DEPARTMENT OF CHEMISTRY

The Department of Chemistry was founded in 1948 and offers a Bachelor of Science degree in Chemistry, which has been fully approved by the American Chemical Society since 1978. The department also offers a graduate program leading to a Doctor of Philosophy degree in Applied Chemistry and a Master of Science degree in Chemistry, the latter since 1959 (see Graduate Catalogue). The Department’s web site: http://www.uprm.edu/quim, offers additional information about the programs and the research interests of the faculty members involved in the program. The Chemistry Department collaborates with the interdisciplinary Master of Science in Food Technology and the Bachelor of Science in Biotechnology programs together with the departments of Chemical Engineering and Biology and the School of Agriculture. The Chemistry Department is the largest service department offering laboratory courses within the University of Puerto Rico system.

The mission of the department is to offer students a program of excellence in chemistry by means of a formal education, research and community service, to enable them to develop as professionals in the various fields of chemistry. Students completing the program are made aware of the problems that affect the Puerto Rican and international communities and of their responsibilities and opportunities as citizens and scientists in areas such as education, industry, government, and scientific research. The Chemistry Department’s Student Affiliate Chapter has been selected by the American Chemical Society’s Department of Educational Activities as outstanding on numerous occasions.

The department is housed in a four-story building (214,000 square feet) with modern facilities for teaching and research. The building has 40 research and 20 teaching laboratories as well as 10 classrooms, a computer center, a visualization center, and cold and dark rooms. Research facilities include a large variety of sophisticated instrumentation, including systems for femtochemistry (laser system), NMR spectroscopy, atomic force microscopy, scanning electron microscopy, and electrochemistry. The department hosts several research groups and two research centers: the Center for Protein Characterization and Function, and the Center for Development of Chemical Sensors. An outreach program, Science on Wheels, is also housed within the departmental facilities.

PROGRAM OF STUDY

BACHELOR OF SCIENCE IN CHEMISTRY

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUIM 3041</td>
<td>General Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>*MATE 3005</td>
<td>Pre-Calculus</td>
<td>5</td>
</tr>
<tr>
<td>*INGL 3—</td>
<td>First year course in English</td>
<td>3</td>
</tr>
<tr>
<td>*ESPA 3101</td>
<td>Basic course in Spanish</td>
<td>3</td>
</tr>
<tr>
<td>HUMA 3111</td>
<td>Intro. to Western Culture I</td>
<td>3</td>
</tr>
</tbody>
</table>

Second Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUIM 3042</td>
<td>General Chemistry II</td>
<td>4</td>
</tr>
<tr>
<td>MATE 3031</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>*INGL 3—</td>
<td>First year course in English</td>
<td>3</td>
</tr>
<tr>
<td>*ESPA 3102</td>
<td>Basic course in Spanish</td>
<td>3</td>
</tr>
<tr>
<td>HUMA 3112</td>
<td>Intro. to Western Culture II</td>
<td>3</td>
</tr>
<tr>
<td>EDFI</td>
<td>Course in Physical Education</td>
<td>1</td>
</tr>
</tbody>
</table>

SECOND YEAR

First Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUIM 3071</td>
<td>Organic Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>CIBI 3031</td>
<td>Intro. to the Biological Sciences I</td>
<td>3</td>
</tr>
<tr>
<td>FIST 3171</td>
<td>Physics I</td>
<td>4</td>
</tr>
<tr>
<td>MATE 3032</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>*INGL 3—</td>
<td>Second year course in English</td>
<td>3</td>
</tr>
</tbody>
</table>

Undergraduate Catalogue 2010-2011
<table>
<thead>
<tr>
<th>Subject</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUIM 3072</td>
<td>Organic Chemistry</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CIBI 3082</td>
<td>Intro. to the Biological Sciences II</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>FISI 3172</td>
<td>Physics II</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>FISI 3173</td>
<td>Physics Laboratory I</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>MATE 3063</td>
<td>Calculus III</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>INGL 3---</td>
<td>Second year course in English</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**Third Year**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUIM 3025</td>
<td>Analytical Chemistry I</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>QUIM 4041</td>
<td>Physical Chemistry</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>FISI 3174</td>
<td>Physics Laboratory II</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>ESPA 3---</td>
<td>Course above level of basic Spanish</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>+Course in Social Sciences</td>
<td>ELECTIVE</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Free Elective</td>
<td></td>
<td>17</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subject</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUIM 3065</td>
<td>Analytical Chemistry II</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>QUIM 4042</td>
<td>Physical Chemistry</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>QUIM 4101</td>
<td>Physical Chemistry Laboratory</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>ESPA 3---</td>
<td>Course above level of basic Spanish</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>EDFI 4---</td>
<td>Course in Physical Education</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>+Course in Social Sciences</td>
<td>ELECTIVE</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Free Elective</td>
<td></td>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>

