

## Chemistry

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### OBJECTIVES

The objective of the Graduate program in Chemistry is to provide theoretical and experimental training for students pursuing M.S. in Chemistry, M.A. in Teaching Chemistry, interdisciplinary M.S. in computer science and engineering, and interdisciplinary Ph.D. in Energy and Environmental Systems. The Department also offers special courses that may be used for teacher renewal certificates.

### DEGREES OFFERED

Master of Science- Chemistry  
Master of Arts in Teaching - Chemistry

### GENERAL REQUIREMENTS

Admission to the Graduate School under one of the following options:

1. Unconditional admission
2. Provisional admission

### DEPARTMENTAL REQUIREMENTS

Admission to degree programs for the Master of Science in Chemistry and the Master of Arts in Teaching - Chemistry require a baccalaureate degree from an accredited undergraduate institution. Unconditional admission to the Master of Science in Chemistry requires an undergraduate degree in chemistry that includes one year of physical chemistry and one year of differential and integral calculus.

#### M.S. in Chemistry: Thesis Option

##### 1. Required Core Courses:

	Credit
Chemistry 711 — Structural Inorganic Chemistry	3.0
Chemistry 722 — Advanced Organic Chemistry	3.0
Chemistry 743 — Chemical Thermodynamics	3.0
Chemistry 701 — Seminar	1.0
Chemistry 732 — Advanced Analytical Chemistry	3.0
Chemistry 799 — Thesis Research	3.0
Chemistry 702 — Chemical Research	3.0 -9.0

(A maximum of 9 hrs. may be earned in 702.)

##### 2. Other Requirements:

- a. 2-9 semester hours in electives
- b. Successful completion of 30 credit hours, at least 17 credit hours at 700 level
- c. Pass comprehensive examinations
- d. Satisfactory presentation and defense (open to public) of a thesis.
- e. Thesis to be submitted to the School of Graduate Studies
- f. One academic year of residence at A&T
- g. Regular attendance of departmental seminars

#### M.S. in Chemistry –Project Option

This option requires 30 hours of course work and 3 credits of project research (CHEM 703). Of the 33 credit hours of course work, at least 17 credits must be at the 700 level. The advisor and the student select a suitable project of mutual interest. A formal advisory committee is required for this option. The project advisor appoints the project committee members after consultation with the student. All project option students are required to defend their findings in a public seminar and submit a final report on their project.

<b>1. Required Courses (17 Credit hours)</b>	<b>Credit</b>
Chemistry 701 – Seminar	1.0
Chemistry 711 – Structural Inorganic Chemistry	3.0
Chemistry 722 – Advanced Organic Chemistry	3.0
Chemistry 732 – Advanced Analytical Chemistry	3.0
Chemistry 743 – Chemical Thermodynamics	3.0
Chemistry 703 – Masters Project Research	3.0
Chemistry 715, 725, 735, 745, or 755	1.0

## **2. Electives (16 Credit hours)**

Students are required to complete a minimum of 11 credit hours from the Chemistry electives and the other 5 credit hours from Chemistry and/or non-chemistry electives listed below:

<b>Chemistry Electives</b>	<b>Credit</b>
Chemistry 610 Inorganic Synthesis	2.0
Chemistry 611 Advanced Inorganic	3.0
Chemistry 621 Intermediate Organic	3.0
Chemistry 651 General Biochemistry	3.0
Chemistry 652 General Biochemistry Lab	2.0
Chemistry 663* Selected Topics in Chem. Instruction I	1.0
Chemistry 664* Selected Topics in Chem. Instruction II	1.0

Any 700 level courses included in the Department's regular offerings.

\*These courses are required for Graduate Teaching Assistants.

### **Non-Chemistry Electives:**

Any 600 or 700 level course from the College of Arts & Science, School of Agriculture and Environmental Sciences, or College of Engineering

### **3. Other Requirements:**

- Satisfactory completion of an examination in foreign language or computer language
- Satisfactory presentation and defense of the project
- One academic year of residence at A&T
- Pass comprehensive examinations.

