

# DEPARTMENT OF CHEMISTRY

## COLLEGE OF ARTS AND SCIENCES

### Faculty

**Randy F. Johnston** (1994). Professor of Chemistry and Department Chair. B.S., University of Missouri, St. Louis; Ph.D., Texas Tech University.

**Charles M. Baldwin** (1970-81, 1988). O.P. and Evalyn Hammons University Professor of Pre-Medical Studies. B.A., University of Corpus Christi; Ph.D., Texas Tech University; CChem FRSC. Additional study, University of Texas, Stanford University, Imperial College (London).

**Jimmy H. Davis** (1978). University Professor of Chemistry and Vice President - Germantown Campus. B.S., Union University; Ph.D., University of Illinois; Additional study, University of Florida, Oak Ridge Associated Universities, Argonne National Laboratory, Harvard University, and Oxford University (England).

**Sally A. Henrie** (1998). Professor of Chemistry. B.S., University of Arizona; Ph.D., South Dakota State University.

**Marlyn Newhouse** (1992). Associate Professor of Chemistry. M.A. and B.S.Ed., Northern Arizona University; D.A., Middle Tennessee State University.

**Michael R. Salazar** (2001). Associate Professor of Chemistry. B.S., New Mexico State University; Ph.D., University of Utah; Additional study, Los Alamos Laboratory.

**David A. Wing** (2008). Visiting Professor. B.S., Wheaton College; Ph.D., Northwestern University.

### Curriculum

The chemistry program at Union University seeks to serve effectively all students, recognizing different needs, interests, and career goals. The faculty seeks to help students understand the physical world, the methods by which it may be studied, and its relationship to other aspects of the human experience. It is the intention of the faculty to create an environment in which students are challenged to acquire skills in problem solving utilizing the modern methods of science and to study in-depth the chemical processes which characterize life systems while developing an inquiring attitude toward scientific exploration. The curriculum is intended to provide liberal arts students with a working knowledge of science and to meet the needs of students who wish to:

- teach science at the elementary or secondary school level,
- prepare to enter a health science profession such as medicine, dentistry, medical technology, pharmacy, nursing, physical therapy, or other allied health fields,
- become a professional/industrial chemist, or
- continue study in chemistry at the graduate level.

Students pursuing a major in Chemistry must complete Math 211, 212; Physics 231, 232, and meet the following requirements in Chemistry:

#### I. Major in Chemistry—46 hours

- A. CHE 111, 112, 211, 221, 314, 315, 317, 318, 319, 324, 326, 327, 335, 498
- B. Research, 3 hours from: 424 or 425
- C. One of: 405, 430, 435

#### II. Major in Medical Technology Leading to the BS in Medical Technology

- A. Chemistry 111, 112, 211-21, 314-15, 319, 324, 326
- B. Biology 112, 211, 221, 222, 315, 316, 320
- C. Physics 213-214 or 231-232
- D. Computer Science (3 hours) and MAT 111 or preferably MAT 211
- E. A minimum of 33 hours of Medical Technology at an affiliated hospital as the fourth year of study.

#### III. Major in Chemical Physics

Designed for those seeking a broad background in the physical sciences to pursue graduate work in chemistry or physics or secondary teacher licensure, the major permits students with previous experiences to shorten the time spent in formal education without reducing the quality of the degree obtained.

Students with an advanced preparation in secondary school or as college sophomores may be selected for this program. Entrance as a freshman requires an ACT Composite of 26 or higher with a Math ACT of 25 or higher, 4 units of high school math with a B average or better, high school chemistry and physics with a B average or better, and a successful personal interview with a faculty admissions committee. Entrance as a sophomore requires readiness to enter MAT 211, CHE 111 and PHY 231 with a CUM and science GPA of 2.5 or higher, and a successful interview with admissions committee.