**Fourth Year**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUIM 4000</td>
<td>Intermediate Inorganic Chemistry</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>QUIM 4007</td>
<td>Inorganic Chemistry</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>QUIM 4102</td>
<td>Physical Chemistry Laboratory</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>QUIM 425</td>
<td>Bibliography and Seminar in Chemistry</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>QUIM 4055</td>
<td>Biochemistry</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ELECTIVE</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subject</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUIM 4015</td>
<td>Instrumental Methods of Analysis</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>ELECTIVE</td>
<td>Professional Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Recommended Elective</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELECTIVE</td>
<td>Free Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ELECTIVE</td>
<td>Free Elective</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

**Total credits required:** 139

*Refer to the Academic Regulations section for information on Advanced Placement.
+Choose any course in Social Sciences: ANTR 3005, ANTR 3015, ANTR/CISO 4066, CISO 301, CISO 3025, CISO 3035, CISO 3095, CISO 3175, CISO 4016, CISO 3036, CISO 4236, CISO 3121-3122, GEOG 3155, GEOG 3185, HIST 3001-3002, SOCI 301, SOCI 3261-3262, SOCI 3315, or ECON 3021-3022, ECON 3091-3092, ECON 4037 or ECON 4056.

**Departmental Faculty**

MARÍA A. APONTE-HUERTAS, Professor, Ph.D., 1982, University of Florida.

MAYRA E. CÁDIZ-GARCÍA, Professor, Ph.D., 1985, University of Puerto Rico.

ARNALDO CARRASQUILLO, Professor, Ph.D., 1995, Texas A&M University.

MIGUEL E. CASTRO, Professor, Ph.D., 1991, University of Texas.

JOSÉ E. CORTÉS, Professor, Ph.D., 1989, University of North Texas.

ASTRID J. CRUZ, Professor, Ph.D., 1993, University of Massachusetts.

MARCO A. DE JESÚS, Associate Professor, Ph.D., 2004, University of Tennessee, Knoxville.

MARITZA DE JESÚS-ECHEVARRÍA, Professor, M.S., 1984, University of Puerto Rico.

SARA DELGADO, Associate Professor, M.S., 1981, University of Puerto Rico.

EMILIO DÍAZ-MORALES, Professor, Ph.D., 1986, University of Wisconsin.
MARÍA GUNTÍN-BURGOS, Associate Professor, M.S., 1991, University of Puerto Rico.

SAMUEL P. HERNÁNDEZ-RIVERA, Professor, Ph.D., 1986, Johns Hopkins University.

AIDALÚ DE LOS A. JOUBERT-CASTRO, Associate Professor, Ph.D., 1998, Washington State University.

JORGE LABOY, Professor, Ph.D., 1993, University of Cincinnati.

GUSTAVO LÓPEZ, Professor, Ph.D., 1992, University of Massachusetts at Amherst.

JUAN LÓPEZ-GARRIGA, Professor, Ph.D., 1986, Michigan State University.

ENRIQUE MELÉNDEZ, Professor, Ph.D., 1990, University of Utah.

NAIRMEN MINA-CAMILDE, Professor, Ph.D., 1996, Baylor University.

LUIS A. MORELL, Professor, Ph.D., 1993, University of California.

YLDÉFONSO MUÑOZ-SOLÁ, Professor, M.S., 1982, Purdue University.

IVELISSE M. PADILLA-VARGAS, Professor, M.S., 1988, University of Puerto Rico.

JOSÉ I. PADOVANI-PADILLA, Professor, M.S., 1972, University of Puerto Rico.

ELSIE PARES, Associate Professor, Ph.D., 2000, Purdue University.

BELINDA PASTRANA, Professor, Ph.D., 1995, Rutgers University.

