UNIVERSIDAD AUTÓNOMA DE NUEVO LEÓN
FACULTAD DE MEDICINA
PROGRAMA ANALÍTICO

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):	Organic Analysis
Total number of class hours-theory and practice:	80
Class hours per week:	4
Independent study hours:	10
Course modality:	Face-to-face instruction
Module level:	Fifth semester
Core/elective module:	Core
Curriculum area:	ACFB
UANL credit points:	3
Create date:	11/07/2018
Date of last amendment made:	26/06/2022
Person(s) responsible for the design and amendment of the module	Dr. C. Verónica Mayela Rivas Galindo, Dra. Q. Noemí Waksman Minsky and Dra. Q. Tannya Rocío Ibarra Rivera.

2. Presentation:

The Organic Analysis learning unit is offered in the fifth semester of the Clinical Chemistry degree program taught at the UANL Faculty of Medicine. This learning unit applies knowledge about properties and specific reactivity of the different functional groups present in an organic compound, as well as the application of different spectroscopic instrumental techniques for the structural determination and/or identification of organic compounds. Through the application of qualitative and instrumental techniques, the identification of the chemical structure of organic compounds is achieved. Knowledge of this learning unit is essential in laboratory tests that help in clinical, toxicological, forensic and/or environmental analysis.

In this learning unit, a training sequence is developed based on four main stages, which begin in stage 1 with the recognition of the importance of organic analysis in the identification of organic compounds and in the identification of the techniques or methods that exist for the structural elucidation of organic compounds. During stage 2 the student applies the systematic qualitative methods of organic functional analysis through knowledge of physical properties and specific reactions of each organic functional group. Subsequently, in stage 3, the student will acquire the theoretical foundations of spectroscopic methods useful in the identification of the structures of organic compounds. Finally, in stage 4, the student will acquire skills associated with the identification of organic compounds by combining qualitative tests and instrumental methods used in organic analysis. Finally, the course integrative product (CIP) will be developed through the structural elucidation of organic compounds based on problems that involve qualitative and spectroscopic data.

3. Purpose:

The purpose of the Organic Analysis Learning Unit is to contribute to achieving the profile of the graduate through training in the analysis of organic molecules by traditional methods of qualitative analysis, as well as by spectroscopic methods. This course will allow the student to support the generation of knowledge and the resolution of problems in the professional field. In this learning unit, general skills are developed, especially in the preparation of inter, multi and transdisciplinary academic and professional proposals according to the best global practices to promote and consolidate collaborative work, since training is provided in the interpretation of spectroscopic data obtained from equipment used worldwide for structural analysis. Furthermore, the use and management of analytical results, in the resolution of problems that lead to the characterization and structural elucidation of various organic compounds, will allow you to intervene in the challenges of contemporary society locally and globally with a critical attitude and human commitment, academic and professional to contribute to consolidating general well-being and sustainable development. The training received to resolve results interpretation exercises in this field of organic analysis will allow you to resolve personal and social conflicts according to specific techniques in the academic and professional field. The student will acquire specific skills to develop knowledge, skills and abilities for the analysis of organic compounds, from the chemical composition of the matter, as well as its physicochemical properties, which will be used to determine analytes in biological, environmental and food matrices, through the functional organic analysis and modern spectroscopic methods. In addition, the knowledge acquired will allow the making of timely and relevant decisions that can be applied in toxicological diagnosis, chemical analysis of food, forensic and environmental. The learning unit Organic Analysis is located in the fifth semester of the Clinical Chemistry degree; for its development, it requires the knowledge acquired in previous learning units such as Basic Organic Chemistry, Organic Techniques and Biochemistry since it is necessary to know organic compounds, their chemical behavior, nomenclature, as well as the use of some physical and chemical constants of organic compounds. This course has a broad relationship with the Comprehensive Organic Analysis Laboratory, since it provides all the theoretical knowledge necessary for the development of analysis of organic molecules with traditional techniques and spectroscopic methods. In addition, the skill acquired in the analysis of compounds will allow the application in the study and analysis of various biological matrices in the courses of Clinical Biochemistry, Food Analysis, Instrumental Analysis and Toxicology.

4. Competences of the graduate profile:

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

- *Instrumental skills:*

  7. To develop inter, multi and transdisciplinary academic and professional proposals in accordance with the best global practices to promote and consolidate collaborative work.

