemical processes and food analysis. **b) Thermodynamic bases of equilibrium:** - Reversible and irreversible processes. - Search for a criterion of spontaneity. - Entropy and the second law of thermodynamics. - How to make qualitative predictions of entropy. - Third law of thermodynamics. - Entropy changes in chemical reactions. - Homogeneous and heterogeneous equilibria and examples of systems in equilibrium. - Determination of the equilibrium constant and the direction of a reaction. - Factors affecting equilibrium and Le Chatelier's principle. - Gibbs free energy and the equilibrium constant. - Chemical balance and physiology.	Power Point presentations. Scientific calculator. Faculty Libraries Classroom elements: blackboard, markers, computer, projector, etc. Offprints of scientific articles and books provided by the professor electronically. Notes provided by the teacher electronically or physically. List of educational videos, available on the Internet, related to the contents. Repositories available on the

		multimedia material, the objectives and the contextualization of the topics to be reviewed. In the classroom, the student participates in a discussion guided by the teacher on the laws of thermodynamics and thermochemistry. In the classroom, the teacher specifies basic terms and exemplifies the correct resolution of the exercises with the applications of the laws of thermodynamics, sharing his screen and/or with electronic presentations. The student, inside and outside the classroom, in collaborative work uses electronic programs and digital platforms for peer learning and teaching to correctly apply the foundations of thermodynamics.	**c) Physicochemical behavior of gases and liquids:** – Characteristics of gases and pressure. – Gas laws (Boyle, Charles and Avogadro). – Ideal gas equation and its applications. – Application of Dalton's law to obtain gases in an aqueous medium. – Behavior of real gases and the Van der Waals equation. – Gases of physiological importance and gaseous environmental pollutants. – Liquids, comparison with other states of matter. – Comparison of intermolecular forces. – Energy changes that accompany phase change processes. – Critical temperature and pressure. – Vapor pressure, volatility and boiling point. – Phase diagrams, characteristics and applications of supercritical fluids.	Internet, related to the contents. Textbook (Brown, 2014) chapters: 5. Thermochemistry 19. Chemical Thermodynamics 15. Chemical Equilibrium 10. Gases 11. Liquids and intermolecular forces 13. Properties of solutions. Checklists and/or rubrics of accredited activities.

		Through individual and collaborative work, students carry out autonomous learning using digital platforms, print and electronic media on the topics covered in class. Outside the classroom, the student uses electronic programs and digital platforms and solves exercises as a team on: Introduction to thermodynamics and thermochemistry (**accredited activity 1a-4**), analysis by calorimetry (**accredited activity 1a-5**), thermodynamic bases of equilibrium (**accredited activity 1b**), physicochemical behavior of gases and liquids (**accredited activities 1c-1 and 1c-2**), physicochemical behavior of solutions and colligative properties (**accredited activity 1d -1**), separation	**d) Dissolutions, colligative and c oloid properties:** – The dissolution process and the natural tendency towards mixing. – Intermolecular forces and solution formation. – Energy changes and formation of solutions. – Types of solutions and solubility. – Factors affecting solubility. – Ways of expressing the concentration of solutions: molarity, molality and molar fraction. – Laws governing the behavior of solutions: Raoult's and Henry's. – Colligative properties of solutions and their applications. – Function of electrolytes in the body and osmolality. – Types of distillation: simple, fractional, reduced pressure and steam distillation . – Composition vs. vapor pressure and composition vs. temperature diagrams.	

		techniques based on thermodynamics (**accredited activity 1d-2**) and colloids (**accredited activity 1d-3**). Delivery in PDF format via digital platforms or in physical form. In the classroom, the student uses electronic programs and digital platforms and solves problems provided by the teacher, where the bases of thermodynamics are used (**1e accredited activity**). Delivery via digital platforms or in physical form. The teacher, inside or outside the classroom, guides the sharing of the results of the exercises carried out by the students.	– Behavior of ideal vs. real solutions and deviations from Raoult's Law. – Azeotropes. – Classius - Clapeyron equation . – Freeze-drying. – Characteristics of colloidal systems. – Classes of colloidal dispersions. – Optical, electrical and osmotic properties of colloids. – Sutherland-Einstein equation and Stokes equation. – Applications of the properties of colloids. – Colloids of biological importance.	
Evidence 2.	He writes his answers and the procedures he followed to obtain the	Outside of class, the student reads for comprehension of the	- Laboratory safety measures and measurement units. - Energy content of a food.	Computer with internet access.

