

# CHEMISTRY

Professors: Gerald Caple\*, *Chairperson*; Peter L. Hamlet\*, Robert R. Pavlis\*  
Associate Professors: William M. Shirley\*, Khamis S. Siam\*  
Assistant Professors: James McAfee\*, Dilip K. Paul\*  
Lecturer: Irene Zegar

\*Graduate Faculty

Telephone: 316-235-4748

## Degree Programs

### Undergraduate

Bachelor of Science Degree with a Major in Chemistry

Bachelor of Science in Education Degree with a  
Major in Chemistry

### Graduate

Master of Science Degree with a Major in Chemistry

Specialist in Education Degree with a Major in  
Teaching (Chemistry)

## Baccalaureate Degrees

The Bachelor of Science degree with a major in chemistry is available in two options. Option I is an American Chemical Society approved degree plan. Option II is designed for dual majors or for a major with a specific emphasis. Both degree plans are designed to prepare students for professional careers. The Option I major is for students desiring a professional career in chemistry, but is also useful as a pre-medical, pre-dental degree program. The Option II major also prepares students for professional careers. As a major program, it can be used for pre-medicine, pre-veterinarian, pre-dentistry, pre-pharmacy, or pre-physical therapy. This degree plan can also be used as part of a dual major program. The Option II degree plan allows a more directed program with proper selection of electives from other departments; possible emphases are biochemistry, polymer science, or environmental science.

The Bachelor of Science in Education with a major in chemistry is designed for the student desiring to prepare for secondary level chemistry teaching.

## Other Professional Programs

The Department of Chemistry offers pre-professional work in pharmacy, medical and health sciences, chemical engineering, metallurgical engineering, petroleum engineering, and nuclear engineering. Details concerning these programs can be obtained from the department.

Five-year cooperative programs (3, 2) have been established with KSU and KU whereby students can earn a B.S. degree in chemistry at Pittsburg State University and a second B.S. in chemical, petroleum, or nuclear engineering. Details concerning these degrees can be obtained from the Department of Chemistry.

The University's requirements for all baccalaureate degrees can be found on page 46, for the master's degree on page 60, and the Specialist in Education degree on page 64.

## Bachelor of Science, Major in Chemistry

The Bachelor of Science degree in chemistry may be completed under either Option I or Option II as outlined below.

### Option I. (American Chemical Society approved degree)

<i>General Education Component*</i>	<i>Hours</i>
Basic Skills**	15
Core Courses	17
Natural Sciences**	8
Languages and Cultures	3
Fine Arts	3
Economy and Society	3
	<b>49</b>

\*See "General Education Requirements for All Degrees", page 47, for specific areas and courses.

\*\*MATH 150, PHYS 104/130 and computing courses required in the professional component will fulfill a part of each of these requirements.

### *Professional Studies Component*

<i>Chemistry</i>	
CHEM 215/216 General Chemistry/Laboratory	5
CHEM 225/226 General Chemistry and Qualitative Analysis/Laboratory	5
CHEM 325/326 Organic Chemistry I/Laboratory	5
CHEM 335/336 Organic Chemistry II/Laboratory II	5
CHEM 445/446 Analytical Chemistry/Laboratory	5
CHEM 593/594 Physical Chemistry I/Laboratory I	5
CHEM 595 Physical Chemistry II	3
CHEM 596 Advanced Inorganic-Physical Chemistry Laboratory	2
CHEM 601 Chemistry Colloquium	1
CHEM 623 Inorganic Chemistry	3
CHEM 645/646 Instrumental Analysis/Laboratory	5
Chemistry electives chosen from:	6
CHEM 620/621 Polymer Chemistry/Laboratory	3-5
CHEM 699 Senior Research in Chemistry	1-3
CHEM 773/774 Biochemistry II/Laboratory	3-5
CHEM 793 Advanced Physical Chemistry	3
	<b>50</b>

### *Other*

PHYS 104/130 Engineering Physics I/Elementary Physics Laboratory I	5
PHYS 105/131 Engineering Physics II/Elementary Physics Laboratory II	5
MATH 150 Calculus I through MATH 253 Calculus III	13
A programming course in computing selected from:	
CSIS 121 Programming in BASIC or	
CSIS 225 Computer Applications for Science and Technology or	
CSIS 235 Pascal or	
CSIS 240 C++ Programming	3
	<b>26</b>

The student may substitute three hours of advanced mathematics or physics for three hours of advanced chemistry with the approval of the department.

