

# Chemistry

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203-C Materials Science Building

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**Chair:** Carmen Scholz, Professor and Interim Chair

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The Chemistry department offers the following graduate degree program:

- Masters of Science
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## Admission Requirements

General requirements of the School of Graduate Studies must be satisfied. In addition, students admitted to the graduate chemistry program are assumed to have training equivalent to the chemistry B.S. degree recommended by the American Chemical Society. The degree includes lecture and laboratory work in organic chemistry, physical chemistry, inorganic chemistry, analytical chemistry, biochemistry, polymer chemistry, and materials chemistry. Graduation from an undergraduate program not adhering to ACS standards does not preclude entrance into the UAH program. Students should realize, however, that if deficiencies exist, some additional undergraduate courses might be required. The time required to complete the M.S. degree may then be proportionately increased.

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## Program Objective

The Department of Chemistry is to provide high quality education in all aspects of chemistry. Graduates of the Master of Science program will present their work in well-respected journals with significant impact. Our second objective is to educate our students in chemistry to obtain either satisfactory employment or enrollment in a graduate or professional degree program.

## Learning Outcomes

Students will demonstrate:

- Ability to effectively present chemical knowledge in writing
- Ability to deliver an effective oral presentation of their research
- An excellent understanding of the basic concepts, methods, terminology, and theories of modern chemistry related to their research interests

## Master's Program in Chemistry

General requirements of the School of Graduate Studies under Plan I or Plan II must be satisfied.

### Plan I – Master of Science with Thesis

Up to 12 semester hours of the course requirements may be accepted as transfer credits from graduate work done in other chemistry programs.

#### Fields

Select one course from each of the following fields:

12

##### Analytical:

CH 521	CHEMICAL INSTRUMENTATION
CH 549	SPECTROSCOPY & MOLEC STR
CH 621	METHODS OF CHEMICAL ANALYSIS
CH 633	ORGANIC STRUCTURE DETERMINAT'N <sup>1</sup>

##### Inorganic:

CH 600	ADV INORGANIC CHEMISTRY
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##### Organic:

CH 631	SYNTHETIC ORGANIC CHEMISTRY
CH 632	PHYSICAL ORGANIC CHEMISTRY
CH 633	ORGANIC STRUCTURE DETERMINAT'N <sup>1</sup>
CH 634	MOLECULAR MODELING

##### Physical Chemistry:

CH 640	ADV CHEMICAL THERMODYNAMICS	
CH 641	STATIST THERMODYNAMICS	
CH 642	ADV CHEMICAL DYNAMICS	
CH 643	QUANTUM CHEMISTRY	
CH 646	THERMODYNAMICS OF MATRLS	
CH 647	ADV BIOPHYSICAL CHEMISTRY I	
CH 648	ADV BIOPHYSICAL CHEMISTRY II	
Select one course from one of the following fields:		3
Biochemistry:		
CH 561	BIOCHEMISTRY I	
CH 562	BIOCHEMISTRY II	
Polymer:		
CH 540	POLYMER SYNTHESIS & CHARACTERI	
CH 645	POLYMER PHYSICAL CHEMISTRY	
Select one course from your field of study		3
Select two additional courses of choice		6
<b>Total Semester Hours</b>		<b>24</b>

<sup>1</sup> CH 633 can only be applied to one area: Organic or Analytical Chemistry

## Plan II – Master of Science without Thesis

Graduate students entering Plan II must qualify by meeting one of the following preliminary examination requirements:

1. Passing ACS exams in biochemistry, inorganic chemistry, organic chemistry, or physical chemistry.
2. Having previously passed at least two sections of the Materials Science Program Exam I.
3. Having previously passed the Biotechnology Science and Engineering Preliminary Exam.

### Fields

Select one course from each of the following fields:		12
Analytical:		
CH 521	CHEMICAL INSTRUMENTATION	
CH 549	SPECTROSCOPY & MOLEC STR	
CH 621	METHODS OF CHEMICAL ANALYSIS	
CH 633	ORGANIC STRUCTURE DETERMINAT'N <sup>1</sup>	
Inorganic:		
CH 600	ADV INORGANIC CHEMISTRY	
Organic:		
CH 631	SYNTHETIC ORGANIC CHEMISTRY	
CH 632	PHYSICAL ORGANIC CHEMISTRY	
CH 633	ORGANIC STRUCTURE DETERMINAT'N <sup>1</sup>	
CH 634	MOLECULAR MODELING	
Physical Chemistry:		
CH 640	ADV CHEMICAL THERMODYNAMICS	
CH 641	STATIST THERMODYNAMICS	
CH 642	ADV CHEMICAL DYNAMICS	
CH 643	QUANTUM CHEMISTRY	
CH 646	THERMODYNAMICS OF MATRLS	
CH 647	ADV BIOPHYSICAL CHEMISTRY I	
CH 648	ADV BIOPHYSICAL CHEMISTRY II	
Select one course from one of the following fields:		3
Biochemistry:		
CH 561	BIOCHEMISTRY I	
CH 562	BIOCHEMISTRY II	

Polymer:		
CH 540	POLYMER SYNTHESIS & CHARACTERI	
CH 645	POLYMER PHYSICAL CHEMISTRY	
Select at least 18 semester hours in graduate coursework in chemistry or related fields		18
<b>Total Semester Hours</b>		<b>33</b>

<sup>1</sup> CH 633 can only be applied to one area: Organic or Analytical Chemistry

At least 18 semester hours out of the 33 total semester hours must be in Chemistry.