Reports of experimental work carried out in the laboratory on the applications of thermodynamics.	results in good handwriting. Submit the reports on the date and time indicated (practices 1 to 8) in PDF format via platform or in physical form. The report must contain: -Student name -Date and signature of the teacher (if in person) -All spaces answered -Bibliographic references -Development of the calculations performed -Must be answered by hand -The color drawings -Graphs on graph paper or made in Excel It includes the fundamentals of calorimetry, the relationship between free energy and	practice; uses electronic programs and digital platforms and answers a questionnaire on prior knowledge and safety and delivers it in PDF format or in physical form. The student, outside the classroom, creates a flow chart of the experimental methodology. Submit it in PDF format via the platform or in physical form. In the laboratory, the teacher creates the framework for the practice using electronic presentations, infographics and/or multimedia material; presenting the objectives it pursues and asking exploratory questions presented orally. In the laboratory, the student participates individually in the discussion guided by the	- Heat of reaction. - Factors affecting balance. - Influence of equilibrium on the change in free energy. - Gases. Obtaining oxygen in an aqueous medium. - Colligative properties. Molecular weight determination by cryoscopy. - Distillation. - Colloidal systems.	Digital platforms. Support guide for the laboratory teacher. Practice Manual. Regulations of the practical laboratory. Checklists and/or rubrics of accredited activities.

	chemical equilibrium, as well as the factors that affect the latter, properties of gases, liquids, solutions and their application to analysis techniques and distillation.	teacher about the practice and applies the learning in situ. The student performs the practice in compliance with the laboratory regulations (accredited **activity 1f, performance**). The professor, in the laboratory, advises the student on how to resolve the report. The student starts his/her report in the laboratory and finishes it outside of class. It is delivered in PDF format via the platform or in physical form.		

6.2. Stage 2. Spectroscopy.
Component(s) of the competence: Distinguish the fundamentals of ultraviolet-visible, mid-infrared and fluorescence spectroscopies applied in biochemical analysis, according to the interaction of electromagnetic radiation (EMR) with matter, to interpret and predict the physicochemical behavior of substances.

Evidence of student learning	Performance criteria	Learning activities	Content	Resources
Evidence 3. Problem set with solved exercises for spectroscopy.	• Delivery on the date and time indicated, either via digital platform or in physical form. • Solve in teams (the same ones used for the seminar). • Follow the additional instructions provided in the evidence form. • Presents the identification data of the evidence and the team members. • Includes the statements of the exercises and the development of the calculations performed. • Your answers and the procedures you followed to obtain the result in good handwriting. • Clearly state the result or answer.	The student individually and prior to the face-to-face session reads and analyzes the materials indicated by the professor and applies the prior organizer provided by him. In the classroom, the teacher explains the objectives and the contextualization of the topics to be reviewed using electronic presentations, infographics and/or multimedia material. In the classroom, the student participates in a discussion guided by the teacher on the fundamentals of the interaction of REM with matter and of spectroscopy. In the classroom, the teacher specifies basic	- General properties of REM. - The electromagnetic spectrum and its units. - Quantum-mechanical properties of the EMR. - Absorption of REM by matter: electronic, rotational and vibrational transitions. - Emission and absorption spectra. - Spectrometric instrumentation . - Ultraviolet-visible spectroscopy (UV-Vis). - Lambert- Beer law and quantitative calculations in biochemical analysis. - Infrared (IR) spectroscopy. - Fluorescence spectroscopy (FL). - Modern spectroscopies and their applications.	Microsoft Teams platform . Faculty of Medicine Platform (Moodle). Forms Platform Examsoft Platform . Computer with internet access. MS Office 365 programs. University Email Account. Power Point presentations. Scientific calculator. Faculty Libraries Classroom elements: blackboard,

