The Chemistry department offers the following graduate degree program:

Masters of Science

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.

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.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Semester Hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Fields</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Select one course from each of the following fields:</td>
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<td></td>
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<tr>
<td>CH 521</td>
<td>CHEMICAL INSTRUMENTATION</td>
<td></td>
</tr>
<tr>
<td>CH 549</td>
<td>SPECTROSCOPY &amp; MOLEC STR</td>
<td></td>
</tr>
<tr>
<td>CH 621</td>
<td>METHODS OF CHEMICAL ANALYSIS</td>
<td></td>
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<tr>
<td>CH 633</td>
<td>ORGANIC STRUCTURE DETERMINAT'N</td>
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</tr>
<tr>
<td>CH 600</td>
<td>ADV INORGANIC CHEMISTRY</td>
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<tr>
<td>CH 631</td>
<td>SYNTHETIC ORGANIC CHEMISTRY</td>
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<tr>
<td>CH 632</td>
<td>PHYSICAL ORGANIC CHEMISTRY</td>
<td></td>
</tr>
<tr>
<td>CH 633</td>
<td>ORGANIC STRUCTURE DETERMINAT'N</td>
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</tbody>
</table>
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.

**Code** | **Title** | **Semester Hours**
--- | --- | ---

**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 DETERMINATION 1

**Inorganic:**
- CH 633  ADV INORGANIC CHEMISTRY

**Organic:**
- CH 631  SYNTHETIC ORGANIC CHEMISTRY
- CH 632  PHYSICAL ORGANIC CHEMISTRY
- CH 633  ORGANIC STRUCTURE DETERMINATION 1
- 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

CH 633 can only be applied to one area: Organic or Analytical Chemistry
Select one course from one of the following fields:  

**Biochemistry:**

- CH 561  BIOCHEMISTRY I
- CH 562  BIOCHEMISTRY II

**Polymer:**

- CH 540  POLYMER SYNTHESIS & CHARACTERIZATION
- CH 645  POLYMER PHYSICAL CHEMISTRY

Select at least 18 semester hours in graduate coursework in chemistry or related fields  

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>CH 500</td>
<td>TOPICS IN CHEMISTRY</td>
</tr>
<tr>
<td>Semester Hours: 1-3</td>
<td></td>
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</tbody>
</table>

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.

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<tbody>
<tr>
<td>CH 521</td>
<td>CHEMICAL INSTRUMENTATION</td>
</tr>
<tr>
<td>Semester Hours: 4</td>
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</table>

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

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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>CH 540</td>
<td>POLYMER SYNTHESIS &amp; CHARACTERIZATION</td>
</tr>
<tr>
<td>Semester Hours: 3</td>
<td></td>
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</table>

Same as MTS 649.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>CH 549</td>
<td>SPECTROSCOPY &amp; MOLECULAR STRUCTURE</td>
</tr>
<tr>
<td>Semester Hours: 3</td>
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</table>

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

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<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>CH 553</td>
<td>INTRO QUANTUM MECHANICS I</td>
</tr>
<tr>
<td>Semester Hours: 3</td>
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</tbody>
</table>

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.

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<tbody>
<tr>
<td>CH 554</td>
<td>INTRO QUANTUM MECHANICS II</td>
</tr>
<tr>
<td>Semester Hours: 3</td>
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</tbody>
</table>

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. Prerequisite: PH 551 or CH 553.

<table>
<thead>
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<th>Course Title</th>
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<tbody>
<tr>
<td>CH 561</td>
<td>BIOCHEMISTRY I</td>
</tr>
<tr>
<td>Semester Hours: 3</td>
<td></td>
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</tbody>
</table>

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 DETERMINATION  
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  

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. Prerequisite: CH 640.

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