Chemistry and Biochemistry

CHAIR
Ralph M. Pollack
Professor
Bio-organic chemistry: Mechanistic enzymology, model systems for enzymatic reactions

PROFESSORS
C. Allen Bush
Physical chemistry: Conformation and dynamics of complex carbohydrates by NMR and computer modeling

Donald J. Creighton
Biochemistry: Enzyme mechanisms and protein structure studies of glutathione-dependent enzymes

James C. Fishbein
Organic chemistry: Reaction mechanisms and reactive intermediates, chemical toxicology

Ramachandra S. Hosmane
Organic chemistry: Antiviral and antineoplastic compounds, artificial blood and hemoglobin research

Richard L. Karpel
Biochemistry: Structure-function studies on protein-nucleic acid interactions

Joel F. Liebman
Theoretical chemistry: Strain and aromaticity, gaseous ions, organic thermochemistry, nonmetal inorganic chemistry

Michael F. Summers
Howard Hughes Medical Investigator: Nuclear magnetic resonance studies of proteins and macromolecular interactions

Dale L. Whalen
Organic chemistry: Reactions of carcinogenic polycyclic aromatic hydrocarbon epoxides

ASSOCIATE PROFESSORS
Bradley R. Arnold
Physical chemistry: Application of time-resolved polarized spectroscopy

William R. LaCourse
Analytical chemistry: Pulsed electrochemical detection following bioanalytical separations and advanced analytical methodology

Katherine L. Seley
Organic chemistry: Design and synthesis of nucleoside/nucleotide and heterocyclic enzyme inhibitors for use as medicinal agents

Paul J. Smith
Organic chemistry: Molecular recognition, protein and DNA binding by small molecules

ASSISTANT PROFESSORS
Daniele Fabris
Bioanalytical chemistry: Mass spectrometry of nucleic acid adducts and protein-nucleic acid interactions

Colin W. Garvie
Protein crystallography and X-ray diffraction

Susan K. Gregurick
Computational studies of protein structure, dynamics and function

Lisa A. Kelly
Photochemistry: Photoredox-initiated oligonucleotide and polypeptide cleavage and heterogeneous catalysis

Brian M. Cullum
Laser-based spectroscopic techniques for biomedical and environmental applications

Veronika A. Szalai
Bioinorganic chemistry of Amyloid proteins, nucleic acid-based magnetic materials

INSTRUCTORS
Vera R. da Silva
Biochemistry laboratory and health science chemistry

H. Mark Perks
Organic and environmental chemistry

Tara Carpenter
General and analytical chemistry

Suzanne Rottman
General chemistry, Tutorial Center director

ADJUNCT FACULTY
Aristotle G. Kalivretenos
Synthesis of ion transport models

Wuyuan Lu
Structural chemistry and function of novel engineered proteins

AFFILIATE FACULTY
Bruce Fowler
Professor
Toxicology

Katherine Squibb
Associate Professor
Toxicology research

EMERITUS FACULTY
Associate Professors Emeritus
James S. Vincent
Arthur S. Hyman

Professors Emeritus
Robert F. Steiner
Fred Gornick

The undergraduate programs in chemistry and biochemistry offer students the opportunity to study in a program tailored to meet their career objectives in a department that is large enough to provide excellent training and research facilities and small enough to encourage a close working relationship with professors. The experienced, dynamic faculty of the department present outstanding credentials, with advanced degrees and post-doctoral training from some of the most prestigious schools in the country. They are devoted to both teaching and research. Their scientific and scholarly achievements attract close to $4 million in funding per year, resulting in many opportunities for students to participate in undergraduate research in faculty labs and to gain exposure to cutting-edge science in their classrooms.

The department offers three major programs: the B.S. in Chemistry, a rigorous program certified by the American Chemical Society; a B.A. in Chemistry, which provides the option of an increased number of electives so the student may combine a solid background in chemistry with other areas of interest, such as law, education, business management, etc.; and a B.S. in Biochemistry and Molecular Biology (jointly with the Department of Biological Sciences). A combined chemistry B.S./M.S. and minor in chemistry are also available to qualified students.