Plan II requires a program of study drawn up by the student and the Chemistry M.S. degree program advisor. Students must also complete two credit hours of CH 780 (<http://catalog.uah.edu/search/?P=CH%20780>). Plan II is not recommended for students seeking employment as industrial laboratory chemists because it does not require any experimental work.

## Non-Traditional Fifth-Year Program Leading to the M.S. in Chemistry Plus a Class A Alabama High School Teacher's Certificate

Those who have a B.A. or B.S. degree with a major or its equivalent in chemistry as determined by the Department of Chemistry, who have not taken more than 12 semester hours in teacher education (graduate or undergraduate), and who are interested in obtaining Class A (master's level) certification for secondary school teaching, should consider the Non-Traditional Fifth Year Program. Contact the College of Education for preliminary advisement on admission and general program requirements. See the description in the Education (<http://catalog.uah.edu/search/?P=Education>) section for more details.

### CH 500 - TOPICS IN CHEMISTRY

Semester Hours: 1-3

Advanced laboratory research in one of the departmental research groups. The student works on an independent or group research project. Completion of the course requires an appropriate written and oral report. Prerequisites: Approval of instructor.

### CH 521 - CHEMICAL INSTRUMENTATION

Semester Hours: 4

Use of basic instrumentation in NMR, mass spectrometric, chromatographic, and spectrophotometric analysis.

### CH 540 - POLYMER SYNTHESIS & CHARACTERI

Semester Hours: 3

Same as MTS 649.

### CH 549 - SPECTROSCOPY & MOLEC STR

Semester Hours: 3

Intermediate level treatment of principles of spectroscopy and their application to determination of molecular structure.

### CH 553 - INTRO QUANTUM MECH I

Semester Hours: 3

Waves and particles; Bohr's model; de Broglie waves, wave-packets, uncertainty principle; quantum mechanics postulates; Schroedinger equation; systems in 1, 2 & 3 dimensions; hydrogen atom. Same as PH 551, OSE 555, and MTS 651.

### CH 554 - INTRO QUANTUM MECH II

Semester Hours: 3

Angular momentum and spin; atomic structure and spectrum; time-independent perturbation theory, variational methods; time-dependent perturbation theory and interactions of light with matter; scattering theory; electronic structure of solids; relativistic quantum mechanics. Same as: PH 552, MTS 652.

### CH 561 - BIOCHEMISTRY I

Semester Hours: 3

Structural chemistry and function of biomolecules, mechanisms of biochemical reactions, enzyme kinetics, and energy transfer. Same as: BYS 547.

### CH 562 - BIOCHEMISTRY II

Semester Hours: 3

Metabolism, biosynthesis of macromolecular precursors, storage, transmission, and expression of genetic information, and molecular physiology. Same as BYS 548. Prerequisites: CH 561 or BYS 547.

CH 600 - ADV INORGANIC CHEMISTRY

Semester Hours: 3

Survey with emphasis on structure and reactivity of inorganic compounds.

CH 602 - CHEM COORD COMPOUNDS

Semester Hours: 3

Modern bonding theory and stereo chemistry of coordination compounds.

CH 621 - METHODS OF CHEMICAL ANALYSIS

Semester Hours: 3

Literature, seminar course. Theory and methodology of various techniques of chemical analysis.

CH 631 - SYNTHETIC ORGANIC CHEMISTRY

Semester Hours: 3

Survey of certain reactions that enjoy widespread application to the synthesis of organic compounds.

CH 632 - PHYSICAL ORGANIC CHEMISTRY

Semester Hours: 3

Reactive intermediates, structure-activity relationships, reaction mechanisms and techniques used to determine them.

CH 633 - ORGANIC STRUCTURE DETERMINAT'N

Semester Hours: 3

Structure determination of organic molecules using spectroscopic methods, especially NMR, IR, and MS. Emphasis on the theory and interpretation of many NMR methods useful in chemistry research.

CH 634 - MOLECULAR MODELING

Semester Hours: 4

Molecular modeling methods, including molecular mechanics, molecular docking, molecular orbital theory, and density functional theory, will be used to investigate conformational properties of organic compounds, molecular interactions between biological macromolecules and organic ligands, electronic structure of organic and inorganic compounds, frontier molecular orbitals, pericyclic reactions, and reactive intermediates. Extensive computational laboratory work included.

