

**BIOL 370 Physiology of the Nervous System** 5 hrs (2 lec, 3 lab), 3 cr. Prereq: BIOL 100, 102, 200, 202 or perm instr. Offered spring. Neuron structure, conduction; neuroanatomy, synapses, integration; neuroembryology. Laboratory covers major concepts presented in lectures: neurophysiological experiments, histology, anatomy and development of the nervous system.

**BIOL 375 Molecular Systematics** 3 hrs, 3 cr. Prereq: BIOL 300 or perm instr. An overview of the various methods and kinds of data used in systematics, the study of organism diversity and biological relationships. Emphasis is on modern molecular and genetic approaches to identification of individual species and strains, and full phylogenetic analyses of suites of species to determine their evolutionary history. The knowledge base is provided for experimental investigation of questions of current interest in phylogeny and population biology.

**BIOL 376 Endocrinology** 3 hrs (lec), 3 cr. Prereq: BIOL 202 or perm instr. Cellular organization of the endocrine system; molecular mechanisms of hormone action; hormonal physiology of metabolism and reproduction; integration of endocrine responses by the central nervous system.

**BIOL 380 Molecular Neurobiology** 3 hrs (lec), 3 cr. Prereq: BIOL 300 or perm instr. Offered fall alt yrs. Molecular components and molecular mechanisms involved in the cell biology of neurons and glia, neuronal signaling, neuronal development, learning, memory, and diseases of the nervous system.

**BIOL 390 Laboratory in Cell Structure** 5 hrs (1 lec/demo, 4 lab), 3 cr. Prereq or coreq: BIOL 300, or BIOL 202 and perm instr. Offered fall. Applications of light and electron microscopy to study of cell structure and function. Lab projects utilize thin sectioning, negative staining, scanning, darkroom printing, digital imaging, and other techniques.

**BIOL 400 Special Topics in Advanced Laboratory Techniques** 4 hrs (lab), 2 cr. Prereq: BIOL 300 or perm instr. Advanced laboratory techniques used in contemporary biological research, including areas such as immunology, microbiology, and molecular neurobiology. Topics change from term to term.

**BIOL 410 Workshop in Biotechnology** 30 hrs/week for 4 weeks, 4 cr. Prereq: BIOL 200, 202, and perm instr. A series of laboratory-intensive experimental projects, each lasting one week or more, which introduce current research techniques and include individual participation in planning and preparation of experiments. The focus is on a broad biotechnology topic such as the isolation, cloning, and expression of a gene, utilizing the techniques of molecular genetics. This course satisfies the research requirement for graduation with departmental honors, and is a component of the interdisciplinary BS/MA (MLS/Biol) Program in Biotechnology.

**BIOL 450 Individual Tutorial in Biology** 1 or 2 cr. Prereq: 18 cr in biology, approval of advisor in addition to the sponsor. This course may be taken only once. Research paper written under the direction of a full-time faculty member in Department of Biological Sciences.

**BIOL 460 Introduction to Planning and Teaching of Laboratory Work in Biology** 5 hrs (2 planning, 3 lab), 2 cr. Prereq: 16 cr in BIOL, 12 cr in CHEM, 2 letters from faculty required. Participation in discussions and assisting in the teaching of laboratories in an introductory course, or peer mentoring in the undergraduate biological sciences research Techniques Facility.

**BIOL 470, 471 Special Topics in Biology** 2 hrs (lec), 2 cr per sem. Prereq: BIOL 300. Specific area of contemporary interest in biology. Topics change from term to term. An oral presentation and a written paper are required.

**BIOL 480-483 Introduction to Experimental Biology** 1 or 2 cr per sem; hours to be arranged. Prereq: BIOL 100 and 102, BIOL 200 or 202 (or the equiv), and written permission of instructor prior to registration. Laboratory research under guidance of faculty member. Work at another institution may be permitted in some cases, under auspices of a faculty member. Written report required upon completion of research. A minimum of 2 credits satisfies the research requirement for graduation with departmental honors.