In conjunction with the education department, a program leading to secondary-school certification may be pursued.

*See www.umbc.edu/chem-biochem for updated information.
Courses in this program are listed under CHEM.

The programs of the chemistry and biochemistry department periodically are reviewed by the American Chemical Society (ACS), the organization that sets the standards for chemical education, and UMBC chemistry students consistently place at, or above, the norm in their standardized examinations. In a recent report, the ACS ranked UMBC 23rd in the nation as far as the number of chemistry/ biochemistry graduates it produced.

Career and Academic Paths

More than 60 percent of graduates pursue further education (graduate programs in chemistry and biochemistry) and professional training (medical, dental, pharmacy, nutrition, veterinary medicine and environmental science) at such distinguished schools as Harvard, MIT, Oxford, The Johns Hopkins University, Stanford, University of Virginia and University of Maryland, Baltimore. Many students choose to continue post-baccalaureate studies here, enrolling in the M.S. or Ph.D. programs in chemistry, the M.S. or Ph.D. programs in biochemistry (joint with UMB) or molecular and cell biology, or the M.S. program in applied molecular biology (joint with the Department of Biological Sciences).

Academic Advising

The department assigns students to faculty advisors based upon the student's declared major of either chemistry or biochemistry. After filing a Declaration of Major form, students should contact the department office.

Major Programs

Note: Chemistry, math and physics courses that serve as prerequisites for other chemistry courses must be satisfied with no less than a grade of "C." The cumulative grade point average of courses required for the undergraduate chemistry major must be at least 2.0.

* (MATH 251, required by the B.S. program, must be completed with no less than a grade of "C.")

Bachelor of Science (B.S.), Chemistry

The Bachelor of Science in Chemistry, which provides graduates with an American Chemical Society-certified degree, consists of at least 73 credits distributed as follows:

