



# 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

|  |  |   |                               |   |                     |
|--|--|---|-------------------------------|---|---------------------|
| <b>Learning unit</b><br>Analytical Chemistry Instrumentation I |  | <b>Department</b><br>Chemistry                        |                               | <b>Format</b><br>Lecture                          |                     |
| <b>Prerequisites(P)</b><br>Analytical Chemistry II             | <b>Corequisites (CO)</b><br>Analytical Chemistry Instrumentation Lab I | <b>Ascribed Academy</b><br>Analytical Instrumentation |                               | <b>Module</b><br>M3 Analysis and characterization |                     |
| <b>Type</b><br>Basic Particular mandatory                      | <b>Lecture hours</b><br>68 hrs.  | <b>Practice hours</b><br>0 hrs.                       | <b>Total hours</b><br>68 hrs. |   | <b>Credits</b><br>9 |

## 2.- GENERIC COMPETENCIES

Students solve quantitative and qualitative problems through the interaction of radiant energy with matter. They also solve problems of physical changes and chemical transformations using precise mathematical relationships.

## 3.- SPECIFIC CHARACTERISTICS OF THE COMPETENCIES

|           |   |
|-----------|---|
| Knowledge | Students...<br>... identify the properties of light and classify the electromagnetic spectrum zones.<br>... identify the transitions that matter goes through with the influence of light<br>... identify the UV, Vis and Infrared spectra to analyze them quantitatively and qualitatively, and to analyze the laws that apply in them.<br>... distinguish the theoretical bases of the atomic emission and absorption spectroscopies.<br>... know and apply the mass spectra and nuclear magnetic resonances (NMR) to identify compounds.<br>... know the theoretical bases of X-ray spectrophotometry,<br>... know the theoretical bases of fluorescence, turbidimetry, nephelometry, refractometer and polarimetry. |
| Skills    | ... are able to work autonomously and in teams.<br>... are able to present information and to know the analytical instruments.<br>... handle and distinguish the different spectrophotometries.<br>... identify and apply the different spectra.<br>... relate the interaction of energy with matter.<br>... perform mathematical calculations.<br>... reason   |
| Aptitudes | ... work individually and collectively.<br>... have logical-mathematical reasoning.   |
| Values    | Responsibility, punctuality, honesty, cooperation.  |



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## 4.- TRANSVERSAL COMPETENCIES

|                                     |  |
|-------------------------------------|--|
| <input checked="" type="checkbox"/> | Foreign Language (English)                     |
| <input checked="" type="checkbox"/> | Critical, analytical and synthetic thinking.   |
| <input checked="" type="checkbox"/> | Oral and written expression                    |
| <input checked="" type="checkbox"/> | Professional ethics                            |
| <input checked="" type="checkbox"/> | Administration of human and material resources |
| <input checked="" type="checkbox"/> | Leadership and sustainability                  |
| <input checked="" type="checkbox"/> | Creativity, innovation and entrepreneurship    |
| <input type="checkbox"/>            | Other  |

## 5.- COURSE CONTENT OF THE LEARNING UNIT

1. Ultraviolet visible spectrophotometry
2. Infrared and Raman spectrophotometry
3. Atomic absorption and emission spectrophotometry
4. Mass spectrophotometry
5. Nuclear magnetic resonance spectrophotometry
6. X-ray diffraction spectrophotometry
7. Different instrumental analytical techniques (turbidimetry – nephelometry, refractometer, polarimetry)

## 6.- ASSESSMENT

|                                     |               |
|-------------------------------------|---------------|
| <input checked="" type="checkbox"/> | Numeric grade |
| <input type="checkbox"/>            |               |
| <input type="checkbox"/>            |               |

## 7.- GRADING CRITERIA OF THE LEARNING UNIT

| Indicator of evaluation | Percentage |
|-------------------------|------------|
| Departmental exams      | 30         |
| Partial exam            | 40         |
| Homework                | 10         |
| Research activities     | 10         |
| Practice reports        | 0          |



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|                      |    |
|----------------------|----|
| Class participation  | 10 |
| Other: Presentations | 0  |

## 8.- REQUIRED MATERIAL (for students)

- |                                     |                |
|-------------------------------------|----------------|
| <input checked="" type="checkbox"/> | Calculator     |
| <input checked="" type="checkbox"/> | Periodic table |
| <input type="checkbox"/>            | Lab coat       |
| <input checked="" type="checkbox"/> | Text book      |
| <input type="checkbox"/>            | Workbook       |
| <input type="checkbox"/>            | Other          |