A minor is required with this major and a minor in mathematics is recommended.

The degree requirements for a Bachelor of Science degree with a major in chemistry requires a minimum of 124 semester hours.

Students majoring in chemistry may complete the last 34 hours of their degree at an accredited school of engineering, provided a cooperative program leading to both a B.S. degree in chemistry and B.S. degree in engineering has been established by both schools.

**Option II.** (Can be obtained with a Biochemistry, Polymer, Pre-Medical, or Environmental emphasis).

*General Education Component\**

Basic Skills**.....	15
Core Courses.....	17
Natural Sciences**.....	8
Languages and Cultures.....	3
Fine Arts.....	3
Economy and Society.....	3
	49

\*See "General Education Degree Requirements for All Baccalaureate Degrees", page 47, for specific areas and courses.

\*\*MATH 150 and PHYS 104/130 courses required in the professional component will partially fulfill these requirements.

*Professional Studies Component*

<i>Chemistry</i>		<i>Hours</i>
CHEM 215/216	General Chemistry/Laboratory .....	5
CHEM 225/226	General Chemistry and Qualitative Analysis/Laboratory.....	5
CHEM 325/326	Organic Chemistry I/Laboratory .....	5
CHEM 335/336	Organic Chemistry II/Laboratory .....	5
CHEM 445/446	Analytical Chemistry/Laboratory*.....	5
CHEM 593/594	Physical Chemistry I/Laboratory .....	5
CHEM 601	Chemistry Colloquium.....	1
	Elective in advanced chemistry.....	3
		34

*Other*

PHYS 104/130	Engineering Physics I/Elementary Physics Laboratory I.....	5
PHYS 105/131	Engineering Physics II/Elementary Physics Laboratory II.....	5
Math 150	Calculus I.....	5
		15

\*For some Option II majors, a substitution for Analytical Chemistry is suggested.

Option II Chemistry majors may select courses necessary for specialized careers. A minor or a second major is required for the Option II Chemistry major, several possible suggested programs of study are listed.

*Biochemistry*

The Option II major with an emphasis in Biochemistry can be done by substituting CHEM 575 Biochemistry I and CHEM 576 Biochemistry I Laboratory for the analytical chemistry. CHEM 773 Biochemistry II and CHEM 774 Biochemistry II Laboratory would be selected as the advanced elective. A Biology minor designed to complement this major should be selected or is highly recommended. An undergraduate research experience in this area is highly recommended.

*Pre-Medicine/Pre-Medical Profession*

The chemistry electives chosen for the Option II major should be CHEM 773 Biochemistry II and CHEM 774 Biochemistry II Laboratory. The suggested minor or second major should be chosen from Biology. All prospective pre-medicine students should see a Chemistry Department Pre-Medicine Advisor prior to their first registration. This program is also designed for pre-dental, pre-physical therapy, pre-veterinary and other medically related programs.

*Environmental Chemistry*

The chemistry electives chosen for the Option II major should be CHEM 645 Instrumental Analysis and CHEM 646 Instrumental Analysis Laboratory. An appropriate minor or second major should be chosen from Engineering Technology or Biology. A course in Statistics is highly recommended. An undergraduate research experience in analytical chemistry is highly recommended.

*Polymer Chemistry*

The chemistry electives chosen for the Option II major should be CHEM 620 Polymer Chemistry and CHEM 621 Polymer Chemistry Laboratory. If an advanced polymer course and laboratory is offered it may be used as a substitute for the analytical chemistry course. The suggested minor or second major should be selected from Plastics Engineering Technology.

*Chemical Sales and Service*

The chemistry elective(s) should be chosen to best fit the desired career. A minor in economics or business administration or a second major in economics, marketing, or management is suggested. Due to the growth of multi-national corporations and the increased interest in international trade, students selecting this career goal should strongly consider foreign language courses when selecting electives in the area of languages and cultures.

The Bachelor of Science degree with a major in chemistry requires a minimum of 124 semester hours.