- *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:*

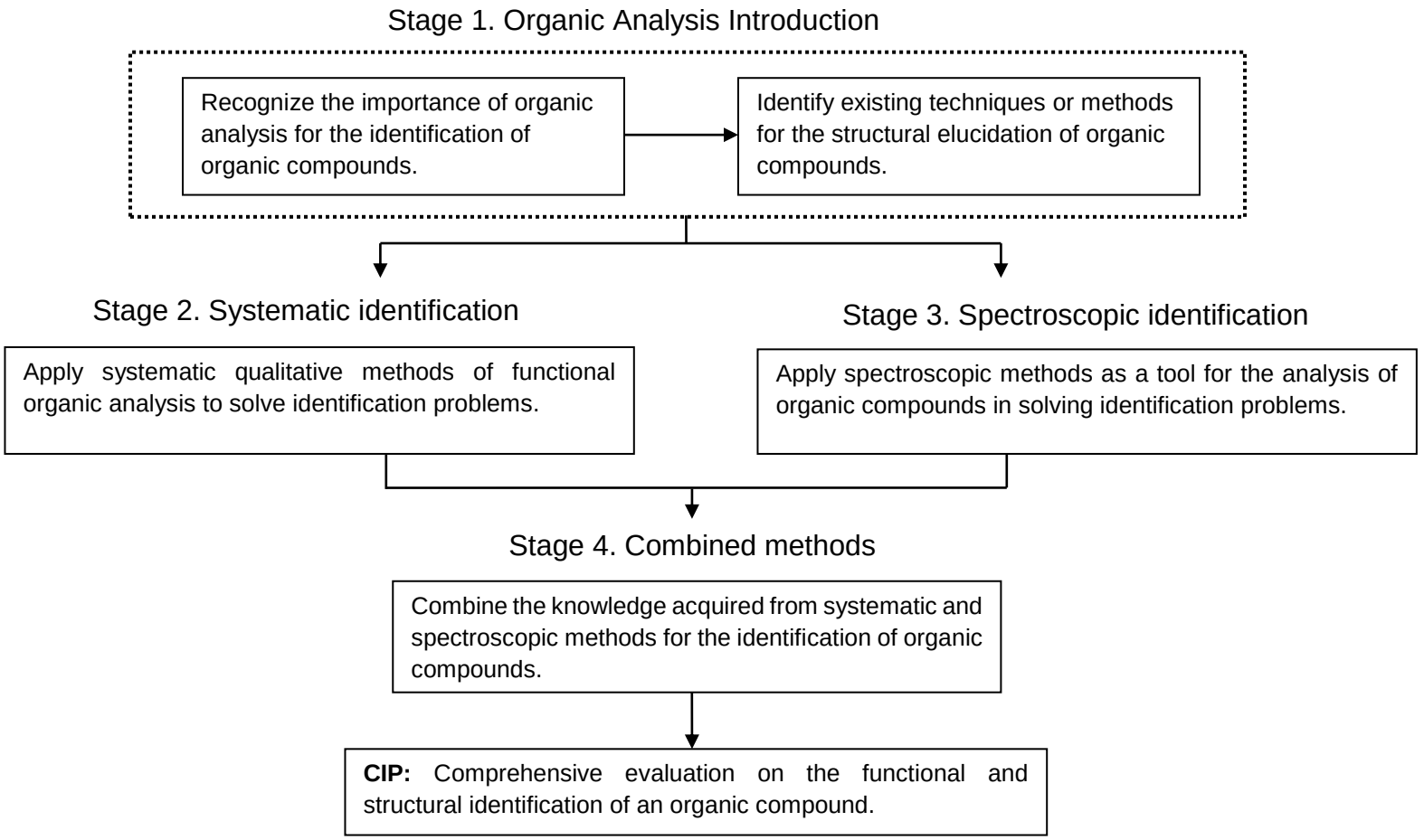
  14. To resolve personal and social conflicts, in accordance with specific techniques in the academic field and in their profession for appropriate decision-making.

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.

6. To interpret the results of analyses based on established criteria that allow timely and pertinent decision-making in clinical, toxicological, chemical, food, forensic, and environmental diagnosis.