	• Delivery in PDF format via digital platform or in physical form. • It includes the general properties of REM, the fundamentals of ultraviolet-visible, mid-infrared and fluorescence spectroscopies, as well as their applications in qualitative and quantitative analysis.	terms and exemplifies the correct resolution of the exercises with the applications of spectroscopy and the Lambert- Beer law with electronic presentations. The student, inside and outside the classroom, in collaborative work uses electronic programs and digital platforms for peer learning and teaching to correctly apply the bases of spectroscopy. Through individual and collaborative work, students carry out autonomous learning using digital platforms, print and electronic media on the topics covered in class. In the classroom, the student uses electronic programs and digital platforms and solves problems provided by the		markers, computer, projector, etc. Offprints of scientific articles and books provided by the professor electronically. Notes provided by the professor electronically. List of educational videos, available on the Internet, related to the contents. Repositories available on the Internet, related to the contents. Reference book (Christian, 2008) chapter: Spectrochemical methods .

		teacher, where the bases of spectroscopy and the Lambert- Beer law are used (**accredited activity 2a**). Delivery via digital platforms or in physical form. The teacher, in or out of class, guides the sharing of the results of the exercises carried out by the students.		Reference book (Skoog, 2015) chapters: Spectrochemical methods. 25. Optical spectrometry instruments. 26. Molecular absorption spectrometry. 27. Molecular fluorescence spectroscopy. Checklists and/or rubrics of accredited activities.
Evidence 4. Report of the experimental work carried out in the laboratory on the applications of spectroscopy.	He writes his answers and the procedures he followed to obtain the results in good handwriting. Submit the report on the date and time indicated (practice 9) in PDF format via platform or in physical form.	The student reads for comprehension of the practice; uses electronic programs and digital platforms and answers a questionnaire on prior knowledge and safety and submits it in PDF or physical format. The student, outside the classroom, creates a flow	- Spectroscopy: applications of Beer's law.	Computer with internet access. Digital platforms. Support guide for the laboratory teacher. Practice Manual.

	The report must contain: -Student name -Date and signature of the teacher (if in person) -All spaces answered -Bibliographic references -Development of the calculations performed -It must be answered by hand -The color drawings -Graphs on graph paper or made in Excel It includes obtaining and interpreting a UV-Vis spectrum, calculating the molar absorptivity coefficient of a compound (ε) and applying Beer's Law in quantitative analysis.	chart of the experimental methodology. Submit it in PDF format via the platform or in physical form. In the laboratory, the teacher creates the framework for the practice using electronic presentations, infographics and/or multimedia material; presenting the objectives it pursues and asking exploratory questions presented orally. In the laboratory, the student participates individually in the discussion guided by the teacher about the practice and applies the learning in situ. The student performs the practice in compliance with the laboratory regulations (**accredited activity 2b, performance**).		Regulations of the practical laboratory. Checklists and/or rubrics of accredited activities.

		The professor, in the laboratory, advises the student on how to resolve the report. The student starts his/her report in the laboratory and finishes it outside of class. It is delivered in PDF format via the platform or in physical form.		

6.3. Stage 3. Chemical and Enzymatic Kinetics.				
Component(s) of the competence: Compare chemical and enzymatic kinetics, based on the physicochemical principles that govern them, to interpret and predict the behavior of chemical reactions and base biochemical analysis techniques.				
Evidence of student learning	Performance criteria	Learning activities	Content	Resources
Evidence 5. Theoretical and practical written evaluation with application problems and evaluation of concepts involving chemical and enzymatic kinetics.	• Submit on the date, place and time indicated. • Includes identification data. • Solve problems individually. • Write your answers and the procedures you followed to obtain the result in good handwriting. • Clearly state the result or answer. • Enzymatic reactions, as well as the application of UV-Vis spectroscopy for monitoring reactions and determining their kinetic parameters.	The student individually and prior to the face-to-face session, reads and analyzes the materials indicated by the professor and applies the prior organizer provided by him. In the classroom, the teacher explains the objectives and the contextualization of the topics to be reviewed using electronic presentations, infographics and/or multimedia material. In the classroom, the student participates in the discussion guided by the teacher on the physicochemical foundations that govern	**a) Chemical kinetics.** - Reaction speed and factors that affect it. - Concentration and speed law. - Change in concentration with time and reaction order. - Half-life. - Effect of temperature on reaction rate and use of the Arrhenius equation. - Reaction mechanisms and molecularity. **b) Enzyme kinetics.** - Catalysis. Types of catalysts. Examples. - Classification, structure and characteristics of enzymes. - Mechanisms of enzymatic action. - Reaction order of enzymatic catalysis.	Microsoft Teams platform. Faculty of Medicine Platform (Moodle). Forms Platform. Examsoft Platform. Computer with internet access. MS Office 365 programs. University Email Account. Power Point presentations. Scientific calculator. Faculty Libraries