A. Chemistry (49 credits)

CHEM 101
Principles of Chemistry I

CHEM 102
Principles of Chemistry II

CHEM 102L
Introductory Chemistry Lab

CHEM 351
Organic Chemistry I

CHEM 352
Organic Chemistry II

CHEM 351L
Organic Laboratory I

CHEM 352L
Organic Laboratory II

CHEM 300
Analytical Chemistry

CHEM 301
Physical Chemistry

CHEM 302
Physical Chemistry II

CHEM 311L
Advanced Laboratory I

CHEM 312L
Advanced Laboratory II

CHEM 405
Inorganic Chemistry

CHEM 420
Scientific Computing

CHEM 437
Comprehensive Biochemistry I

CHEM 461
Advanced Instrumental Analysis

B. Mathematics (12 credits)

MATH 151
Calculus and Analytic Geometry I

MATH 152
Calculus and Analytic Geometry II

MATH 251
Multivariable Calculus

C. Physics (8 credits)

PHYS 121
Introductory Physics I

PHYS 122
Introductory Physics II

D. Approved Electives (3 credits)

CHEM 401
Chemical and Statistical Thermodynamics

CHEM 406
Bioinorganic Chemistry

CHEM 410
Quantum Chemistry

CHEM 415
Statistical Mechanics and Theories of Rate Processes

CHEM 431
Chemistry of Proteins

CHEM 432
Advanced Biochemistry

CHEM 433
Biochemistry of Nucleic Acids

CHEM 435
Biochemistry of Complex Carbohydrates

CHEM 437L
Biochemistry Laboratory

CHEM 438
Comprehensive Biochemistry II

CHEM 441
Physical Chemistry of Macromolecules

CHEM 442
Physical Biochemistry

CHEM 443
Molecular Spectroscopy and Biomacromolecules

CHEM 444
Molecular Modeling

CHEM 450
Chemistry of Heterocyclic Compounds

CHEM 451
Mechanisms of Organic Reactions

CHEM 452
Physical Organic Chemistry

CHEM 453
Organic Chemistry of Nucleic Acids

CHEM 455
Introduction to Biomedicinal Chemistry

CHEM 457
Total Synthesis of Natural Products

CHEM 465
Mass Spec at the Chemistry-Biochemistry Interface

CHEM 470
Toxicological Chemistry

CHEM 472
Enzyme Reaction Mechanisms

CHEM 499*
Undergraduate Research

*See Special Opportunities: Undergraduate Research section on page 68.

Qualified undergraduates also may enroll in graduate courses offered by the department. Specific graduate-level, current or special topics courses may be approved as chemistry electives when their topic is appropriate.

Bachelor of Arts (B.A.), Chemistry

The Bachelor of Arts in Chemistry consists of at least 61 credits distributed as follows:

A. Chemistry (36 credits)

CHEM 101
Principles of Chemistry I

CHEM 102
Principles of Chemistry II

CHEM 102L
Introductory Chemistry Lab

CHEM 351
Organic Chemistry I

CHEM 352
Organic Chemistry II

CHEM 351L
Organic Laboratory I

CHEM 352L
Organic Laboratory II

CHEM 300
Analytical Chemistry

CHEM 301
Physical Chemistry I

CHEM 302
Physical Chemistry II

CHEM 311L
Advanced Laboratory I

CHEM 405
Inorganic Chemistry

B. Mathematics (8 credits)

MATH 151
Calculus and Analytic Geometry I

MATH 152
Calculus and Analytic Geometry II

C. Physics (8 credits)

PHYS 121
Introductory Physics I

PHYS 122
Introductory Physics II

D. Approved Electives (9 credits)

Bachelor of Science (B.S.), Biochemistry and Molecular Biology

Course requirements for the biochemistry and molecular biology B.S. are listed in the catalog section describing the Biochemistry and Molecular Biology Program.

General Information

University requirements specify that students must complete at least 120 academic credits with a cumulative grade point average of 2.0 or better. At least 45 of those credits must be in courses designated at UMBC by a 300- or 400-level course number.

Students planning to major in chemistry should begin their first course in chemistry during the first semester of the freshman year to complete the required core of credits. Such students also are urged to fulfill the requirements in mathematics and physics during their freshman and sophomore years.

To do so within this period, it is strongly recommended that a course in calculus be taken promptly in the freshman year and that the appropriate physics courses be taken no later than the sophomore year. Suggested partial programs for each degree are listed below. Both sample programs are designed for students prepared to begin MATH 151 during the first semester. If a student requires the precalculus course, MATH 150, it should be taken first semester and the calculus sequence begun immediately thereafter. In each case, the sequence of chemistry courses is the same.

Sample Program
Bachelor of Science in Chemistry

Note: Chemistry, math and physics courses that serve as prerequisites for other chemistry courses must be satisfied with no less than a grade of "C." The cumulative grade point average of courses required for the undergraduate chemistry major must be at least 2.0.

* MATH 251, required by the B.S. program, must be completed with no less than a grade of "C."