- A. CHE 111, 112, 211, 221, 314, 315, 324, 326, 317, 318, 327, 319, 335–38 hours
- B. PHY 231, 232, 311, 313, 314; 325 or 420; 430–26 hours
- C. PHY or CHE 424; PHY or CHE 498; Upper level PHY or CHE—6 hours
- D. MAT 211, 212, 213, 314—15 hours
- E. ENG 111, 112; 201 or 202—9 hours
- F. ART 210; CHR 111, 112; BIO 112; CLU 195; HIS 101; and 9 hours of social science—27 hours

#### IV. Teacher Licensure with Endorsement in Chemistry 7-12

- A. Complete the requirements for the Chemistry major as shown above including CHE 405.
- B. Professional Education: EDU 150, 250, 326, 418, 433; PSY 213, 318; SE 225
- C. Completion of applicable portions of the Praxis II.
- D. For additional information, see the Assistant Dean for Teacher Education and Accreditation.

#### V. Teacher Licensure With Dual Endorsements in Chemistry and Physics 7-12

- A. Complete the requirements for the Chemical Physics major including both PHY 498 and CHE 498 plus PHY 317.

- B. Professional Education: EDU 150, 250, 326, 418, 433; PSY 213, 318; SE 225.
- C. Completion of applicable portions of the Praxis II.
- D. For additional information, see the Assistant Dean for Teacher Education and Accreditation.

#### VI. Minor in Chemistry

- A. CHE 111, 112, 211, 221, 314, 315, 324 326—23 hours
- B. Elective, one of: 317, 319, 335, 405, 430—3 or 4 hours

### Assessment of Majors

The Department utilizes standardized tests of the American Chemical Society as final examinations for the second semester of all one-year courses. These courses include General (CHE 111-2), Organic (CHE 314-5 and CHE 435), and Physical (CHE 317-8). Standardized examinations are also used as the final examination in Fundamentals (CHE 105), Analytical (CHE 211), and Biochemistry (CHE 319), Inorganic (CHE 335 and CHE 430). Examination results are used to monitor progress of students as a group through their course of study at Union. Strengths and weaknesses of courses are also assessed by comparing class averages with national norms. Students are required to complete a research project (CHE 424) and give a seminar to faculty and colleagues (CHE 498).

### Student Organizations

**Student Affiliate of the American Chemical Society** is organized to better acquaint students interested in chemical science with professional opportunities in the field and the mechanics of preparing and presenting technical material.

The organization instills professional pride in the chemical sciences, while stimulating awareness of the responsibilities and challenges of the modern chemist. Membership is open to any student pursuing an undergraduate degree in chemistry or physics.

**Sigma Zeta** is a national honorary science society for those who have completed 15 hours in natural science and mathematics and with a minimum 3.0 GPA in these courses. Membership advantages include recognition for academic achievements by the Sigma Zeta Honor Award, participation in nationally recognized research projects, and a means of cooperation in similar areas of interest by students of different colleges.

### Student Awards

**The Chemistry Research Award** is given by the faculty of the Department of Chemistry and Physics to the student who presents the best research paper of the year. The research must have been an original piece of work and must have been presented at a state, regional, or national professional chemistry meeting prior to graduation.

**The C.R.C. Freshman Chemistry Award**, given to encourage and sustain interest in the sciences, is awarded in recognition of outstanding scholastic achievement in Freshman Chemistry.

**Whiteaker Freshman Chemistry Award.** The Chemistry Department selects a freshman chemistry major or minor to receive this award based on outstanding scholastic achievement, financial need, Christian service, and school spirit.

### Course Offerings in Chemistry (CHE)

( ) Hours Credit; F-Fall, W-Winter; S-Spring; Su-Summer

#### 105. Fundamentals of Chemistry I (4) F, S, Su

An introductory general chemistry course that includes study of both physical and chemical properties, structure and reaction of matter. Not applicable to pre-health professions except Nursing. Science credit will not be given to a student who has completed a course in either CHE or PHY. Three lectures and one 2-hour laboratory period/week.

#### 106. Fundamentals of Chemistry II (4) As Needed

Prerequisite: CHE 105 or 111.

A beginning course in organic and biochemistry with emphasis on topics specifically related to the health sciences: carbohydrates, fats, proteins, vitamins, and hormones. Normal and abnormal metabolic processes and the role of ATP. Not open to science majors other than physical science and nursing. Three 1-hour lectures and one 3-hour laboratory period/week.