FRANCIS B. PATRON, Professor, Ph.D., 1997, Purdue University.

DORIS RAMÍREZ-SOTO, Professor, Ph.D., 1989, Rutgers University.

CÉSAR REYES-ZAMORA, Professor, Ph.D., 1969, Ottawa University, Canada.

JORGE RÍOS, Associate Professor, Ph.D., 1991, University of Puerto Rico, Rio Piedras.

ROBERT RÍOS, Professor, Ph.D., 1995, Rutgers University.

LUIS RIVERA, Researcher, Ph.D., 1990, University of Puerto Rico.

NILKA RIVERA-PORTALATÍN, Assistant Professor, Ph.D., 2006, University of Florida.

CYNTHIA ROBLEDO-LUIGGI, Professor, Ph.D., 1981, University of Florida.

LOLITA DE LOS A. RODRÍGUEZ, Professor, M.S., 1986, University of Puerto Rico.

FÉLIX ROMÁN, Professor, Ph.D., 1989, University of Nebraska.

RODOLFO ROMÁNACH, Professor, Ph.D., 1986, University of Georgia.

VERÓNICA SÁNCHEZ, Associate Professor, M.S., 1995, University of Puerto Rico.

ALBERTO SANTANA, Assistant Professor, Ph.D., 2003, University of Florida.

ISMAEL SCOTT, Professor, Ph.D., 1985, University of Florida.

FERNANDO A. SOUTO, Professor, Ph.D., 1978, University of Alberta.

JESSICA TORRES, Assistant Professor, Ph.D., 2004, Johns Hopkins University.

CARMEN A. VEGA-OLIVENCIA, Professor, Ph.D., 1975, University of Florida.

MARISOL VERA, Professor, Ph.D., 1986, Purdue University.

RENÉ S. VIETA-RIVERA, Professor, Ph.D., 1984, Texas A&M University.
COURSES OF INSTRUCTION

Undergraduate Courses

QUIM 3001. GENERAL CHEMISTRY I. Four credit hours. Three hours of lecture and one three-hour laboratory per week.

Basic principles of chemistry; composition, properties, and changes of matter. Topics include: atomic structure, chemical reactions, periodic properties of the elements, stoichiometry chemical bonding, and thermochemistry.

QUIM 3002. GENERAL CHEMISTRY II. Four credit hours. Three hours of lecture and one three-hour laboratory per week. Prerequisite: QUIM 3001.

Basic principles of chemistry; composition, properties, and changes of matter. Topics include: the states of matter, solutions, acid and bases, kinetics, chemical equilibrium, and electrochemistry.

QUIM 3025. ANALYTICAL CHEMISTRY I. Four credit hours. Three hours of lecture and one four-hour laboratory per week. Prerequisite: QUIM 3002 or QUIM 3042.

General concepts of quantitative chemical analysis with emphasis on classical methods including volumetric and gravimetric analysis and chemical equilibria.

QUIM 3041. GENERAL CHEMISTRY I. Four credit hours. Three hours of lecture and one three-hour laboratory per week. Corequisite: MATE 3171 or MATE 3005 or MATE 3143.

Qualitative and quantitative aspects of fundamental chemical principles, emphasizing the relationship between the chemical behavior of matter and its atomic and molecular structure. Topics include dimensional analysis, atomic theory, and stoichiometry.

QUIM 3042. GENERAL CHEMISTRY II. Four credit hours. Three hours of lecture and one three-hour laboratory per week. Prerequisite: QUIM 3041.

Qualitative and quantitative aspects of fundamental chemical principles, emphasizing the relationship between the chemical behavior of matter and its atomic and molecular structure. Topics include colligative properties, chemical kinetics, and chemical equilibrium.

QUIM 3055. ANALYTICAL CHEMISTRY. Four credit hours. Three hours of lecture and one four-hour laboratory per week. Prerequisite: QUIM 3002 or QUIM 3042.

A study of fundamental topics in analytical chemistry. Emphasis will be given to both theory and practice of current instrumental methods of analysis.

QUIM 3061. FUNDAMENTALS OF ORGANIC CHEMISTRY AND BIOCHEMISTRY I. Four credit hours. Three hours of lecture and one four-hour laboratory per week. Prerequisite: QUIM 3002 or QUIM 3042.