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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   |
|---|---|---|-------------|--|--|--|
| <b>Unit 1:</b><br>Ultraviolet visible spectrophotometry | Students know the fundamentals of the theory of light, its interaction with matter, and the application of UV and Vis spectrophotometries | Theory of light                                       | 2           | Professor...<br>-lectures 3-5 hours<br>- leads a brainstorming activity to enhance the knowledge on the topic. | Students...<br>BEFORE<br>• Read about the topic.<br>DURING<br>• Participate in the brainstorming to contrast and contribute to building knowledge.<br>AFTER<br>• solve problems in teams by searching extra sources of information when necessary. | Daniel C. Harris <i>Análisis Químico Cuantitativo</i> 3rd Edition (sixth original edition) Editorial Reverté<br><br>Francis Rouessac, Annick Rouessac (2003) <i>Análisis Químico (Métodos y Técnicas instrumentales Modernas)</i> Mc Graw Hill/<br><br>Gary D. Christian <i>Química Analítica</i> Mc Graw Hill/Sixth Edition |
|   |   | Transitions   | 2           |  |  |  |
|   |   | UV and Vis. spectra                                   | 2           |  |  |  |
|   |   | Law of spectrophotometry and the effects it produces. | 2           |  |  |  |
|   |   | Application   | 2           |  |  |  |



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|   |   |  |   |  |  |  |
|---|---|--|---|--|--|--|
| <b>Unit 2</b><br>Infrared and Raman spectrophotometry             | Students know the fundamentals of infrared spectrophotometry and identify the organic compounds through IR and raman. | Division of the infrared region.                               | 2 |  |  | Daniel C. Harris <i>Análisis Químico Cuantitativo</i> 3rd Edition (sixth original edition) Editorial Reverté<br><br>Francis Rouessac, Annick Rouessac (2003) <i>Análisis Químico (Métodos y Técnicas instrumentales Modernas)</i> Mc Graw Hill/<br><br>Gary D. Christian <i>Química Analítica</i> Mc Graw Hill/Sixth Edition |
|   |   | Transition and its types                                       | 2 |  |  |  |
|   |   | Infrared spectra and raman to interpret them.                  | 6 |  |  |  |
|   |   |  |   |  |  |  |
| <b>Unit 3</b><br>Atomic absorption and emission spectrophotometry |   | Transitions, stages in the process of absorption and emission. | 2 |  |  | Daniel C. Harris <i>Análisis Químico Cuantitativo</i> 3rd Edition (sixth original edition) Editorial Reverté<br><br>Francis Rouessac, Annick Rouessac (2003) <i>Análisis</i>   |
|   |   | Identifying the atomic spectra of absorption and emission.     | 2 |  |  |  |



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|  |  |  |   |  |  |   |
|--|--|--|---|--|--|---|
|  |  | Attachments used in atomic absorption. | 4 |  |  | <i>Químico (Métodos y Técnicas instrumentales Modernas</i><br>Mc Graw Hill/<br><br>Gary D. Christian<br><i>Química Analítica</i> Mc Graw Hill/Sixth Edition   |
|  |  | Atomic emission equipment.             | 2 |  |  |   |
|  |  |  |   |  |  |   |
| <b>Unit 4.</b><br>Mass spectrophotometry |  |  | 2 |  |  | Daniel C. Harris <i>Análisis Químico Cuantitativo</i> 3rd Edition (sixth original edition) Editorial Reverté<br><br>Francis Rouessac, Annick Rouessac (2003) <i>Análisis Químico (Métodos y Técnicas instrumentales Modernas</i><br>Mc Graw Hill/<br><br>Gary D. Christian<br><i>Química Analítica</i> Mc Graw Hill/Sixth Edition |
|  |  |  | 2 |  |  |   |
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|--|--|---|--|--|--|
| <b>Unit 5.</b><br>Nuclear magnetic resonance spectrophotometry | Identifying NMR process in the molecules.      | 2 |  |  | Daniel C. Harris <i>Análisis Químico Cuantitativo</i> 3rd Edition (sixth original edition) Editorial Reverté<br><br>Francis Rouessac, Annick Rouessac (2003) <i>Análisis Químico (Métodos y Técnicas instrumentales Modernas)</i> Mc Graw Hill/<br><br>Gary D. Christian <i>Química Analítica</i> Mc Graw Hill/Sixth Edition |
|  | Nuclear magnetic resonances (NMR)              | 2 |  |  |  |
|  | Identifying molecules through the NMR spectra. | 4 |  |  |  |
|  | NMR instrumentation                            | 2 |  |  |  |
|  |  |   |  |  |  |
| <b>Unit 6.</b><br>X-ray diffraction spectrophotometry          |  | 2 |  |  | Daniel C. Harris <i>Análisis Químico Cuantitativo</i> 3rd Edition (sixth original edition) Editorial Reverté   |
|  |  | 2 |  |  |  |
|  |  | 4 |  |  |  |
|  |  | 2 |  |  |  |
|  |  |   |  |  |  |



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|   |  |  |    |  |  |   |
|---|--|--|----|--|--|---|
|   |  |  |    |  |  | Francis Rouessac, Annick Rouessac (2003) <i>Análisis Químico (Métodos y Técnicas instrumentales Modernas</i><br>Mc Graw Hill/<br><br>Gary D. Christian<br><i>Química Analítica</i> Mc Graw Hill/Sixth Edition |
| <b>Unit 7</b><br>Different instrumental analytical techniques (turbidimetry – nephelometry, refractometer, polarimetry) |  |  | 10 |  |  |   |
| <b>COURSE EVIDENCES</b><br><b>(Deliverables)</b>  |  |  |    |  |  |   |

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