		chemical kinetics and enzymatic kinetics. In the classroom, the teacher specifies basic terms and exemplifies the correct resolution of the exercises with the laws of reaction rates, the Michaelis-Menten equation and the Lineweaver-Burk equation with electronic presentations. The student, inside and outside the classroom, in collaborative work uses electronic programs and digital platforms for peer learning and teaching to correctly apply the principles of chemical and enzymatic kinetics. Through individual and collaborative work, the student carries out autonomous learning using digital platforms, print and electronic media	- Description of Michaelis-Menten. - Lineweaver-Burk representation. - Identification of types of enzyme inhibition. **c) Seminar.** - Thermodynamics applied to biochemical processes - Thermodynamics applied to industry: food and fuels - Chemical equilibrium applied to physiological buffer systems - Gases of physiological importance and environmental pollutants - Osmotic functions in the body - Analytical methods applied to colloids - Application of reduced pressure distillation and lyophilization techniques - Supercritical fluid extraction - Nuclear magnetic resonance and mass spectrometry - Methods of analysis in the clinical laboratory involving enzymes	Classroom elements: blackboard, markers, computer, projector, etc. Offprints of scientific articles and books provided by the professor electronically. Notes provided by the professor electronically. List of educational videos, available on the Internet, related to the contents. Repositories available on the Internet, related to the contents. Textbook (Brown, 2014) chapter:

		on the topics covered in class. Outside the classroom, the student uses electronic programs and digital platforms and solves exercises in teams on: chemical kinetics (**accredited activity 3a**) and enzymatic kinetics (**accredited activity 3b**). In the classroom, the student uses electronic programs and digital platforms and solves problems provided by the teacher, where the laws of reaction rates, the Michaelis-Menten equation and the Lineweaver-Burk equation are used (**3c accredited activity**). Delivery via digital platforms (or in physical form).		14. Chemical kinetics Reference book (Christian, 2008) chapter: 22. Kinetic methods of analysis Reference book (Skoog, 2015) chapter: 30. Kinetic methods of analysis Rubrics for accredited activities. Checklists and/or rubrics of accredited activities.

		The teacher, in or out of class, guides the sharing of the results of the exercises carried out by the students. The student, outside the classroom, as a team, conducts a bibliographic search in print or electronic media on the assigned topic, prepares a summary and a PowerPoint presentation. The teacher, outside the classroom, verifies the electronic presentation and provides feedback orally or in writing in person or through digital platforms. Students, outside the classroom, correct the summary and the electronic presentation. Students make an oral presentation of the assigned topic with the support of electronic		

		presentations and/or multimedia material (**3d accredited activity**). In the classroom, the teacher moderates a forum on questions about the content presented.		
Evidence 6. Reports of experimental work carried out in the laboratory on the applications of chemical and enzymatic kinetics.	He writes his answers and the procedures he followed to obtain the results in good handwriting. Submit the reports on the date and time indicated (practices 10 and 11) in PDF format via platform or in physical form. The report must contain: -Student name -Date and signature of the teacher -All spaces answered -Bibliographic references -Development of the calculations performed	The student reads for comprehension of the practice; uses electronic programs and digital platforms and answers a questionnaire on prior knowledge and safety and delivers it in PDF format or in physical form. The student, outside the classroom, creates a flow chart of the experimental methodology. Submit it in PDF format via the platform or in physical form. In the laboratory, the teacher creates the framework for the practice using electronic presentations,	- Chemical Kinetics: spectroscopic study of the reaction of phenolphthalein with a strong base. - Evaluation of the speed of a reaction catalyzed by an enzyme.	Computer with internet access. Digital platforms. Support guide for the laboratory teacher. Practice Manual. Regulations of the practical laboratory. Checklists and/or rubrics of accredited activities.

	-It must be answered by hand -The color drawings -Graphs on graph paper or made in Excel It includes the application of UV-Vis spectroscopy in the calculation of the kinetic parameters of a chemical reaction: the reaction order and the rate constant. The effect of different concentrations of a substrate on the rate of an enzymatic reaction and the use of enzymes to quantify an analyte.	infographics and/or multimedia material; presenting the objectives it pursues and asking exploratory questions orally. In the laboratory, the student participates individually in the discussion guided by the teacher about the practice and applies the learning in situ. The student carries out the practice in compliance with the laboratory regulations (**accredited activity 3e, performance**). The professor, in the laboratory, advises the student on how to resolve the report. The student starts his/her report in the laboratory and finishes it outside of class. Submit it in PDF		

		format via the platform or in physical form.		