5. Course roadmap:



6. Structuring into stages or phases:

Stage 1: Organic Analysis Introduction

Component(s) of the competence:

Identify the systematic and spectroscopic methods used in the structural analysis of organic compounds, to recognize their application in organic analysis.

Evidence of student learning	Performance criteria	Learning activities	Content	Resources
1. Opinion essay on organic analysis (**Evidence 1**)	Personal opinion essay on organic analysis, general issues, uses and applications. Inquires into methods of systematic and spectroscopic identification of organic compounds and literature. Write the free format essay in Word with no more than two pages, font size 12, Arial type, line spacing 1.15, margins 2.5 cm on each side, correct spelling, identification data.	• The student reviews the course framework, the activity program and the conditions of the type of activity to be carried out and the form of evaluation, presented by the teacher. • The student reflects in class, with the support of the teacher, on the definition of organic analysis, generalities and importance in the identification of compounds. • The student individually will complete a free-form essay on organic	The essay must contain: • Definition and generalities of organic analysis. • Methods and techniques used for the structural analysis of organic compounds. • Uses of organic functional and structural analysis.	Computer Microsoft Office and internet conection. Platforms Moodle, Microsoft Teams and Nearpod. Instructional Guide for evidence 1 Reference books: • Organic Chemistry, L. G. Wade. Seventh edition. Chapters: 12, 13 and 15. • Sistematic Identification of Organics Compounds. Shriner, et al. (2nd Edition) Chapters 1 and 2.

	Submit individually through the MS Teams platform or by email on the date and time specified by the teacher. Evaluation instrument: through rubric.	analysis, its relationship with other learning units and its usefulness in professional and daily life. • It will be prepared according to the established performance criteria and in a suitable place for the analysis of concepts. You can rely on textbooks and do a free search on the topic on suggested electronic pages.	• Relationship with other fields of study. • References	Analytic Program of Organic Analysis Free search of the topic on electronic pages: 1. Qualitative Organic Analysis. 2. De Química, Recursos Educativos de Química. 3. Study.com, Analyzing Organic Compounds: Methods & Tools.

Stage 2: Systematic identification

Component(s) of the competence:

Apply systematic qualitative methods used for functional organic analysis to solve identification problems for organic compounds.

Evidence of student learning	**Performance criteria**	**Learning activities**	**Content**	**Resources**
2. Written evaluation **1** about qualitative sistematic identification of organic compounds (**Evidence 2**).	The student answers the written evaluation 1, which includes methods for systematic qualitative identification of organic compounds. Evaluation instrument: written in-person exam.	The student reviews the conditions of the type of activities to be carried out and the form of evaluation, provided by the teacher. The student reviews the foundations and applications of specific	• Problem solving: fundamentals and applications of specific reactions used in organic analysis as qualitative techniques for the	Computer Microsoft Office and internet conection. Platforms Moodle, Microsoft Teams and Nearpod. Instructional Guide for evidence 2.

	Individually turns questionnaires and problems on the date and time specified by the teacher (**Accredited Activity 1**). Turns a comparative table on specific reactions of each functional group (**Accredited Activity 2**). Turns a report of the qualitative systematic analysis of an organic compound assigned by working group (**Accredited Activity 3**).	reactions of the main functional groups using the audiovisual material provided by the teacher, to facilitate the information understanding. The student practices and consolidates the concepts and resolves doubts, through guidance and contextualization questions asked by the teacher. The student analyzes examples of typical problem solutions with the teacher's advice, and is assigned an organic compound to simulate a functional organic analysis by each team. The student solves and delivers: • individually, the questionnaires and problems indicated in the guide (**Accredited Activity 1**); • in group form the comparative table of	identification of organic substances. • Comparative table: Specific reactions for the identification of alkanes, alkenes, alkynes, alkyl halides, ethers, alcohols, amines, aldehydes, ketones, carboxylic compounds, esters, amides, nitriles, anhydrides, acyl halides, amino acids, carbohydrates. • Functional organic analysis report of the compound assigned by group.	Chem Draw Program. Main book: • Sistematic Identification of Organics Compounds. Shriner, et al. (2nd Edition). Chapters 1, 2 and 9. Reference book: • Organic Chemistry, L. G. Wade. 7th edition. Capítulos: 6, 7, 9, 10, 12, 13, 14, 15, 16, 18, 19 and 20. Analytic Program of Organic Analysis. Electronic information files on the subject. Suggested websites: 1. Khan academy, Una breve introducción a la química orgánica. 4. Biblioteca Farmacéutica. 5. Study.com, Analyzing Organic Compounds: Methods & Tools.