## **Master of Arts in Teaching – Chemistry**

**Entrance Requirements** - Minimum 2.5 GPA

**Prerequisites** - 11 or more hours as needed

- One year of physical chemistry
- Organic Chemistry II
- General Biochemistry
- Qualitative and Quantitative Analysis

### **Phase I (Initial Licensure Coursework) 24 hours**

<b>Course</b>	<b>Title</b>	<b>Credit Hours</b>
CHEM 611	Advanced Inorganic Chemistry	3.0
CHEM 621	Intermediate Organic Chemistry	3.0
CHEM 732	Environmental Chemistry	3.0
CHEM 643	Introduction to Quantum Mechanics	3.0
CHEM 651	Advanced Biochemistry	3.0
CHEM 703	Methods of Chemistry Instruction Internship I	3.0
CHEM 704	Methods of Chemistry Instruction Internship II	3.0
CUIN 624	Teaching Reading in the Secondary School	3.0

**Benchmark** - Minimum 3.0 GPA, Pass PRAXIS II, teach successfully for a minimum of one year or complete 12 semester hours of student teaching. Students must take the GRE to advance further.

**Phase II (Advanced Studies Coursework) 15 hours**

Course	Title	Credit Hours
CHEM 703	Master Project Research	3.0
CUIN 711	Research and Inquiry	3.0
CUIN 729	Diversity	3.0
CUIN 728	Technology	3.0
CUIN 721	Advanced Methods	3.0
CUIN 713	Learning Theories	3.0
CUIN 788	Comprehensive Exam	0.0

**Exit Requirements -**

**Notes:** See Curriculum & Instruction section for detailed course descriptions.

**COURSES FOR ADVANCED UNDERGRADUATES AND GRADUATES**

Course	Title	Credit
CHEM 610	Inorganic Synthesis	2
CHEM 611	Advanced Inorganic	3
CHEM 621	Intermediate Organic Chemistry	3
CHEM 624	Qualitative Organic Chemistry	3
CHEM 631	Electroanalytical Chemistry	3
CHEM 632	Environmental Chemistry	3
CHEM 641	Radiochemistry	3
CHEM 642	Radioisotope Techniques and Application	2
CHEM 643	Introduction to Quantum Mechanics	4
CHEM 651	General Biochemistry	3
CHEM 652	General Biochemistry Lab	2
CHEM 673	Introduction to Computational Chemistry	3
CHEM 674	Computational Methods in Protein Modeling and Drug Design	3

**GRADUATE STUDENTS ONLY**

*(Inorganic)*

Course	Title	Credit
CHEM 711	Structural Inorganic Chemistry	3
CHEM 716	Selected Topics in Inorganic Chemistry	3

*(Organic)*

CHEM 721	Elements of Organic Chemistry	3
CHEM 722	Advanced Organic Chemistry	3
CHEM 723	Organic Chemistry	2
CHEM 726	Selected Topics in Organic Chemistry	3
CHEM 727	Organic Preparations	1-2

*(Biochemistry)*

CHEM 756	Selected Topics in Biochemistry	3
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*(Analytical Chemistry)*

CHEM 731	Modern Analytical Chemistry	3
CHEM 732	Advanced Analytical Chemistry	3

CHEM 736 Selected Topics in Analytical Chemistry 3

*(Physical Chemistry)*

CHEM 741 Principles of Physical Chemistry I 3

CHEM 742 Principles of Physical Chemistry II 3

CHEM 743 Chemical Thermodynamics 3

CHEM 744 Chemical Spectroscopy 3

CHEM 746 Selected Topics in Physical Chemistry 3

CHEM 748 Colloid Chemistry 2

CHEM 749 Chemical Kinetics 2

**RESEARCH AND SPECIAL TOPICS**

CHEM 701 Seminar 1

CHEM 702 Chemical Research 2-5

CHEM 715 Special Problems in Inorganic Chemistry 1

CHEM 725 Special Problems in Organic Chemistry 1

CHEM 735 Special Problems in Analytical Chemistry 1

CHEM 745 Special Problems in Physical Chemistry 1

CHEM 755 Special Problems in Biochemistry 1

**CHEMICAL INSTRUCTION**

CHEM 663 Selected Topics in Chemistry INSTRUCTION I 1

CHEM 664 Selected Topics in Chemistry INSTRUCTION II 1

CHEM 765 Special Problems in Chemistry INSTRUCTION I 3

CHEM 766 Special Problems in Chemistry INSTRUCTION II 3

CHEM 767 Special Problems in Chemistry INSTRUCTION III 3

CHEM 768 Special Problems in Chemistry INSTRUCTION IV 3

**COURSES WITH DESCRIPTION IN CHEMISTRY**

**Advanced Undergraduate and Graduate**

**CHEM-610. Inorganic Synthesis** **Credit 2 (1-3)**

Discussion of theoretical principles of synthesis and development of manipulative skills in the synthesis of inorganic substances. Prerequisites: One year of organic chemistry; one semester of quantitative analysis.