Principles of organic chemistry; the chemistry of organic functional groups and reaction mechanisms, emphasizing their importance in biochemistry.

QUIM 3062. FUNDAMENTALS OF ORGANIC CHEMISTRY AND BIOCHEMISTRY II. Four credit hours. Three hours of lecture and one four-hour laboratory per week. Prerequisite: QUIM 3061.

Fundamental concepts of biochemistry; the nature and properties of compounds of biochemical interest.

QUIM 3065. ANALYTICAL CHEMISTRY II. Four credit hours. Three hours of lecture and one four-hour laboratory per week. Prerequisite: QUIM 3025.

Theory and practice of optical spectroscopy, electrometrical methods, and modern separation techniques.

QUIM 3071-3072. ORGANIC CHEMISTRY. Four credit hours. Three hours of lecture and one four-hour laboratory per week per semester. Prerequisite: QUIM 3042 or QUIM 3002. For chemistry majors.

A study of the reactions, methods of preparation and theories on structure of organic compounds, with emphasis on the mechanisms of organic reactions.

QUIM 3085. ENVIRONMENTAL CHEMISTRY. Three credit hours. Three hours of lecture per week. Prerequisite: QUIM 3002 or QUIM 3042.

Effect of man’s activities upon the biosphere, with particular emphasis on the chemistry of the processes involved.
QUIM 3086. ENVIRONMENTAL CHEMISTRY LABORATORY. One credit hour. One four-hour laboratory per week. Prerequisite: QUIM 3055 or QUIM 3065. Corequisite: QUIM 3085.

Environmental chemical analysis providing practical experience in spectrophotometric, titrimetric, potentiometric, and chromatographic procedures used in water, air, and soil analysis. Field trips are required.

QUIM 3131. GENERAL CHEMISTRY I. Three credit hours. Three hours of lecture per week. Corequisites: QUIM 3133 and (MATE 3171 or MATE 3005 or MATE 3143).

Introduction of the fundamental principles of chemistry. Liquids, solids and properties of gases; changes of matter states. Stoichiometry, atomic theory, molecular structure and chemical properties. Periodic classification and the electronic theory of the ionic and covalent bonds.

QUIM 3132. GENERAL CHEMISTRY II. Three credit hours. Three hours of lecture per week. Prerequisite: QUIM 3001 or (QUIM 3131 and QUIM 3133). Corequisite: QUIM 3134.


QUIM 3133. GENERAL CHEMISTRY LABORATORY I. One credit hour. One three-hour laboratory per week. Corequisites: QUIM 3131 and (MATE 3171 or MATE 3005 or MATE 3143 or MATE 3173).

This laboratory responds to the course QUIM 3131 whose description is the following: Introduction of the fundamental principles of chemistry. Liquids, solids and properties of gases; changes of matter status. Stoichiometry, atomic theory, molecular structure and chemical properties. Periodic classification and the electronic theory of the ionic and covalent bonds.

QUIM 3134. GENERAL CHEMISTRY LABORATORY II. One credit hour. Three hours of laboratory per week. Prerequisite: QUIM 3001 or QUIM 3133. Corequisite: QUIM 3132.

This laboratory responds to the course QUIM 3132 whose description is the following: Introduction to thermodynamics, solutions, kinetics, chemical equilibrium, oxidation-reduction. Electrochemistry.

QUIM 3141. PRINCIPLES OF GENERAL, ORGANIC AND BIOLOGICAL CHEMISTRY I. Four credit hours. Three hours of lecture and one two-hour laboratory per week.

Principles of organic and biochemistry with emphasis on biological applications. Topics include: atoms, molecules, chemical equations, states of matter, solutions, kinetics and equilibrium.

QUIM 3142. PRINCIPLES OF GENERAL, ORGANIC AND BIOLOGICAL CHEMISTRY II. Four credit hours. Three hours of lecture and one two-hour laboratory per week. Prerequisite: QUIM 3141.

Principles of organic and biochemistry with emphasis on biological applications. Topics include: organic functional groups, carbohydrates, lipids, proteins, enzymes, and nucleic acids.

QUIM 3335. INTRODUCTION TO FOOD CHEMISTRY. Three credit hours. Three hours of lecture per week. Prerequisites: QUIM 3002 or QUIM 3042.