		specific reactions of each functional group (**Accredited Activity 2**) • in group form to the qualitative systematic analysis of the assigned compound (**Accredited Activity 3**)		

Stage 3: Spectroscopic identification

Component(s) of the competence:

Apply spectroscopic methods as a tool for the analysis of organic compounds in solving identification problems.

Evidence of student learning	**Performance criteria**	**Learning activities**	**Content**	**Resources**
3. Written evaluation **2** about ultraviolet-visible and infrared spectroscopy (**Evidence 3**).	The student answers the written evaluation 2, which includes the basic concepts of UV-Vis and infrared spectroscopy, applied to the structural analysis of organic compounds. Evaluation instrument: written in-person exam. Visualize the advantages and limitations of a technique through real cases.	The student reviews the conditions of the type of activities to be carried out and the form of evaluation, provided by the teacher. The student analyzes real cases that limit the use of organic functional analysis and in a synchronized manner with his classmates and reviews the foundations of spectroscopic methods and their use in the identification of organic substances, as well as	1. Introduction of modern techniques in organic structural analysis. 2. Definition, foundation, generalities and applications of ultraviolet-visible and infrared spectroscopy. • UV-Vis spectroscopy: chromophore groups, electronic	Computer Microsoft Office and internet conection. Platforms Moodle, Microsoft Teams and Nearpod. Instructional Guide for evidence 3. Chem Draw Program. Main book: • Systematic Identification of Organics Compounds. Shriner, et al. (2nd Edition) Chapter 7. Reference books:

	Assertively answers questions and problems with appropriate justification. Interacts with his teacher and classmates synchronously in collective activities. Solve and turns questionnaires, problems and concept maps in a timely manner, individually or collectively (**Accredited Activities 4 and 5**).	their advantages in this application. What they have learned is developed in an infographic on spectroscopic methods (**Accredited Activity 4**). The student reviews the fundamentals and generalities of ultraviolet-visible and infrared spectroscopy from the audiovisual material provided by the teacher. The student carries out online activities to acquire concepts through questionnaires to solve problems individually and collectively (**Accredited Activity 5**).	transitions, Woodward-Fieser rules. • Infrared (IR) Spectroscopy: bond vibrations, frequencies.	• Química Orgánica, L. G. Wade. Séptima edición. Capítulos: 12 y 15. • Spectrometric identification of organic compounds. Silverstein, R. M. Capítulo 3. Suggested websites: 1. Análisis Orgánico Cualitativo. 2. University of Alberta. Interactive Tutorial of Infrared Spectroscopy. 3. Chemistry Libre text. Empirical rules for absorption wavelengths of conjugated systems.
4. Written evaluation **3** about mass spectrometry (**Evidence 4**).	The student answers the written evaluation 3, which includes the basic concepts of mass spectrometry and its application in structural analysis of organic molecules. Evaluation instrument: written in-person exam.	The student reviews the conditions of the type of activities to be carried out and the form of evaluation, provided by the teacher. The student reviews the fundamentals and generalities of mass spectrometry using the	Definition, foundation, generalities and applications of mass spectrometry. • Determination of molecular formulas, fragmentations and	Computer Microsoft Office and internet conection. Platforms Moodle, Microsoft Teams and Nearpod. Instructional Guide for evidence 4. Chem Draw Program. Main book:

