

UNIVERSITY OF PUERTO RICO AT ARECIBO  
PHYSICS/CHEMISTRY DEPARTMENT  
BACHELOR OF TECHNOLOGY IN INDUSTRIAL CHEMICAL PROCESSES

**Course N°:** QUIM 4011

**Title of Course:** Instrumental Analysis

**Credits:** 3

**Open to:** Industrial Chemical Processes Technology students

**Contact Hours:** 2/weekly

**Pre- requisite:** QUIM 3025

**Textbook:** "Principios de Análisis Instrumental"

**Co-requisite:** QUIM 4012

**Author/s:** Douglas A. Skoog, F. James Holler and Stanley R. Crouch

**Publisher:** Cengage Learning, Mexico

**Publication Year:** 2008

**Other Supplemental Materials:**

- Douglas A. Skoog, Donald M. West, F. James Holler y Stanley R. Crouch. *Química Analítica*, 8va Edición, Cengage Learning, México, 2009.
- Douglas A. Skoog, F. James Holler y Timothy A. Nieman, *Principios de Análisis Instrumental*, 5ta Edición, McGraw-Hill, España, 2001.
- D. Harvey, *Modern Analytical Chemistry*, McGraw-Hill, NY, 2002.
- Judith F. Rubinson and Kenneth A. Rubinson. *Análisis Instrumental*, Pearson Educación, España, 2001.
- <http://latinoamerica.cengage.com/skoog>
- [www.analyticalchemistry.com](http://www.analyticalchemistry.com)
- [www.atomicabsorption.com](http://www.atomicabsorption.com)
- [www.acs-analytical.duq.edu](http://www.acs-analytical.duq.edu)

**Term:** Second Semester

**Course Coordinator:** Dr. Maiella L. Ramos

**Course Description:** Fundamentals of emission and absorption spectra, chromatography and electrochemistry. It includes the study of the instrumentation and analysis methods.

**Course Objectives:**

- Describe the basic concepts of an analytical instrument.
- Describe the advantages and disadvantages of the instrumental methods of analysis.
- Apply the basic concepts that will allow students to select the best instrumental method of analysis for solving an analytical problem.
- Apply the basic concepts and the solution problem skills in the area of instrumental analysis combined with the area of analytical chemistry.
- Present oral reports using materials related to the different instrumental topics.
- Relate the conceptual information with the laboratory work, industrial processes and the chemistry in the environment.

**Relation of Course to Program Objectives:**

1	2	3	4
x	x		

**Relation of Course to Program Outcomes:**

1	2	3	4	5	6	7	8	9	10	11
x	x	x								

**Evaluation/Grade Reporting:** Two (2) partial examinations (100 pts each; 15% ea), Oral presentation (100 pts; 15%), Final exam (100 pts; 15%) and Laboratory (40%).

Topics	Specific Topics	Teaching/Learning Strategies Time Distribution (hours)
<b>1. Introduction to the Chemical Analysis and Basic Concepts of Instrumental Analysis</b>	a. Classification of analytical methods b. Types of instrumental methods c. Basic components of a typical instrument for analysis d. Calibration of instrumental methods e. Selection of an analytical method	Lectures, examples, modules, work in groups, scientific papers (Journal of Chemical Education from the American Chemical Society) (6)
<b>2. Spectrophotometry</b>	a. Properties of the electromagnetic radiation b. Physical processes including emission, absorption, photoluminescence, quimioluminescence among others c. Problem solving relating transmittance (T) and absorbance (A). d. <i>Beer's</i> Law and mathematical problems relating the variables of this law e. Components of a spectrophotometer f. Qualitative and quantitative applications of the UV-Vis spectroscopy g. Infrared (IR) absorption spectroscopy h. IR spectrophotometers i. Atomic absorption (AA) spectroscopy j. Components of AA instruments by flame, electrothermal and cold vapor generation k. Inductively coupled plasma atomic emission spectroscopy (ICP-AES) l. Mass spectrometry	Lectures, examples, modules, work in groups (9)
<b>3. Chromatography</b>	a. Different types of chemical separations b. Basic principles of chromatography c. Problem solving of quantification in chromatography d. Basic instrument of gas chromatography (GC) e. Identification of the chemical substances by the GC method f. Basic instrument of high performance liquid chromatography (HPLC) g. Identification of the chemical substances by the HPLC method	Lectures, examples, modules, work in groups\ (9)
<b>4. Electrochemistry</b>	a. Standard electrode potential based on the <i>Nernst</i> equation b. Ion selective electrodes c. Potentiometry and some of it analytical applications d. Voltametry and some of it analytical applications	Lectures, examples, modules, work in groups (6)
Total		30