**Bachelor of Science in Education,  
Major in Chemistry**

*General Education Component\**

All students preparing to teach must meet the general education requirements for all baccalaureate degrees as well as the requirements for teacher certification. The following plan will satisfy both requirements.

Basic Skills**.....	18
Core Courses.....	17
Natural Sciences**.....	8
Languages and Cultures.....	3
Fine Arts.....	3
Economy and Society .....	3
	52

\*See "General Education Degree Requirements for Students Preparing to Teach Secondary School", page 48, for specific areas and courses. Also see scholastic achievement requirements on common core courses for admission to teacher education for secondary teaching majors, page 174.

\*\*MATH 150, BIOL 111/112 or 113/114, PHYS 104/130 and computing courses required in the professional components will partially fulfill these requirements.

*Professional Studies Component*

In addition to the professional education courses listed in (1), the student must complete the courses for the teaching specialty listed in (2).

(1) Teaching and learning theory with laboratory and clinical experience

CURIN 305	Explorations in Education***.....	2
CURIN 306	Pre-Professional Laboratory I*** .....	1

PSYCH 263 Developmental Psychology .....	3
PSYCH 357 Educational Psychology.....	3
CHEM 479 Techniques for Teaching Chemistry.....	3
SSLS 510 Overview of Education for Exceptional Students.....	3
CURIN 520 Middle and Secondary Reading.....	18

\*\*\*Concurrent enrollment required in CURIN 305 and 306.

*Professional Semester (Sr. year)*

CURIN 458 Methods and Curriculum.....	3
CURIN 462 Secondary and Middle Level Education.....	2
CURIN 464 Foundations of Measurement and Evaluation.....	2
CURIN 480 Supervised Teaching in the Secondary School.....	3
CURIN 482 Supervised Teaching in the Secondary School.....	5
CHEM 579 Supervised Student Teaching and Follow-up of Students .....	2
	17

(2) Content for the teaching specialty

<i>Chemistry</i>	
CHEM 215/216 General Chemistry/Laboratory .....	5
CHEM 225/226 General Chemistry and Qualitative Analysis/Laboratory.....	5
CHEM 325/326 Organic Chemistry I/Laboratory .....	5
CHEM 335/336 Organic Chemistry II/Laboratory .....	5
CHEM 445/446 Analytical Chemistry/Laboratory .....	5
CHEM 593/594 Physical Chemistry I/Laboratory .....	5
CHEM 601 Chemistry Colloquium.....	1
	31

*Other*

MATH 150 Calculus I.....	5
PHYS 104/130 Engineering Physics I/Elementary Physics Laboratory I .....	5
PHYS 105/131 Engineering Physics II/Elementary Physics Laboratory II .....	5
PHYS 101/131 College Physics II*/Elementary Physics Laboratory II.....	5
A programming course in computing selected from:	
CSIS 121 Programming in BASIC or	
CSIS 225 Computer Applications for Science and Technology or	
CSIS 235 Pascal or	
CSIS 240 C++ Programming.....	3
BIOL 111/112 General Biology/Laboratory or	
BIOL 113/114 Environmental Life Science/Laboratory.....	5
	23

\*Engineering Physics is recommended and required for physics certification or additional study in chemistry.

A minor is required. Either biology or mathematics is recommended.

The Bachelor of Science in Education degree requires a minimum of 124 semester hours.

Students planning to teach should become familiar with the current Regulations for Certifying School Personnel, issued by The State Board of Education. Information concerning these regulations may be obtained from the Dean of the College of Education, 115 Hughes Hall, Pittsburg State University.

**Minor Sequences**

Applicable to Bachelor of Arts, Bachelor of Science and Bachelor of Science in Education degrees.

**Minor in Chemistry**

At least 20 semester hours in chemistry. Students may not count both CHEM 105/106 Introductory Chemistry/ Laboratory and CHEM 215/216 General Chemistry/Laboratory or both CHEM 320/326 Introductory Organic Chemistry/Laboratory and CHEM 325/326 Organic Chemistry I/ Laboratory, no geology courses toward the 20 semester hours.

**Minor in Physical Science**

See Physics, page 138 for requirements.