	Assertively answers questions and problems with appropriate justification. Interacts with his teacher and classmates synchronously in collective activities. Solve and turns questionnaires and problems in a timely manner, individually or collectively (**Accredited Activity 6**).	audiovisual material provided by the teacher. The student solves, individually or in groups, the questionnaires and standard problems indicated in the guide (**Accredited Activity 6**).	rearrangements, main ions.	• Systematic Identification of Organics Compounds. Shriner, et al. (2nd Edition). Chapter: 8. Reference books: • Organic Chemistry, L. G. Wade. Seventh edition. Chapter: 12. • Spectrometric identification of organic compounds. Silverstein, R. M. Capítulo: 2. Suggested websites: 1. Scai Uma Es, Espectrometria de Masas. 2. You Tube. Espectrometría Principios Básicos. 3. You Tube, How2: interpret a Mass Spectrum
5. Written evaluation **4** about nuclear magnetic resonance (**Evidence 5**).	The student answers the written evaluation 4, which includes the basic concepts of nuclear magnetic resonance and the use for solving structures of simple organic molecules. Evaluation instrument: written in-person exam.	At the beginning of the topic, the student receives a study guide with the schedule of the topics to be covered and the accredited activities to carry out to complete the evidence 5. The student reviews at home, prior to class, the material delivered by the teacher, whether in the	Definition, foundation, generalities and applications of nuclear magnetic resonance spectroscopy. Resonance phenomenon Nuclear spin	Computer Microsoft Office and internet conection. Platforms Moodle, Microsoft Teams and Nearpod. Instructional Guide for evidence 5. Chem Draw Program. Main book: • Systematic Identification of Organics Compounds.

	Assertively answers questions and problems with appropriate justification. Solve and turns questionnaires and problems in a timely manner, individually or collectively (**Accredited Activity 7**).	form of a video, presentation or some other resource, according to the case. At the beginning of class, the student answers a quiz (non-accredited activity) that reflects their degree of understanding of the topic; Later, the teacher will ask the teacher for clarification of doubts on the topic. The student attends to the examples of solving typical problems posed by the teacher. The student solves, individually or in groups, in digital format, the questionnaires and problems included in the guide (**Accredited Activity 7**) and submitted as homework for evaluation.	Quantum spin number Chemical equivalences ^{1}H-NMR spectra ^{13}C- NMR spectra Chemical shifts Integrations Multiplicity	Shriner, et al. (2nd Edition). Chapter 6. Reference books: • Organic Chemistry, L. G. Wade. Seventh edition. Chapter: 13. Suggested websites: 1. University of Alberta. Interactive Tutorial of NMR Spectroscopy. 2. WebSpectra.

Stage 4: Combined methods

Component(s) of the competence:

Combine the knowledge acquired from systematic and spectroscopic methods for the identification of organic compounds.

Evidence of student learning	Performance criteria	Learning activities	Content	Resources
6. Combined problem solving (**Evidence 6**).	Through all the methods used in an organic structural analysis, the student solves in groups and turns problems combined with proposals for organic structures (**Evidence 6**). Individually presents a comparative table of the spectroscopic techniques studied (**Accredited Activity 8**). Turns a final group report of the qualitative systematic analysis and spectroscopic analysis of the organic compound assigned by the work group (**Accredited Activity 9**).	The student reviews the conditions of the type of activities to be carried out and the form of evaluation, provided by the teacher. The student analyzes, with the teacher's advice, the way to approach the analysis of the different spectra and qualitative data of specific organic compounds to propose an appropriate structure. Solution of typical problems by students with guidance from the teacher in class. The student solves, individually or in groups, during the face-to-face sessions or at home, the questionnaires, problems and activities indicated in the guide (**Evidence 6, Accredited Activities 8 and 9**).	All topics reviewed in the Learning Unit.	Computer Microsoft Office and internet conection. Platforms Moodle, Microsoft Teams and Nearpod. Instructional Guide for evidence 5. Chem Draw Program. Main book Reference books Suggested websites: 1. Interactive Spectroscopy. Combined exercises for problem solving. 2. Organic Structure Elucidation, A workbook of unknowns.

7. Comprehensive evaluation of processes and products:

Evidences		%
1	Ensayo sobre análisis orgánico	**3**
2	Written evaluation **1** about qualitative systematic identification of organic compounds.	**10**
3	Written evaluation **2** about ultraviolet-visible and infrared spectroscopy.	**10**
4	Written evaluation **3** about mass spectroscopy.	**10**
5	Written evaluation **4** about nuclear magnetic resonance.	**10**
6	Combined problem solving.	**5**
Accredited Activities		
1	Questionnaires and problems on qualitative techniques for the identification of organic compounds.	**3**
2	Comparative table of specific reactions of each functional group.	**3**
3	Report of the qualitative systematic analysis of the organic compound assigned.	**5**
4	Infographic on spectroscopic methods.	**3**
5	Questionnaires and problems on UV-Visible and Infrared.	**5**
6	Questionnaires and problems on mass spectroscopy.	**5**
7	Questionnaires and problems on nuclear magnetic resonance.	**5**
8	Comparative table of the spectroscopic techniques studied.	**3**
9	Final group report of the qualitative systematic analysis and spectroscopic analysis of the organic compound assigned.	**5**
Course integrative product (CIP):		**15**
Total		**100**