** CHEM 437, 455 or 470 may be used for the biochemistry requirement.

Freshman

Fall	Spring
CHEM 101	CHEM 102
MATH 151	CHEM 102L
	MATH 152
	PHYS 121

Sophomore

Fall	Spring
CHEM 351	CHEM 352
CHEM 351L	CHEM 352L
CHEM 300	MATH 251
PHYS 122	

Junior

Fall	Spring
CHEM 301	CHEM 302
CHEM 311L	CHEM 312L
CHEM 405	*MATH 251

Senior

Fall	Spring
CHEM 420	CHEM 461
**Biochemistry requirement	Approved elective

Sample Program
Bachelor of Arts in Chemistry

Freshman

Fall	Spring
CHEM 101	CHEM 102
MATH 151	CHEM 102L
	MATH 152

Sophomore

Fall	Spring
CHEM 351	CHEM 352
CHEM 351L	CHEM 352L
CHEM 300	PHYS 121

Junior

Fall	Spring
CHEM 301	CHEM 302
CHEM 311L	Approved elective
PHYS 122	

Senior

Fall	Spring
CHEM 405	Approved elective
Approved elective	

Chemistry Minor/ Non-Majors

Any student, except those majoring in biochemistry, may complete a formal minor in chemistry. The chemistry minor thoroughly covers the basic chemical principles and offers opportunities for advanced study that can be tailored to the student's particular interests. The minor consists of a minimum of 26 credits and will include advanced course work in biochemistry, organic, inorganic, physical or analytical chemistry. Students interested in completing a minor in chemistry may get more complete information from the department office (Chemistry Building, room 109).

Outside of the major and minor programs, the chemistry curriculum is designed to meet the needs of students with diverse goals. Biological sciences majors, as well as students preparing for entrance into schools of dentistry, medicine, pharmacy, veterinary medicine or programs in medical technology should complete CHEM 101, 102, 102L, 351, 351L, 352 and 352L. Students preparing for programs in dental hygiene, nursing and physical therapy should complete CHEM 123, 124 and 124L.

Chemistry Minor Program

The chemistry minor consists of a minimum of nine courses/ 26 credits.

Core Courses (Required)

CHEM 101
Principles of Chemistry I [4]
Pre- or Corequisite:
MATH 150

CHEM 102
Principles of Chemistry II [3]
Prerequisite: CHEM 101

CHEM 102L
Introductory Chemistry Laboratory I [2]
Pre- or Corequisite: CHEM 102

CHEM 351
Organic Chemistry I [3]
Prerequisite: CHEM 101, 102

CHEM 351L
Organic Chemistry Laboratory I [2]
Pre- or Corequisite: CHEM 101, 102, 102L, 351

CHEM 352
Organic Chemistry II
Pre- or Corequisite: CHEM 101, 102, 351

CHEM 352L
Organic Chemistry Laboratory II [2]
Pre- or Corequisite: CHEM 351L, 351, 352

CHEM 300
Analytical Chemistry [4]
Prerequisite: CHEM 102, 102L

Required Electives (one required)

CHEM 301
Physical Chemistry [4]
Pre- or Corequisite: CHEM 102, MATH 152, PHYS 122

CHEM 4XX [3]
Any upper-level chemistry course with the approval of the department chair or with the student's chemistry advisor.

Honors Program

The department does not offer an honors track, however specific honors sections of the introductory chemistry courses are offered. CHEM 101H and 102H, Introductory Chemistry I and II, are offered in the fall and spring, respectively. In addition, departmental honors are awarded to graduates in chemistry or biochemistry who achieve scholastic excellence, which is defined as a GPA of 3.5 or better in all chemistry and biochemistry courses, combined with an overall GPA of at least 3.0. At least 18 credit hours in the major must be completed at UMBC.

Combined B.S./M.S. Graduate Program

This program is open to advanced undergraduates of superior ability. To be considered for the combined B.S./M.S. program in chemistry, undergraduate students should declare their intentions to apply to the program no later than the first semester of their senior year. This declaration should be in writing to the graduate program director in chemistry. In addition, the student must apply for admission to the Graduate School one semester prior to completion of requirements for the bachelor's program. A maximum of nine credits of graduate-level courses may be taken at the undergraduate level.

The B.S. degree may be awarded after the department requirements are met and 120 or more credits are earned. The student must be enrolled in the Graduate School while the remaining 21 or more required graduate-level credits are earned. The M.S. may be granted upon completion of the program requirements for the master's degree and after a minimum of 141 credits total are earned for the combined degree.

To remain in the program, a student is required to maintain an overall grade point average of 3.0 or better and to receive no grade lower than a "B" in any course required for the major. A requirement to participate in advanced research is an important aspect of the program. This may be done by either thesis or non-thesis options, as described below.