Basic aspects of the relationships of food chemistry to health, nutrition, and industry.

QUIM 3450. FUNDAMENTALS OF ORGANIC CHEMISTRY. Five credit hours. Four hours of lecture and one four-hour laboratory per week. Prerequisite: QUIM 3002 or QUIM 3042.

Properties, reactions, synthesis, and reaction mechanisms of organic compounds.

QUIM 3461. ORGANIC CHEMISTRY I. Three credit hours. Three hours of lecture per week. Prerequisite: QUIM 3002

Nomenclature, structure, preparation, and reactions of non-aromatic and alkyl halides.

QUIM 3462. ORGANIC CHEMISTRY LABORATORY I. One credit hour. One four-hour laboratory per week. Corequisite: QUIM 3461.

Experimental techniques in organic chemistry: separation; purification; reactions of nonaromatic hydrocarbons and alkyl halides; polarimetry.
**QUIM 3463. ORGANIC CHEMISTRY II.** Three credit hours. Three hours of lecture per week. Prerequisite: QUIM 3461.

Nomenclature, structure, preparation, and reactions of aromatic hydrocarbons, alcohols, ethers, carbonyl compounds, carboxylic acids, amines, and related compounds; biological compounds.

**QUIM 3464. ORGANIC CHEMISTRY LABORATORY II.** One credit hour. One four-hour laboratory per week. Prerequisite: QUIM 3462. Corequisite: QUIM 3463.

Experimental techniques in organic chemistry: identification and preparation of organic compounds; spectroscopy.

**QUIM 4000. INTERMEDIATE INORGANIC CHEMISTRY.** Three credit hours. Three hours of lecture per week. Prerequisite: QUIM 4041.

A study of the elements and their inorganic compounds based on modern concepts of atomic and molecular structure.

**QUIM 4007. INORGANIC CHEMISTRY LABORATORY.** One credit hour. Four hours of laboratory per week. Corequisite: QUIM 4000.

Inorganic chemistry laboratory including synthesis of inorganic compounds and the study of their spectroscopic properties.

**QUIM 4015. INSTRUMENTAL METHODS OF ANALYSIS.** Four credit hours. Three hours of lecture and one four-hour laboratory per week. Prerequisite: QUIM 3065.

Theory and practice of atomic and molecular spectroscopic methods, mass spectrometry, ion and surface science techniques, and current topics in instrumental analytical chemistry.

**QUIM 4026. HISTORY OF CHEMISTRY.** Three credit hours. Three hours of lecture per week. Prerequisite: QUIM 3002 or QUIM 3042.

The development of Chemistry from antiquity to the present time with an emphasis on the critical analysis of its concepts.

**QUIM 4040. PRINCIPLES OF PHYSICAL CHEMISTRY.** Three credit hours. Three hours of lecture per week. Prerequisite: (QUIM 3002 or QUIM 3132 or QUIM 3042) and (MATE 3022 or MATE 3031) and (FISI 3152 or FISI 3172).

Study of the principles of classical thermodynamics, chemical kinetics, and quantum chemistry directed toward strengthening the teaching of secondary school chemistry.

**QUIM 4041. PHYSICAL CHEMISTRY I.** Three credit hours. Three hours of lecture per week. Prerequisites: (QUIM 3002 or QUIM 3042) and (FISI 3151 or FISI 3171). Corequisite: MATE 3063 or MATE 3048.

Fundamentals and laws of classical thermodynamics applied to ideal and real gases, phase equilibrium, chemical equilibrium, heterogeneous equilibrium of binary systems, and solutions.

**QUIM 4042. PHYSICAL CHEMISTRY II.** Three credit hours. Three hours of lecture per week. Prerequisites: QUIM 4041 and (MATE 3063 or MATE 3048).

Chemical kinetics, molecular kinetic theory of gases, introduction to quantum mechanics and its application to vibrational, rotational, and electronic spectroscopy.

**QUIM 4055. INTRODUCTION TO BIOCHEMISTRY.** Three credit hours. Three hours of lecture per week. Prerequisites: QUIM 3072 or QUIM 3450 or QUIM 3463.

Fundamental basics of structure, conformation and function of biological molecules. Design and organization of vital processes.