**Second Teaching Option in Physical Science**

**Content for the Teaching Specialty: Physical Science**

(a) Chemistry.....	15
CHEM 215/216 General Chemistry/Laboratory.....	5
CHEM 225/226 General Chemistry and Qualitative Analysis/Laboratory.....	5
CHEM 320/326 Introductory Organic Chemistry/Laboratory.....	5
(b) Physics.....	22
PHYS 100/130 College Physics I/Elementary Physics Laboratory I or	
PHYS 104/130 Engineering Physics I/Elementary Physics Laboratory I.....	5
PHYS 101/131 College Physics II/Elementary Physics Laboratory II or	
PHYS 105/131 Engineering Physics II/Elementary Physics Laboratory II.....	5
PHYS 160 Physical Geology .....	3
PHYS 516 Modern Physics and PHYS 530 Intermediate Physics Laboratory ( ) or PHYS 532 Electronic Circuits I.....	6
PHYS 575 Introductory Astrophysics or	
PHYS 175 Descriptive Astronomy .....	3
(c) Mathematics.....	7
MATH 150 Calculus I.....	5
MATH 212 Matrix Algebra.....	2
(d) A programming course in computing selected from:	
CSIS 121 Programming in BASIC or	
CSIS 225 Computer Applications for Science and Technology or	
CSIS 235 Pascal or	
CSIS 240 C++ Programming.....	3
	47

NOTE: The general education degree requirement in biological science for students wishing to certify for a second teaching option in physical science must be met with BIOL 111/112 General Biology/Laboratory.

**Second Teaching Option in Chemistry**

Those persons interested in chemistry as a second teaching option should contact the chairperson of the Department of Chemistry or the Certification Officer in the College of Education, 115 Hughes Hall, for specific requirements.

**Master of Science, Major in Chemistry**

The Master of Science degree with a major in chemistry is available in two options. Option I, a thesis program, is designed to prepare students for advanced professional careers. The Option II program is designed to prepare students for advanced technical positions in chemistry, chemical technology or chemical related industry.

Candidates for the master's degree should have completed college programs comparable to the undergraduate majors offered by this department. The department's graduate faculty will act as a committee for the purpose of planning, approving, and monitoring each graduate student's program. Only senior-graduate and graduate courses in chemistry may be used to meet the degree requirements; however, credit in senior-graduate and graduate courses in other disciplines may be substituted if approved by the chemistry department's graduate faculty.

At least one three-hour graduate level course must be completed in physical chemistry and two three-hour graduate level courses must be completed from other major sub-disciplines of chemistry: analytical, biological, computational, inorganic or organic chemistry. Enrollment and participation in Colloquium is required every semester in the M.S. program. In the last semester of enrollment in an M.S. program, CHEM 895 Comprehensive Reviews in Chemistry is required. All M.S. candidates will participate in departmental safety programs.

**Option I**

Graduates from this program are prepared for professional

careers as chemists in research or industrial settings, or to continue graduate study at Ph. D. granting universities.

The degree requires the completion of 31 semester hours (including six hours of CHEM 890 Research and Thesis), a formal oral defense, and an approved thesis.

### Option II (Technical Emphasis)

This program is designed to prepare the graduate for a position in a chemical or chemistry related industry. The degree requires the completion of 33 semester hours, including six hours of CHEM 891 Research Problems, with a written report and an oral presentation.

### Option II (Teaching Emphasis)

Secondary school science teachers electing this program will complete 33 semester hours with a minimum of three semester hours in CHEM 891 Research Problems.

## Specialist in Education, Major in Chemistry

The degree of Specialist in Education with chemistry as the major teaching field for secondary and community college teachers is offered by the Department of Special Services and Leadership Studies in cooperation with the Department of Chemistry. Details concerning these degrees are available from the Department of Chemistry.

## DESCRIPTION OF COURSES

### UNDERGRADUATE

**CHEM 105. Introductory Chemistry.** 3 hours. Introduction to general chemistry. Designed for non-majors, students without previous chemistry, and as a preparation for CHEM 215 General Chemistry. Descriptive chemistry with elementary chemical explanation. Prerequisite: High School Algebra or equivalent. Prerequisite or Corequisite: CHEM 106 Introductory Chemistry Laboratory.