#### 111. General Chemistry (4) F, W

Prerequisite: high school chemistry or PHY 111. A strong mathematics background (especially in algebra) is recommended. A comprehensive study of the fundamental experiments, principles, and theories of chemistry with emphasis on the quantitative relationships. The structure and properties of

matter with their energy relationships are stressed. Three lectures and one 3-hour laboratory/week.

#### 112. Chemical Equilibrium (4) W, S

Prerequisite: CHE 111.

Detailed study of the principles of equilibrium in chemical systems. The laboratory is qualitative analysis. Three lectures and one 3-hour laboratory period/week.

#### 113. Survey of Chemical Instrumentation (2) W

Prerequisite: CHE 111

An introduction to chemical instrumentation used in industry, including titrations, spectroscopy, and chromatography. One lecture and one 3-hour lab/week.

#### 211. Analytical Chemistry (3) S

Prerequisite: CHE 112; Corequisite: CHE 221.

A continuation of the study of fundamental principles including topics in statistics, gravimetric analysis, titrimetric analysis (neutralization, precipitation, complex formation, oxidation-reduction), and spectrophotometric analysis.

#### 221. Analytical Chemistry Laboratory (2) S

Prerequisite: CHE 112; Corequisite: CHE 211.

The application of gravimetric, titrimetric, and spectrophotometric quantitative analysis to the study of chemistry. Two 3-hour laboratory periods/week.

**300. Chemical Safety and Health (1) S**

Safety policies and procedures for the use of hazardous chemicals. Topics include awareness, routes of chemicals into the body, safety apparatus and use; identification, types of chemical hazards; proper ways to handle, store, and dispose of hazardous chemicals.

**301. Perspectives in Science (4) F, W**

Reciprocal credit: PHY 301. See PHY 301 for course description.

**314. Organic Chemistry I (3) F**

Prerequisite: CHE 112; Corequisite: CHE 324.

An introduction to the compounds of carbon, with emphasis on the relationship between structure and properties. Applications of bonding theory, reaction mechanism, and stereochemistry are included. Some functional groups containing halogen and oxygen will be examined in detail.

**315. Organic Chemistry II (3) S**

Prerequisite: CHE 314; Corequisite: CHE 326.

An in-depth examination of the common oxygen and nitrogen functional groups with respect to structure and chemistry. Continued application of basic theory is included. Heterocyclic and biomolecules will also be examined. Three lectures/week.

**317. Physical Chemistry I (3) F**

Prerequisites: CHE 211, MAT 212, and PHY 232.

Application of physical techniques to chemical systems with emphasis on thermodynamics. The laws of thermodynamics will be derived and applied to phase and chemical equilibria, electrochemical cells, and surface phenomena.

**318. Physical Chemistry II (3) S**

Prerequisite: CHE 317.

A continuation of CHE 317 with emphasis on dynamics and quantum chemistry: kinetics, mechanisms, and photochemistry; atomic and molecular electronic structure and application to spectroscopy.

**319. Biochemistry (4) F**

Prerequisite: CHE 315, CHE 326, and BIO 112.

Introduction to the organic chemistry of living systems. Topics include the structure and function of proteins, enzymic control of chemical reactions, catabolism, anabolism, bioenergetics, biosynthesis, and molecular biology. Three lectures and one 3-hour lab/week.

**329. Biochemistry II (3) S**

A continuation of 319 with emphasis on bioenergetics and metabolism. Topics include the function and molecular control of catabolic pathways for proteins, lipids, and carbohydrates as well as anabolic pathways for biological synthesis of these molecules.

**324. Organic Chemistry Laboratory (2) F**

Corequisite: CHE 314.

Introduction to the basic techniques for the physical characterization and isolation of organic compounds. Use of spectrometric methods as applied to the determination of structure is included, as are some synthetic methods. Two 3-hour labs/week.

**326. Organic/Inorganic Synthesis Laboratory (2) S**

Prerequisite: CHE 314 and CHE 324;

Corequisite: CHE 315.

Application of laboratory techniques in synthesis and characterization of organic and inorganic compounds. Two 3-hour laboratory periods/week.