#### Courses not offered in 2003-2004

**BIOL 208 Ecology**

**BIOL 210 Advanced Physiology, lec**

**BIOL 211 Advanced Physiology, lab**

**BIOL 252 Comparative Anatomy of the Vertebrates**

**BIOL 274 Physiology of Activity**

**BIOL 335 Comparative Animal Physiology**

**BIOL 340 Plant Physiology**

## Chemistry

**Department Office** 1307 North Building; 772-5330

**Chair** Dixie Goss

**Professors** Alexandratos, Dannenberg, Diem, Franck, Goss, Grohmann, Massa, Mills, Mootoo, Quigley, Santoro, Sweeney, Tomasz

**Associate Professors** Drain, Francesconi

**Assistant Professors** Kawamura, Krishnamachari, Matsui, Polenova

**Advisors** (day) Pamela Mills, (evening) William Sweeney

**Web Site:** <http://patsy.hunter.cuny.edu/chemistry.html>

The Department of Chemistry offers courses to prepares the science major for professional work and further study in chemistry and other fields of pure and applied science. Courses for the non-science major are designed to present those essentials of chemical fact and theory which will contribute to the student's understanding of present-day scientific knowledge.

**General Education Requirement (GER)** CHEM 100-101, 102-103, 104-105, 111, 112, or 120-121 may be used to fulfill Broad Exposure/Stage 2, Group E (GER credit only if both lecture and corresponding lab are completed).

**Distribution Requirement** See Appendix A for the Distribution Requirement, which was replaced by the General Education Requirement in fall 2001 and which may be binding on students who matriculated prior to fall 2001.

**Major** There are two chemistry majors: Major I, a 41-credit concentration in addition to a 9-credit general chemistry core, is designed to prepare the student with intensive training for professional research and graduate study. Major II consists of two options: Option 1 for students interested in the chemical industry; and Option 2 (the biochemistry option) for students interested in the pharmaceutical industry, medicine, dentistry, veterinary medicine and physical therapy. Major II includes a minimum concentration of 26 credits (Option 1) or 24 credits (Option 2) in 200-level and above chemistry courses, in addition to a 9-credit general chemistry core. Both Options 1 and 2 are appropriate for students pursuing teacher education programs.

Students considering a chemistry major should consult the departmental advisor during their first semester to plan the proper sequence of courses, and they are urged to consult with the advisor at least once each succeeding semester. General Chem lecture I and II and General Chem Labs 1 and 2 are prerequisites for admission to both Major I and Major II.

**Chemistry Major I** The requirements for this major consist of 41 credits in chemistry. There is no allied minor. This major is recommended for students preparing for admission to graduate school or for careers in chemical research. It will also be useful to students seeking a position in the chemical or allied industries, as it is accredited by the Committee on Professional Training of the American Chemical Society.

The 41-credit major consists of CHEM 222-223, 224-225, 249, 349, 352, 354 or 356 with 355, 357, 366, 376 and 390. One further laboratory course must be chosen from 291.02 (research), 491.02 (honors research) or 378. In addition, one additional lecture course must be chosen from among the following: CHEM 322, 345, 354, 356, or 377. Also acceptable for completion of Major I are PHYS 330, PHILO 362 or 379. Students should be aware, however, that if either

of the philosophy courses is used to complete the Major I requirements, the major will not be eligible for accreditation by the American Chemical Society. One year of physics, PHYS 111 and 121, and four semesters of mathematics, MATH 150, 155, 250 and 254 or 260 are also required for this major; CHEM 249, MATH 150 and 155, and PHYS 121 are prerequisites for CHEM 352 and should be completed by the end of the sophomore year. College Russian or German sufficient to meet Hunter's distribution requirement in foreign languages is recommended.

Major I is required of all students who wish to be considered for certification by the American Chemical Society upon graduation. It is recommended for all students intending to enter the profession of chemistry through either graduate study or employment in industry or government.