8. Course integrative product:

Comprehensive evaluation that demonstrates the acquisition of knowledge in qualitative and instrumental techniques for the identification of organic substances and proposal of a chemical structure from chemical and spectroscopic data.

9. References:

Nicolaou, K.C. y Montagnon T. (2008). Molecules that changed the world. EUA: Editorial Wiley-VCH.

Pretsch, E. y Buhlman, P. (2009). Structure determination of organic compounds. USA: Editorial Springer.

Shiner, Hermann, Morrill, Fuson, Curtin. (2013). Identificación Sistemática de Compuestos Orgánicos. México: Editorial Limusa-Wiley.

Silverstein, R. M. (2005). Spectrometric identification of organic compounds. EUA: Editorial Wiley.

Wade, L.G. (2012). Química Orgánica. México: Editorial Pearson.

Suggested websites:

1. Análisis Orgánico Cualitativo. Recuperado el 20 de julio de 2020 de sites google website: https://sites.google.com/site/analisisorganicocualitativo/
2. De Química, Recursos Educativos de Química. Recuperado el 20 de julio de 2020 de dequimica. Website: https://www.dequimica.info/analisis-organico-cualitativo/
3. Biblioteca Farmacéutica, recuperado 24 de julio de 2020. http://www.bibliotecafarmaceutica.com/Enlaces/Aco/Octavo/Documentos/Libro%20Aco-2019.pdf
4. Study.com, Analyzing Organic Compounds: Methods & Tools, recuperado el 24 de julio de 2020. https://study.com/academy/lesson/analyzing-organic-compounds-methods-tools.html
5. Khan academy, Una breve introducción a la química orgánica, recuperado el 26 de julio de 2020. https://es.khanacademy.org/science/organic-chemistry.
6. University of Alberta. Interactive Tutorial of Infrared Spectroscopy. Recuperado el 20 de julio de 2020 de ChemUAlberta.CA. Website: http://www.chem.ualberta.ca/~orglabtutorials/Interactive%20Tutorials/ir/irspec.html
7. Chemistry Libre text. Empirical rules for absortion wavelengths of conjugated systems. Recuperado 24 de julio de 2020. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental_Modules_(Organic_Chemistry)/Spectroscopy/Visible_and_Ultraviolet_Spectroscopy/Empirical_Rules_for_Absorption_Wavelengths_of_Conjugated_Systems
8. University of Alberta. Interactive Tutorial of NMR Spectroscopy. Recuperado el 26 de julio de 2020 de ChemUAlberta.CA. Website: http://www.chem.ualberta.ca/~orglabtutorials/Interactive%20Tutorials/hnmr/HNMRmain.html

9. WebSpectra, Recuperado el 26 de julio de 2020 de University of California https://webspectra.chem.ucla.edu//
10. Scai Uma Es, Espectrometría de Masas, recuperado el 24 de julio de 2020. http://www.scai.uma.es/areas/aqcm/ems/ems.htm
11. Video You Tube. Espectrometría Principios Básicos, Recuperado 24 de julio 2020. https://www.youtube.com/watch?v=ztArLXr8oUEl
12. Video You Tube, How2: interpret a Mass Spectrum, 19-Dic-2012. Recuperado 24 de julio 2020 https://www.youtube.com/watch?v=ookUh91aUCQ
13. Interactive Spectroscopy. Ejercicios combinados para resolución de problemas. Recuperado el 26 de julio de 2020 de University of Calgary CA. http://www.chem.ucalgary.ca/courses/351/WebContent/spectroscopy/spectroscopy.html
14. Organic Structure Elucidation, A workbook of unknowns. Recuperado el 26 de julio de 2020 de University of Notre Dame. https://www3.nd.edu/~smithgrp/structure/workbook.html