7. Summative evaluation:

Stage 1	Evidence 1. Three theoretical-practical written evaluations with application problems and evaluation of concepts	18%	54%
	Evidence 2. Reports of practices 1 to 8	16%	
	Accredited activities 1a-1 to 1a-5	5%	
	Accredited Activity 1b	2%	
	Accredited activities 1c-1 and 1c-2	2%	
	Accredited activities 1d-1 to 1d-3	3%	
	Accredited activity 1e	7%	
	Accredited activity 1f	1%	
Stage 2	Evidence 3. Problem with solved exercises of spectroscopy	5%	9%
	Evidence 4. Practice Report 9	2%	
	Accredited Activity 2a	1%	
	Accredited Activity 2b	1%	
Stage 3	Evidence 5. Theoretical-practical written evaluation with application problems and evaluation of concepts	6%	17%
	Evidence 6. Reports of practices 10 and 11	4%	
	Accredited activities 3a and 3b	2%	
	Accredited Activity 3c	2%	
	3d accredited activity	2%	
	Accredited activity 3e	1%	
CIP	Written evaluation with theoretical and practical resolution of application problems and evaluation of concepts of thermodynamics, spectroscopy and kinetics.	20%	20%
	Total		100%

8. Course integrative project/product:

Written evaluation with theoretical and practical resolution of application problems and evaluation of concepts of thermodynamics, spectroscopy and kinetics.

9. References:

Brown TL. (2014) Chemistry. The Central Science. Mexico: Prentice Hall publishing house.
Christian GD. (2008) Analytical Chemistry. Mexico: Mc Graw Hill publishing house.
Lucio JR. (2020) Manual of Physicochemistry Practices. Mexico: editorial Department of Analytical Chemistry, Faculty of Medicine, UANL.
Skoog DA. (2015) Fundamentals of Analytical Chemistry. Mexico: CENGAGE Learning publishing house .

Free resources.

Abgna , E. (17 May 2014). Partial Pressures and Gas Collection Above a Water Column. Thermodynamics. Retrieved from: https://youtu.be/l5Hd9fVoW2E
Anibal , C. (Jun. 8, 2012). Heat Capacity. Retrieved from: https://youtu.be/2AmZZsLAwwg
Cienciabit : Science and Technology. (Nov. 15, 2015). How to Collect and Measure Gases. Retrieved from: https://youtu.be/ozko7fkg4Ko
Flores, D. (Nov. 6, 2017). UV-Vis Spectrometry – Part 1. Retrieved from: https://youtu.be/KRNhrRqs2UM
Foncea , V. (accessed June 2020). Radio Astronomy Handbook, ALMA at school. Chile. Atacama Large Page Millimeter / submillimeter Array . Retrieved from: https://almaobservatory.org/wp-content/uploads/2016/11/manual_radioastronomia_web.pdf
Maestro TV SNTE. (Feb. 16, 2016). Have fun learning - Laboratory, Heat capacity S3E26 - SNTE National. Retrieved from: https://youtu.be/oqmuQZIDnvk

9. References (continued):

Mateus, A. (2 Mar. 2017). Using the spectrophotometer. Retrieved from: https://youtu.be/EYRmnC7RdNQ
Mobile Science. Merck PTE. (Oct. 31, 2018). The newspaper table in digital form , Mobile application. Retrieved from: https://www.macinchem.org/mobsci/index.php/10-chemistry/75-merck-pte .
National Score Chile. (April 4, 2013) Chemical Sciences, Solutions. Colligative Properties. YouTube. Retrieved from: https://www.youtube.com/watch?v=gSJmWTls-ek.

Annex 1: LU Requirements

To accredit this Learning Unit, it is a condition that the sum of evidence 1, 3 and 5 is greater than or equal to 18% and that the sum of evidence 2, 4 and 6 is greater than or equal to 15%.

The CIP consists of open-ended questions (approximately 25% of the exam) and multiple-choice questions, with a maximum duration of 2 hours. Both open-ended and multiple-choice questions include problem-solving and exercises to apply concepts; that is, most of the questions do not involve memorization of information.