Students who can attend only in the evenings should consult the department advisor regarding the feasibility of completing Chemistry Major I.

## Chemistry Major II

### General Chemistry Core: CHEM 102-105

**Option 1:** For students interested in a career in the chemical industry. It consists of a minimum of 26 credits in chemistry above the introductory level and a 9-credit general chemistry core for a total of 35 credits of chemistry. One year of physics and three semesters of calculus are also required for Major II.

**Required chemistry courses:** CHEM 222-225, 249, 352, 354, or 356, 355, and 357

**Required elective course:** Any chemistry course at the 300 level or above.

**Required allied courses:** MATH 150, 155, 250, and PHYS 111, 121

**Option 2 (Biochemistry option):** For students preparing for admission to medical, dental, veterinary schools or physical therapy programs, or for students interested in a career in the pharmaceutical industry. It consists of a minimum of 24 credits above the introductory level and a 9-credit general chemistry core for a total of 33 credits of chemistry. One year of physics, one year of biology and one year of calculus are also required.

**Required chemistry courses:** CHEM 222-225, 350, 376-378

**Required elective course:** Any chemistry course at the 200-level or above (excluding CHEM 291 and 295) or BIOL 200 or 202

**Required allied courses:** BIOL 100, 102, MATH 150, 155, and PHYS 110, 120

**Minors for Major II** Any combination of the required physics and math courses, totaling 12 credits, may be used as a minor. If students prefer to elect a different minor, they must consult with the department advisor or chair.

**Honors Work** Opportunity for an individual research experience is provided by an honors course, CHEM 491 (Introduction to Research).

**Electives** Advanced lecture courses in special areas of chemistry, and lab courses providing training in inorganic and organic chemistry and in research techniques, are offered as electives for Major I and are open to students enrolled in Major II who have fulfilled the course prerequisites.

**Graduate Study** Qualified chemistry majors may be admitted to 700-level courses in the graduate program. Permission of the department is required.

**Preparation for Teaching** In cooperation with the School of Education, the Department of Chemistry provides opportunities for students to prepare for careers in teaching at the elementary and secondary level in the area of chemistry. Chemistry Major II, Option I (35 credits) and Option 2 (33 credits) both satisfy the requirements for New York State certification for teachers of chemistry in Childhood Education (Grades 1-6) and Adolescence Education (Grades 7-12). For students pursuing certification as chemistry teachers at the secondary level, the 21-credit adolescence education sequence is an appropriate minor. Students who want to qualify for New York City licensing and New York State certification for teaching in secondary schools should consult the Education section of this catalog for additional requirements.

## COURSE LISTINGS

**\*CHEM 100 Essentials of General Chemistry Lecture** 4 hrs (3 lecture, 1 recitation), 3 cr; GER/2/E (Core credit awarded only if CHEM 100 and 101 are completed). Course presents essential facts, laws, and theories of general chemistry.

**\*CHEM 101 Essentials of General Chemistry Laboratory** 4 hrs (3 laboratory, 1 recitation), 1.5 cr. Prereq or coreq: CHEM 100; GER/2/E (Core credit awarded only if CHEM 100 and CHEM 101 are completed). Experiments designed to illustrate fundamental laws and techniques of general chemistry.

**\*\*CHEM 102 General Chemistry I** 4 hrs (3 lecture, 1 recitation), 3 cr. Prereq or coreq: MATH 125/126 or equiv; GER/2/E (Core credit awarded only if CHEM 102 and CHEM 103 are completed). In-depth introduction to stoichiometric calculations, atomic and molecular structure and chemical bonding.

**\*\*CHEM 103 General Chemistry Laboratory I** 4 hrs (3 lab, 1 recitation), 1.5 cr. Pre- or coreq: CHEM 102; GER/2/E (Core credit awarded only if CHEM 102 and CHEM 103 are completed). Study of experiments designed to illustrate fundamental laws and techniques of chemistry.