**QUIM 4057. PHYSICAL CHEMISTRY: APPLICATIONS TO BIOTECHNOLOGY.** Four credit hours. Four hours of lecture per week. Prerequisite: MATE 3032 and (QUIM 3042 or QUIM 3002) and (FISI 3152 or FISI 3162 or FISI 3172).

Study of the principles and applications of physical chemistry that are used to solve problems in biotechnology. Fundamental concepts of classical thermodynamics, chemical kinetics, quantum mechanics, and spectroscopy and their application to biological problems.

**QUIM 4101. PHYSICAL CHEMISTRY LABORATORY I.** One credit hour. One four-hour laboratory per week. Prerequisites: QUIM4041 and (QUIM3055 or QUIM3025).

Experimental determination of thermodynamic properties such as vapor pressure, partial molar volume, enthalpy of reaction, heat capacity, eutectic composition, and equilibrium constants.
QUIM 4102. PHYSICAL CHEMISTRY LABORATORY II. One credit hour. One four-hour laboratory per week. Prerequisite: QUIM 4101. Corequisite: QUIM 4042.

Use of spectroscopic, kinetic, electrochemical, surface, polarimetric, and computational methods to determine physical and chemical properties.

QUIM 4115. PRACTICE TEACHING IN THE CHEMISTRY LABORATORY. One credit hour. Four hours of practice per week. Prerequisites: (QUIM 3072 or QUIM 3032 or QUIM 3450 or QUIM 3463) or (QUIM 3025 or QUIM 3055) and authorization of the Director of the Department.

Training in the teaching of chemistry, organization of a laboratory, handling of chemicals, care of equipment, safety rules and supervision of experimental and written work.

QUIM 4125. BIBLIOGRAPHY AND SEMINAR IN CHEMISTRY. Two credit hours. Two ninety-minute periods per week. Prerequisite: twenty credit hours of chemistry.

Techniques of searching the chemical literature. The student will give a short oral presentation on a recently published paper, and prepare and discuss a review paper on a topic selected by him and approved by the instructor.

QUIM 4137. INDUSTRIAL CHEMISTRY. Three credit hours. Three hours of lecture per week. Prerequisite: QUIM 3032 or QUIM 3072 or QUIM 3450 or QUIM 3062 or QUIM 3463.

Chemical principles related to industrial processes, especially those being carried out in Puerto Rico. Field trips required.

QUIM 4145. PRACTICE IN INDUSTRIAL CHEMISTRY. One credit hour. One laboratory of four to six hours per week. Prerequisite: authorization of the Director of the Department.

Practical experience in Industrial Chemistry in cooperation with private industry or government.

QUIM 4399. SELECTED TOPICS IN CHEMISTRY. One to three credit hours. One to three hours of lecture per week. Prerequisite: third or fourth year student in Chemistry, or authorization of the Director of the Department.


QUIM 4997. CO-OP PRACTICE. Three to six credit hours. Prerequisite: authorization of the Director of the Department.

Practical experience in chemistry in cooperation with industry or government agencies, jointly supervised by the Department, the COOP Program Coordinator, and an official from the cooperating organization.

QUIM 4998. UNDERGRADUATE RESEARCH I. One to three credit hours. Three to nine hours of research per week. Prerequisite: Authorization of the Director of the Department.

Introduction to chemical research under the supervision of professors of the department.

QUIM 4999. UNDERGRADUATE RESEARCH II. One to three credit hours. Three to nine hours of research per week. Prerequisite: three credits in QUIM 4998.

A research project under the supervision of professors of the department.

Advanced Undergraduate and Graduate Courses

QUIM 5065. CHEMISTRY OF SYNTHETIC DRUGS. Three credit hours. Three hours of lecture per week. Prerequisite: QUIM 3032 or QUIM 3072 or QUIM 3450 or QUIM 3463 or authorization of the Director of the Department.

The chemistry of synthetic organic compounds of medical and physiological interest. Topics to be covered will include anesthetics, antispasmodics, antipyretics, analgesics, hypnotics, sedatives, anticonvulsants, anticoagulants, antihistamines, tranquilizers, antimalarials, and anthelmintics.

QUIM 5066. TOXICOLOGICAL CHEMISTRY. Three credit hours. Three hours of lecture per week. Prerequisite: QUIM 3032 or QUIM 3072 or QUIM 3450 or QUIM 3062 or QUIM 3463 or authorization of the Director of the Department.