**CHEM 106. Introductory Chemistry Laboratory.** 1 hour. Experiments to accompany CHEM 105 Introductory Chemistry. One two-hour laboratory session per week. Prerequisite or Corequisite: CHEM 105 Introductory Chemistry.

**CHEM 215. General Chemistry.** 3 hours. An introduction to calculations, atomic structure, atomic periodicity, molecular bonding, chemical reaction and gases. An introductory course for students planning a science major. Prerequisite: Score of 20 on ACT or College Algebra or CHEM 105 Introductory Chemistry. Prerequisite or Corequisite: CHEM 216 General Chemistry Laboratory.

**CHEM 216. General Chemistry Laboratory.** 2 hours. Experiments to accompany CHEM 215 General Chemistry. Four hours of laboratory per week. Prerequisite or Corequisite: CHEM 215 General Chemistry.

**CHEM 225. General Chemistry and Qualitative Analysis.** 3 hours. A continuation of CHEM 215 General Chemistry. Introduction to acid bases, thermodynamics, solutions, equilibria, and modified schematic of qualitative analysis. Prerequisite: CHEM 215 General Chemistry. Prerequisite or Corequisite: CHEM 226 General Chemistry and Qualitative Analysis Laboratory.

**CHEM 226. General Chemistry and Qualitative Analysis Laboratory.** 2 hours. Experiments to accompany CHEM 225 General Chemistry and Qualitative Analysis. Four hours of laboratory per week. Prerequisite or Corequisite: CHEM 225 General Chemistry and Qualitative Analysis.

**CHEM 299. Sophomore Research in Chemistry.** 1-3 hours. Research problems in chemistry. Prerequisite: Approval of instructor.

**CHEM 320. Introductory Organic Chemistry.** 3 hours. Survey of organic chemistry, structure, nomenclature, reactions, biomolecules, and polymers. Three lectures per week. Not open to students with credit in CHEM 325 Organic Chemistry I. Prerequisites: CHEM 105 Introductory Chemistry or CHEM 215 General Chemistry. Prerequisite or Corequisite: CHEM 326 Organic Chemistry Laboratory.

**CHEM 325. Organic Chemistry I.** 3 hours. Introduction to organic bonding, structure, nomenclature, mechanisms and reactions. Prerequisite: CHEM 215 General Chemistry. CHEM 225 General Chemistry and Qualitative Analysis is strongly recommended. Prerequisite or Corequisite: CHEM 326 Organic Chemistry Laboratory.

**CHEM 326. Organic Chemistry Laboratory.** 2 hours. Experiments to accompany CHEM 325 Organic Chemistry I. Four hours of laboratory per week. Prerequisite or Corequisite: CHEM 325 Organic Chemistry I or CHEM 320 Introductory Organic Chemistry.

**CHEM 335. Organic Chemistry II.** 3 hours. A continuation of CHEM 325 Organic Chemistry I, including organic synthesis and the organic chemistry of bio molecules. Prerequisite: CHEM 325 Organic Chemistry I. Prerequisite or Corequisite: CHEM 336 Organic Chemistry II Laboratory. May be taken for honors.

**CHEM 336. Organic Chemistry II Laboratory.** 2 hours. Experiments to accompany CHEM 335 Organic Chemistry II. Four hours of laboratory per week. Prerequisite or Corequisite: CHEM 335 Organic Chemistry II. May be taken for honors.

**CHEM 399. Junior Research in Chemistry.** 1-3 hours. Research problems in chemistry. May be taken for honors. Prerequisite: Approval of instructor.

**CHEM 413. Selected Topics in Chemistry.** 2 or 3 hours. Lecture, laboratory, or seminar study of specific topics in chemistry. Prerequisites: 15 hours of chemistry and permission of instructor.

**CHEM 445. Analytical Chemistry.** 3 hours. Fundamental principles of gravimetric, volumetric, spectroscopic, chromatographic, and electrochemical analysis. Prerequisite: CHEM 225 General Chemistry and Qualitative Analysis. Prerequisite or Corequisite: CHEM 446 Analytical Chemistry Laboratory.