Requirements

Undergraduate:
The requirements for the B.S. phase of the combined B.S./M.S. degree are identical to the normal chemistry B.S. with two exceptions:

A) The graduate-level CHEM 661: Advanced Instrumental Analysis is taken instead of the undergraduate-level equivalent CHEM 461, **AND**

B) A minimum of two of the six credits of approved electives should be at the 600-level for transfer in satisfaction of the M.S. degree requirements.

Graduate:
A candidate for the combined B.S./M.S. degree must complete a total of 30 credit hours of graduate-level course work, 18 of which must be at the 600 level or above. A total of nine chemistry graduate-level credits, taken during the undergraduate period to fulfill the B.S. core requirements, will be accepted as partially meeting the master's core requirements. The remaining 21 credit hours include the rest of the master's-level core courses, the elective courses (in chemistry, biology, physics or math), and the research component. The student must be enrolled in the graduate school while the final 21 or more credits are earned.

The program is designed to be flexible enough to meet a range of student interests. Students may elect either a thesis option, completing six credit hours of research or a non-thesis option in which additional course work is combined with an advanced laboratory project for research experience.

Sample Program
A. Nine credits at the B.S. graduate-level courses accepted:

CHEM 405
Inorganic Chemistry [3]

CHEM 661
Advance Instrumental Analysis [4]

CHEM 6XX
Graduate-level elective [2]

B. 21 credits at the M.S. level:

Two of the following three courses [6-7]:

CHEM 437
Comprehensive Biochemistry I [4] **OR**
CHEM 401
Thermodynamics [3] **OR**
CHEM 451
Mechanisms of Organic Reactions [3]

C. Thesis Option:

CHEM 799
M.S. Thesis Research [6]

CHEM 4XX-6XX
Electives [8-9]

D. Non-Thesis Option:

CHEM 600
Advanced Laboratory Project [1]

CHEM 4XX-6XX
Electives [13-14]

In addition, each candidate must pass a comprehensive examination in one of the following five areas: inorganic, organic, biochemistry, analytical or physical chemistry. The comprehensive examinations will be given at the end of each semester (including summers). A final examination will be arranged in accord with procedures of the graduate school. This examination will follow completion of formal coursework and the submission of either the master's thesis or, in the case of the non-thesis option, a scholarly paper indicating the student's familiarity with an area of modern chemical research.

Special Opportunities

Undergraduate research performed under faculty mentors within the department is encouraged. Participating students may receive credit toward graduation for this research through two upper-level courses. CHEM 399: Tutorial Projects in Chemistry, provides an introduction to research and may be taken for variable credit. CHEM 499: Undergraduate Research is an approved elective for the American Chemical Society-certified B.S. in Chemistry and requires preparation of a formal paper based on the student's original research.

A maximum of six credits of CHEM 499 or a maximum of eight credits from the combination of BIOL 398, 399, 499, CHEM 399 and 499 may be taken. The department also offers industrial internships with various partners for additional hands-on experience. The Vitullo Award is presented each year to a junior or senior student working in a faculty member's laboratory excelling in undergraduate research in the department.

The Chemistry Tutorial Center is staffed by a full-time chemistry instructor and 25 advanced undergraduates who provide free tutoring for students in freshman and sophomore chemistry courses. Small group tutoring and computer-assisted, special topics lessons are available.

Student Organizations

An American Chemical Society (ACS) student affiliate chapter, the Chemistry/Biochemistry Council of Majors (CHEM/COM), supports an active lecture and tour program to acquaint UMBC students with various career options. The CHEM/COM outreach program into local elementary schools involves mentoring young students, as well as providing a program of science demonstrations to assist instructors in teaching chemical principles.

The ACS affiliate chapter also sponsors the presentation of several undergraduate research projects at the student session of the national ACS meeting each year.