**\*\*CHEM 104 General Chemistry II** 4 hrs (3 lecture, 1 recitation), 3 cr. Prereq: CHEM 102 and 103, or CHEM 100 with perm chair; GER/2/E (Core credit awarded only if CHEM 104 and CHEM 105 are completed). In-depth introduction to thermodynamics, redox reactions, electrochemistry and chemical equilibrium.

**\*\*CHEM 105 General Chemistry Laboratory II** 3 hrs, 1.5 cr. Prereq: CHEM 103; prereq or coreq: CHEM 104; GER/2/E (Core credit awarded only if CHEM 104 and CHEM 105 are completed). Laboratory experiments illustrating and applying theory of solutions to qualitative analysis.

**\*\*CHEM 111 Chemical Principles** 7 hrs (3 hrs lecture, 3 hrs lab, 1 hr recitation), 4.5 cr. Pre- or coreq: MATH 125 or equiv, MATH 126; GER/2/E. Offered fall. In-depth introduction to chemical principles including measurement, stoichiometric calculations, inorganic nomenclature, gas laws, and calorimetry. Emphasis is placed on problem-solving, oral presentations, and collaborative work. Laboratory and coursework emphasize analysis and evaluation of data.

**\*\*CHEM 112 Thermodynamics and Solution Chemistry** 7 hrs (3 hrs lecture, 3 hrs lab, 1 hr recitation), 4.5 cr. Prereq: CHEM 111; GER/2/E. Offered spring. The study of aqueous solution chemistry, acids and bases, chemical equilibrium, kinetics, electrochemistry, and thermodynamics.

**\*\*CHEM 113 Atomic Structure, Chemical Bonding and Spectroscopy** 3 hrs (2 hrs lecture, 1 hr recitation), 2 cr. Prereq: CHEM 112. Offered fall. Introduction to quantum theory, atomic structure, periodic properties of the elements, and modern theories of chemical bonding.

\*CHEM 100-101 and 120-121 are primarily for nursing, nutrition and food science, and health science students.

\*\*CHEM 102-105, 111-113 or 130-133 are primarily for pre-med, medical laboratory technician and science majors.

**CHEM 115 Introductory Chemistry** 4 hrs (3 lecture, 1 recitation), 3 cr. Pre- or coreq: MATH 125. An introduction to the fundamental concepts in chemistry including atomic and molecular structure, chemical bonding, stoichiometry, and solution chemistry. This course is appropriate for students who have had no prior coursework in chemistry.

**\*CHEM 120 Essentials of Organic Chemistry Lecture** 4 hrs (3 lec, 1 recitation), 3 cr. Prereq: CHEM 100; GER/2/E (Core credit awarded only if CHEM 120, CHEM 121 are completed). Course presents essential facts, laws and theories of organic chemistry.

**\*CHEM 121 Essentials of Organic Chemistry Laboratory** 4 hrs (3 lab, 1 recitation), 1.5 cr. Prereq or coreq: CHEM 120; prereq: CHEM 101. ; GER/2/E (Core credit awarded only if CHEM 120, CHEM 121 are completed.) Experiments designed to illustrate fundamental laws and techniques of organic chemistry.

**\*\*CHEM 130 Preprofessional Science: Core 1** 2 hrs, 1.5 cr. Coreq: MATH 130, PHYS 130 and PHYS 130 Lab. The chemistry component of the first semester of a four-semester, fully integrated course in general chemistry, general physics, and mathematical functions and graphs. Topics include properties of linear functions and their graphs, mechanics, introductory thermodynamics and stoichiometry.