**CHEM 446. Analytical Chemistry Laboratory.** 2 hours. Experiments to accompany CHEM 445 Analytical Chemistry. Four hours of laboratory per week. Prerequisite: CHEM 226 General Chemistry and Qualitative Analysis Laboratory. Prerequisite or Corequisite: CHEM 445 Analytical Chemistry.

**CHEM 575. Biochemistry I.** 3 hours. The structure and function of enzymes and other proteins. The major metabolic pathways of carbohydrates, lipids, amino acids and nucleic acids. Prerequisites: CHEM 320 Introductory Organic Chemistry or CHEM 335 Organic Chemistry II.

**CHEM 576. Biochemistry I Laboratory.** 2 hours. Biochemistry laboratory experiments to complement CHEM 575 Biochemistry I. Prerequisite or corequisite: CHEM 575 Biochemistry I.

**CHEM 593. Physical Chemistry I.** 3 hours. An introduction to physical chemistry with an emphasis on thermodynamics. Prerequisites: CHEM 225 General Chemistry and Qualitative Analysis, PHYS 105 Engineering Physics II, MATH 150 Calculus I.

**CHEM 594. Physical Chemistry I Laboratory.** 2 hours. Laboratory to accompany CHEM 593 Physical Chemistry I. Four hours laboratory per week. Prerequisite or Corequisite: CHEM 593 Physical Chemistry I.

**CHEM 595. Physical Chemistry II.** 3 hours. A continuation of CHEM 593 Physical Chemistry I including kinetics and quantum chemistry. Three lectures per week. Prerequisites: CHEM 593 Physical Chemistry I and MATH 253 Calculus III. May be taken for honors.

**CHEM 596. Advanced Inorganic-Physical Chemistry Laboratory.** 2 hours. Inorganic synthesis and the physical chemistry of inorganic compounds. Four hours of laboratory per week. Prerequisite: CHEM 594 Physical Chemistry I Laboratory. Prerequisite or Corequisite: CHEM 595 Physical Chemistry II. May be taken for honors.

**CHEM 601. Chemistry Colloquium.** 0-1 hour. Oral reports presented and accompanied by a written paper. May be repeated. Offered on a Pass-Fail basis if taken for zero hours. Offered both semesters.

**CHEM 620. Polymer Chemistry.** 3 hours. High molecular weight molecules including polymer structure, synthesis of polymers and characterization of polymer structure by various instrumental methods. Prerequisite: CHEM 320 Introductory Organic Chemistry or CHEM 325 Organic Chemistry I.

**CHEM 621. Polymer Chemistry Laboratory.** 2 hours. Polymer experiments to accompany CHEM 620 Polymer Chemistry. Four hours of laboratory per week. Prerequisite: CHEM 326 Organic Chemistry Laboratory. Prerequisite or Corequisite: CHEM 620 Polymer Chemistry.

**CHEM 623. Inorganic Chemistry.** 3 hours. Special topics in inorganic chemistry. Prerequisite: CHEM 593 Physical Chemistry I and CHEM 595 Physical Chemistry II. May be taken for honors.

**CHEM 645. Instrumental Analysis.** 3 hours. Concepts of instrumental methods of chemical analysis. Emphasis on design, operation, and theoretical foundations of instruments and instrumental procedures. Prerequisite or Corequisite: CHEM 593 Physical Chemistry I.

**CHEM 646. Instrumental Analysis Laboratory.** 2 hours. Instrumental analysis experiment to accompany CHEM 645 Instrumental Analysis. Prerequisite or Corequisite: CHEM 645 Instrumental Analysis and CHEM 446 Analytical Chemistry Laboratory.

**CHEM 699. Senior Research in Chemistry.** 1-3 hours. Special research in chemistry. A written report is required. Prerequisite: Permission of instructor. May be repeated. May be taken for honors.

### SENIOR-GRADUATE

**CHEM 705. Modern Concepts of Chemistry.** 1-5 hours. Fields available: (a)

analytical chemistry, (b) biochemistry, (c) inorganic chemistry, (d) organic chemistry, (e) physical chemistry. Limited to 1-5 hours in each field. May be repeated if different field is selected. Prerequisite: Approval of the department. May be taken for honors.