CH 635 - CHEMICAL TOXICOLOGY

Semester Hours: 3

An introduction to the principles of chemical toxicology, including the effects of drugs, environmental pollutants, natural toxins and venoms and other potentially hazardous chemicals at the physiological, cellular, and molecular level.

CH 640 - ADV CHEMICAL THERMODYNAMICS

Semester Hours: 3

First, second, and third laws of thermodynamics. Thermodynamic functions. Applications to thermal properties of gases, liquids, solids, and solutions. Chemical reactions, phase transitions, and electrochemistry.

CH 641 - STATIST THERMODYNAMICS

Semester Hours: 3

Principles leading to the development of Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac statistics. Thermodynamic properties calculated from partition functions.

CH 642 - ADV CHEMICAL DYNAMICS

Semester Hours: 3

Non-equilibrium thermodynamics, macroscopic and microscopic theories of diffusion, chemical reaction rate laws and mechanisms, transition state theory, gas phase molecular dynamics, electrical conduction in electrolyte solutions, electrode kinetics.

CH 643 - QUANTUM CHEMISTRY

Semester Hours: 3

Application of quantum theory to the chemical bond.

CH 644 - CHEM ELECTRODYNAMICS

Semester Hours: 3

Maxwell's equations applied to electrodynamic problems in chemistry. Theory of dielectrics, dipole moments, Beer's law, Landolt's rule, light scattering, magnetic properties, quantum theory of radiation.

**CH 645 - POLYMER PHYSICAL CHEMISTRY**

Semester Hours: 3

Introduction to structure, properties and processing of polymers. Physical behavior of polymers, structure-property relationships, polymer characterization, thermodynamics of polymer solutions and melts, mechanical evaluation of polymers. Same as MTS 747. Prerequisite: CH 540.

**CH 646 - THERMODYNAMICS OF MATRLS**

Semester Hours: 3

Fundamental thermodynamic review, phase equilibrium, chemical reaction equilibrium, free energy, binary and ternary phase transformations, solution models and selected topics. Same as CHE 646 and MTS 646.

**CH 647 - ADV BIOPHYSICAL CHEMISTRY I**

Semester Hours: 3

Topics include: computer data analysis & simulation, first & second laws of thermodynamics, free energy & equilibrium, calorimetry, protein stability, binding & interactions, solution thermodynamics, electrolytes. Students who have completed CH 347 cannot earn credit for CH 647.

**CH 648 - ADV BIOPHYSICAL CHEMISTRY II**

Semester Hours: 3

Advanced biophysical chemistry, including biochemical reaction kinetics, enzyme catalysis, quantum mechanics, statistical thermodynamics, spectroscopy, including UV-VIS, fluorescence, circular dichroism, NMR, and Structure determinations. An emphasis is placed on the current research literature. Prerequisite: CH 647 Students who have completed CH 348 cannot earn credit for CH 648.

**CH 650 - PRINC LIQUID/SOLID INTER**

Semester Hours: 3

Applies principles in thermodynamics & kinetics to characterize surfaces & surface phenomena. Fundamental properties of gas-liquid, liquid-liquid, solid-liquid and solid-gas interfaces and phenomena at these interfaces. Same as MTS 650 and CHE 650.

**CH 699 - MASTER'S THESIS**

Semester Hours: 3-6

Required each semester a student is enrolled and receiving direction on a masters thesis. Minimum of two terms is required. (A maximum of six hours may be applied towards the degree).

**CH 700 - CURRENT TOPICS IN CHEMISTRY**

Semester Hours: 1-3

Advanced laboratory research in one of the departmental research groups. The student works on an independent or group research project. Completion of the course requires a written and an oral report. Prerequisite: approval of instructor.

**CH 705 - SEL TOP IN INORGANIC CHEM**

Semester Hours: 3

Prerequisites: CH 600 and approval of instructor.

**CH 721 - SP TOP IN ANALYTICAL CHEMISTRY**

Semester Hours: 3

Prerequisites: CH 621 and approval of instructor.

**CH 735 - SEL TOP IN ORGANIC CHEM**

Semester Hours: 3

Prerequisites: CH 632 and approval of instructor.

**CH 745 - SEL TOP IN PHYSICAL CHEM**

Semester Hours: 3

**CH 746 - SOLID STATE CHEMISTRY**

Semester Hours: 3

Chemical properties of solids. Includes phase equilibria, chemical bonding in ionic and covalent crystals, thermodynamics of atomic defects, ionic conductivity in solids, corrosion, & introduction to surfaces and adsorption.

**CH 765 - SEL TOPICS IN BIOCHEM**

Semester Hours: 3

Prerequisites: CH 560 and approval of instructor.

CH 780 - CHEMISTRY SEMINAR

Semester Hour: 1

Required during each semester of residence.

CH 799 - DOCTORAL DISSERTATION

Semester Hours: 3-9