**\*\*CHEM 131 Preprofessional Science: Core 2** 2 hrs, 1.5 cr. Prereq: MATH 130, PHYS 130, CHEM 130 and PHYS 130 Lab. Coreq: MATH 131, PHYS 131 and PHYS 131 Lab. The chemistry component of the second semester of a four-semester, fully integrated course in general chemistry, general physics, and mathematical functions and graphs. Topics include properties of polynomial, rational, exponential, and logarithmic functions and their graphs, chemical equilibrium, electrochemistry and further topics in thermodynamics. Completion of CHEM 130 and 131 is equivalent to completion of CHEM 102.

**\*\*CHEM 132 Preprofessional Science: Core 3** 2 hrs, 1.5 cr. Prereq: MATH 131, PHYS 131, CHEM 131 and PHYS 131 Lab. Coreq: MATH 132, PHYS 132, PHYS 132 Lab. The chemistry component of the third semester of a four-semester, fully integrated course in general chemistry, general physics, and mathematical functions and graphs. Topics include trigonometric functions, topics in analytic geometry, waves, the structure of the atom, and chemical bonding.

**\*\*CHEM 133 Preprofessional Science: Core 4** 2 hrs, 1.5 cr. Prereq: MATH 132, PHYS 132, CHEM 132 and PHYS 132 Lab. Coreq: MATH 133, PHYS 133 and PHYS 133 Lab. The chemistry component of the fourth semester of a four-semester, fully integrated course in general chemistry, general physics, and mathematical functions and graphs. Topics include trigonometric identities, applications of trigonometry, chemical kinetics, electricity and magnetism, optics and nuclear physics. Completion of CHEM 132 and 133 is equivalent to completion of CHEM 104.

**CHEM 222, 224 Organic Chemistry Lectures I and II** 4 hrs (3 lecture, 1 recitation), 3 cr each. Prereq: CHEM 104; for CHEM 224, CHEM 222. Structure, bonding, and reactions of organic molecules. Synthesis, stereochemistry, spectroscopy, reaction mechanisms.

**CHEM 223 Organic Chemistry Laboratory I** 5 hrs, 2.5 cr. Prereq: CHEM 105; prereq or coreq: CHEM 222. Offered evening/fall, day/fall, spring. Various organic syntheses, crystallization, distillation, extraction, chromatography, qualitative analysis, spectroscopy.

**CHEM 225 Organic Chemistry Laboratory II** 5 hrs, 2.5 cr. Prereq: CHEM 222, 223; prereq or coreq: CHEM 224. Offered evening/fall, day/fall, spring. Continuation of CHEM 223.

**CHEM 249 Quantitative Analysis** 5 hrs (4 lab, 1 rec), 3 cr. Prereq: CHEM 104 and 105. Offered fall. A set of laboratory experiments, performed by individual students, covering important areas of quantitative analysis such as pH and metal ion titrations, spectroscopic analysis including gas chromatography, electronic absorption, and fluorescence.

**CHEM 291 Chemical Investigations** 4 hrs, 1 cr or 8 hrs, 2 cr. Prereq: CHEM 224 and perm chair. Original chemical investigations under supervision of faculty member. Written report required. Enrollment for maximum of 2 semesters.

\*CHEM 100-101 and 120-121 are primarily for nursing, nutrition and food science, and health science students.

\*\*CHEM 102-105, CHEM 111-113 or CHEM 130-133 are primarily for pre-med, medical laboratory technician and science majors.

**CHEM 295 Introduction to Planning and Teaching of Laboratory Work in Chemistry** 5 hrs (2 planning, 3 lab), 2 cr. Prereq: CHEM 104 and CHEM 105, and two letters from faculty who have taught the student. Participate in supervised teaching of experiments that demonstrate important principles of chemistry.

**CHEM 322 Organic Chemistry Lecture III** 3 hrs, 3 cr. Prereq: CHEM 224 and perm instr. Selected topics such as advanced synthesis, reaction mechanisms, MO theory, natural products, NMR spectroscopy.

**CHEM 345 Computers in Chemistry** 5 hrs (2 lec, 3 lab), 3 cr. Prereq: CHEM 352 or perm instr. Laboratory data acquisition, reduction, instrument control. Graphics. Hands-on laboratory. No previous programming experience necessary.