**CHEM 707. Computers and Electronics in Chemistry.** 1 hour. Application of micro and main frame computers to solve and analyze chemical data (including linear and non-linear regression, computation of multistep equilibrium constants, simulation of kinetic curves, molecular orbital calculations). Principles and functions of electronic circuitry in chemical instrumentation, such as power supplies, operational amplifiers, digital logic circuits, analog-to-digital converters, etc.

**CHEM 773. Biochemistry II.** 3 hours. Biochemistry of DNA and RNA, replication, transcription and translation. Recombinant DNA methodologies, polymerase chain reaction technologies and gene cloning. Prerequisites: CHEM 335 Organic Chemistry II and CHEM 593 Physical Chemistry I or permission of the instructor. May be taken for honors.

**CHEM 774. Biochemistry II Laboratory.** 2 hours. Experiments to accompany CHEM 773 Biochemistry II. Four hours of laboratory per week. Prerequisite of Corequisite: CHEM 773 Biochemistry II. May be taken for honors.

**CHEM 793. Advanced Physical Chemistry.** 3 hours. A treatment of chemical kinetics and chemical bonding. Three lectures per week. Prerequisite: CHEM 593 Physical Chemistry I and CHEM 595 Physical Chemistry II.

## GRADUATE

**CHEM 801. Chemistry Colloquium.** 1 hour. Oral reports presented and accompanied by a written paper. May be repeated. Required of all graduate students every semester of enrollment.

**CHEM 815. Advanced Topics in Chemistry.** 1-5 hours. Theoretical or laboratory study. Fields available: (1) analytical chemistry, (2) biochemistry, (3) electronic instrumentation, (4) inorganic chemistry, (5) organic chemistry, (6) physical chemistry. Limited 1-5 hours in each field.

**CHEM 823. Advanced Inorganic Chemistry.** 3 hours. Selected topics in inorganic chemistry.

**CHEM 863. Advanced Organic Chemistry.** 3 hours. Organic reactions and rearrangements organized according to mechanistic types, with emphasis on mechanisms, stereochemistry, and theoretical interpretations of reaction rates and driving forces.

**CHEM 883. Chemical Thermodynamics.** 3 hours. The application of the laws of thermodynamics to chemical systems.

**CHEM 889. Introduction to Chemical Research.** 1-9 hours. Graduate level research, may be repeated, but only six hours may be credited towards the degree program. Prerequisite: Enrollment in the Chemistry Masters Program. Offered on a pass/fail basis only.

**CHEM 890. Research and Thesis.** 1-6 hours. May be repeated. A maximum of six hours to count toward a master's degree.

**CHEM 891. Research Problems.** 1-6 hours. May be repeated for a maximum of six hours.

**CHEM 895. Comprehensive Reviews in Chemistry.** 1 hour. Required of all graduate students during their last semester at Pittsburg State University. The course is designed to prepare the students for their comprehensive examination. A letter grade will be assigned on the basis of the examination. The examination may be repeated for the purpose of raising the grade.

Graduate courses are open only to chemistry majors except by permission of department. Senior-graduate courses may be taken by non-majors if they possess the necessary background.

## GENERAL EDUCATION

These courses have no prerequisites and customarily are taken by students whose degree programs do not call for specific physics or chemistry courses.

**CHEM 305. Rocks and Minerals.** 3 hours. Three one-hour class periods per week. A study of the methods of identification of the more common rocks and minerals, along with a consideration of the occurrence and use of the commercial kinds of rocks and minerals.

## GENERAL AND PROFESSIONAL EDUCATION

**CHEM 479. Techniques for Teaching Chemistry.** 3 hours. Techniques, methods, and course content used in teaching chemistry in the secondary school. Offered by the Department of Chemistry. To be taken before the professional semester. Prerequisites: Admission to teacher education and PSYCH 357 Educational Psychology.

**CHEM 579. Supervised Student Teaching and Follow-Up of Teachers.** 2 hours. Departmental representatives will visit each student teacher during the professional semester. Additionally, departmental representatives will follow up with each area student during the first year of teaching with assistance and support. Concurrent enrollment in the professional semester is required.

Offered on a Pass-Fail basis only.

## GRADUATE

**SSLS 882. College Teaching Internship.** 3 hours. (See Department of Special Services and Leadership Studies for course description.)