Chemical properties, reactions, origin, and the use of toxic substances, including chemical aspects of their effects upon biological systems, and their transformation and elimination.
QUIM 5071. GENERAL BIOCHEMISTRY I.
Three credit hours. Three hours of lecture per week. Prerequisite: QUIM 3463 or QUIM 3072 or QUIM 3450 or QUIM 3062 or authorization of the Director of the Department.

Chemical characterization of proteins, carbohydrates, lipids, and nucleic acids; principles of enzymology and bioenergetics; biological membranes and transport; recombinant DNA techniques; biological oxidations.

QUIM 5072. GENERAL BIOCHEMISTRY II.
Three credit hours. Three hours of lecture per week. Prerequisite: QUIM 5071.

Biosynthesis and biodegradation of carbohydrates, lipids, amino acids, and nucleic acids; integration and regulation of animal metabolism; chemistry of generic expression and regulation.

QUIM 5073. GENERAL BIOCHEMISTRY LABORATORY I. One credit hour. One four-hour laboratory per week. Corequisite: QUIM 5071.

Isolation and characterization of proteins, lipids, and nucleic acids; enzymatic processes; the use of recombinant DNA techniques.

QUIM 5074. GENERAL BIOCHEMISTRY LABORATORY II. One credit hour. Four hours laboratory per week. Corequisite: MATE 3021 or MATE 3031 or MATE 3144 or MATE 3183.

The use of bioinformatics, structural genomics, and the molecular modeling in the spectroscopic characterization and analysis of biological molecules.

QUIM 5085. FOOD CHEMISTRY. Four credit hours. Three hours of lecture and four hours of laboratory per week. Prerequisite: QUIM 3072 and (QUIM 3463 or QUIM 3062) or authorization of the Director of the Department.

A study of the chemistry of the principal food resources and food additives, their role in nutrition, and the effect of processing treatments on their chemical composition.

QUIM 5095. NUCLEAR CHEMISTRY. Three credit hours. Three hours of lecture per week. Prerequisites: (QUIM 3002 or QUIM 3042) and (MATE 3183 or MATE 3031 or MATE 3144).

A course describing the fundamental concepts of nuclear science. Selected topics on nuclear properties, nuclear forces and structure, radioactivity, mathematical relations of radioactive decay, statistics, nuclear reactions, effects of nuclear radiations and transitions, application of nuclear phenomena to chemistry and other related fields.

QUIM 5105. PRINCIPLES OF QUANTUM CHEMISTRY. Three credit hours. Three hours of lecture per week. Prerequisite: QUIM4042 or authorization of the Director of the Department.

Conceptual development, postulates, and models of quantum mechanics. Approximation methods to the solution of the time-independent Schrödinger equation.

QUIM 5125. CHEMICAL THERMODYNAMICS.
Three credit hours. Three hours of lecture per week. Prerequisite: QUIM 4042 or authorization of the Director of the Department.

Systematic analysis of the fundamental concepts of chemical thermodynamics and their applications.

QUIM 5135. PHYSICAL ORGANIC CHEMISTRY.
Three credit hours. Three hours of lecture per week. Prerequisites: QUIM 4042 and QUIM 3032 or QUIM 3072 or QUIM 3450 or QUIM 3463.

A mathematical and quantitative study of organic chemical phenomena. Applications of modern theoretical concepts to the chemical and physical properties of organic compounds, and to the kinetics and mechanisms of organic reactions.

QUIM 5145. HETEROCYCLIC COMPOUNDS.
Three credit hours. Three hours of lecture per week. Prerequisite: QUIM 3032 or QUIM 3072 or QUIM 3450 or QUIM 3463 or authorization of the Director of the Department.

Structure, synthesis, and reactions of ring systems containing other atoms besides carbon. Alkaloids will be given special consideration.

QUIM 5150. SPECTROSCOPIC IDENTIFICATION OF ORGANIC COMPOUNDS. Three credit hours. Three hours of lecture per week. Prerequisite: QUIM 3032 or QUIM 3072 or QUIM 3450 or QUIM 3463 or authorization of the Director of the Department.

Elucidation of the structure of organic compounds by spectroscopic methods, including infrared, ultraviolet, nuclear magnetic resonance, and mass spectrometry techniques.