**CHEM 349 Instrumental Analysis** 8 hrs (2 lec, 6 lab), 5 cr. Prereq: CHEM 354 or 356 with 355. Offered day/fall. Principles of modern instrumental techniques; emphasis on spectroscopic and electrometric methods.

**CHEM 350 Biophysical Chemistry** 4 hrs, 4 cr. Prereq: CHEM 224, BIOL 102 and MATH 150. Offered fall. Essential physical chemical principles as applied to biological problems. Emphasis on kinetics, thermodynamics, and equilibria.

**CHEM 352 Physical Chemistry I** 3 hrs, 3 cr. Prereq: CHEM 249, MATH 155, PHYS 121. Offered fall. Ideal and real gases. Laws of thermodynamics with applications to properties of solutions and phase equilibria in general.

**CHEM 354 Physical Chemistry II-F** 3 hrs, 3 cr. Prereq: CHEM 352, MATH 250. Offered fall. Selected topics from statistical thermodynamics, electrochemistry, kinetic theory and rate processes.

**CHEM 355 Physical Chemistry Laboratory I** 3 hrs, 1.5 cr. Prereq: CHEM 249. Offered fall. Laboratory course involving experiments based on topics covered in CHEM 352 on chemical systems.

**CHEM 356 Physical Chemistry II-S** 3 hrs, 3 cr. Prereq: CHEM 352, MATH 250. Offered spring. Selected topics from quantum chemistry, molecular structure, and spectroscopy.

**CHEM 357 Physical Chemistry Laboratory II** 3 hrs, 1.5 cr. Prereq: Offered spring. Prereq: CHEM 352 or perm chair. Laboratory course involving experiments based on topics covered in CHEM 354 on chemical systems.

**CHEM 366 Inorganic Chemistry** 3 hrs, 3 cr. Prereq: CHEM 352. Offered day/fall. Treatment of structure, bonding and reactivity of inorganic compounds.

**CHEM 376 Biochemistry I** 3 hrs, 3 cr. Prereq: CHEM 224. Offered fall. Chemical aspects of protein structure and function, fundamentals of bioenergetics, biochemical mechanisms of gene replication and expression.

**CHEM 377 Biochemistry II** 3 hrs, 3 cr. Prereq: CHEM 376 or BIOL 300 or perm instr. Offered spring. Biosynthesis of lipids, amino acids, carbohydrates. Muscle contraction, hormones, immune response, DNA sequencing.

**CHEM 378 Biochemistry Laboratory** 5 hrs (4 lab, 1 rec), 3.0 cr. Prereq: CHEM 223; CHEM 376 or CHEM 640. A set of laboratory experiments, performed by individual students, covering important areas of biochemistry such as protein analysis, enzyme purification, enzymatic assays, recombinant DNA and the polymerase chain reaction.

**CHEM 388 Topics of Current Interest in Chemistry** 3 hrs, 3 cr. Pre- or coreq: CHEM 352 and CHEM 356 or perm instr. Offered subject to adequate student interest and enrollment. Taught by specialists from department faculty. The specific topic will be listed in the *Schedule of Classes* for a given semester.

**CHEM 390 Current Laboratory Methods in Chemistry** 4 hrs, 2 cr. Pre- or coreq: CHEM 357 or perm instr. Offered subject to adequate student interest and enrollment. Taught by specialists from department faculty. The specific topic will be listed in the *Schedule of Classes* for a given semester.

#### Honors Course

**CHEM 491 Introduction to Research** 4 hrs, 1 cr or 8 hrs, 2 cr. Prereq: CHEM 224, 354, 349, Jr/Sr only; perm chair. Similar to CHEM 291. Written report required. Fulfills requirement for departmental honors course.

*Note:* No student may receive credit for both CHEM 100-101 and 102-103, or for CHEM 120-121 and 222-223.