**327. Physical Chemistry Laboratory (2) S**

Corequisite: CHE 318.

The application of physical methods in the study of chemical compounds. Two 3-hour labs/week.

**335. Intermediate Inorganic Chemistry (3) S**

Pre- or Corequisite: CHE 315.

Introduction to inorganic compounds with an emphasis on coordination, bioinorganic, nuclear, and organometallic chemistry. The relationships between structure, physical properties, and reactivity will be examined in detail.

**405. Environmental Chemistry (4) S**

Prerequisite: CHE 315.

Study of rapid changes in earth's atmosphere, water, and soil caused by the activities of humankind with attention to the ozone layer, air quality, and water cycles. The vectors, fate, and treatment/removal strategies for organic and heavy metal pollutants will be discussed. Three lectures and one 3-hour lab/week.

**424-5. Introduction to Research (1-3) 424-F; 425-S**

Prerequisite: 20 hours of chemistry and junior/senior standing.

The student's knowledge is integrated by application of a simple piece of original work. Each course will be three hours per week per credit hour.

**430. Advanced Inorganic Chemistry (4) F—Even Years**

Prerequisite: CHE 211. Pre-or Corequisite: CHE 318 & 335.

A theoretical treatment of fundamental inorganic topics such as chemical bonding, periodic relationships, stereochemistry of inorganic complexes, acids and bases, and physical properties of inorganic compounds. Three lectures and one 3 hour lab/week.

**435. Advanced Organic Chemistry (4) F—Odd Years**

Prerequisite: CHE 315.

Extensive treatment of topics including reaction mechanisms, stereochemistry, heterocyclic chemistry, and molecular rearrangements. Three lectures and one 3-hour lab/week.

**498. Seminar (1-3) S**

Prerequisite: 20 hours of chemistry and junior/senior standing.

Skills in scientific and technical presentations, written and oral, will be polished. To be used at the discretion of the department for majors and minors only.

## Medical Technology Hospital-in-Residence Curriculum

### 411. Clinical Chemistry (6)

Chemical analysis of various body fluids and the study of their relationship to disease states.

### 412. Instrumentation (1)

The principles, use, and care of instruments found in up-to-date laboratories.

### 421. Hematology and Coagulation (7)

Application of theory to technical performance in hematological procedures which aid in classification of anemias, leukemias, and other blood cell abnormalities.

### 422. Advanced Microbiology (7)

A lecture and lab course covering the role of microorganisms as they cause disease in man. Methods employed in the identification of bacteria, fungi, viruses, and rickettsiae.

### 423. Serology (2)

A lecture and lab course in immunology, demonstrating reactions between antigens and antibodies are considered. Use of these reactions as a serodiagnostic tool is presented.

### 424. Immunohematology (5)

Includes selection, testing and bleeding of donors, identification of blood group antigens and antibodies, procedures employed in providing compatible blood for patients, and principles and procedures used in blood component therapy.

### 425. Parasitology (2)

A study of parasites of medical significance, both indigenous and foreign, with particular emphasis on life cycles and identification.

### 431. Urinalysis (2)

Gross, physical, microscopic, and chemical analysis of urine.

### 432. Clinical Correlations (1)

Basic understanding of altered physiology in disease; correlation between laboratory test results and anatomical/physiological changes.

### 440. Principles of Management and Ethics (0)

Preparation for the medical graduate for positions of leadership as supervisors and instructors.

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### 179-279-379-479. External Domestic Study Programs (1-3) As Needed

All courses and their applications must be defined and approved prior to registering.

### 180-280-380-480. Study Abroad Programs (1-4)

All courses and their application must be defined and approved prior to travel.

### 195-6-7. Special Studies (1-4)

### 295-6-7. Special Studies (1-4)

Lower-level group studies which do not appear in the regular departmental offerings.

### 395-6-7. Special Studies (1-4)

Upper-level group studies which do not appear in the regular departmental offerings.

### 495-6-7. Independent Study (1-4)

Individual study under the guidance of a faculty member(s).

### 489-9. Seminar (1-3)

To be used at the discretion of the department.