**CHEM-611. Advanced Inorganic Chemistry** **Credit 3 (3-0)**

A course in the theoretical approach to the systematization of inorganic chemistry. Prerequisite: Chemistry 442.

**CHEM-621. Intermediate Organic Chemistry** **Credit 3 (3-0)**

An in-depth examination of various organic mechanisms, reactions, structures, and kinetics. Prerequisite: Chemistry 222.

**CHEM-624. Qualitative Organic Chemistry\*** **Credit 5 (3-6)**

A course in the systematic identification of organic compounds. Prerequisite: One year of Organic Chemistry.

**CHEM-631. Electroanalytical Chemistry** **Credit 3 (3-0)**

A study of the theory and practice of polarography, chronopotentionmetry, potential sweep chronoamperometry and electrodeposition. The theory of diffusion and electrode kinetics will also be discussed along with the factors that influence rate processes, the double layer, absorption and catalytic reactions. Prerequisite: Chemistry 431 or equivalent.

**CHEM-632. Environmental Chemistry** **Credit 3(3-0)**

This course begins with an overview of environmental science and technology. The course covers the study of the sources, reactions, transport, effects, and fates of chemical species in water, soil, and air. Different types of water pollutants, inorganic and organic air pollutants and pollutants in the soil will be discussed in detail. Sources, chemistry, and treatment of

hazardous wastes will also be addressed. Finally, some of the analytical methods used in the determination of water and air pollutants will be covered in this course. Prerequisites: CHEM 221, 231, and 431 or permission of the instructor.

**CHEM-641. Radiochemistry** **Credit 3 (3-0)**

A study of the fundamental concepts, processes, and applications of nuclear chemistry, including natural and artificial radioactivity, sources, and chemistry of the radioelements. Open to advanced majors and others with sufficient background in chemistry and physics. Prerequisite: Chemistry 442 or Physics 406.

**CHEM-642. Radioisotope Techniques and Applications** **Credit 2 (1-3)**

The techniques of measuring and handling radioisotopes and their use in chemistry, biology, and other fields. Open to majors and non-majors. Prerequisite: Chemistry 102 or 105 or 107.

**CHEM-643. Introduction to Quantum Mechanics** **Credit 4 (4-0)**

Non-relativistic wave mechanics and its application to simple systems of means of the operator formulation. Prerequisites: Chemistry 442 and Physics 222. Co-requisite: Mathematics 300.

**CHEM-651. General Biochemistry** **Credit 3 (3-0)**

A study of modern biochemistry. The course emphasizes chemical kinetics and energetics associated with biological reactions and includes a study of carbohydrates, lipids, proteins, vitamins, nucleic acids, hormones, photosynthesis, and respiration. Prerequisites: Chemistry 431 and 442.

**CHEM-652. General Biochemistry** **Credit 3 (3-0)**

This is a companion laboratory to Chemistry 651. Experimentation will include isolation and characterization of biochemical substances as well as studies of physical properties. Students will be introduced to a variety of techniques including high performance liquid chromatography, electrophoresis, and centrifugation. Co-requisite: Chemistry 651. Prerequisites: Chemistry 432 and 444.

**CHEM-673. Introduction to Computational Chemistry** **Credits 3(2-2)**

This course introduces students to the basic principles of classical and quantum mechanics and their application to solving chemical/biochemical problems. A hands-on approach will be taken with equal time being spent in the classroom and in the laboratory. Prerequisites: CHEM 107, PHYS 242, and MATH 231 or their equivalent.

**CHEM-674. Computational Methods in Protein Modeling and Drug Design** **Credit 3(2-2)**

This course introduces various computational chemistry methods involved in modeling macromolecular proteins and structure-based drug design. A hands-on approach will be taken with equal time being spent in class and the laboratory. The course includes homology modeling, ab initio threading methods to model proteins from sequence to three-dimensional structures, chemoinformatics and structure-based drug design methods such as QSAR and docking. Prerequisite: CHEM 673.

\* *Students are required to purchase supplemental materials for this course.*

## INORGANIC CHEMISTRY

### Graduate Students Only

**CHEM-711. Structural Inorganic Chemistry** **Credit 3 (3-0)**

A study of the stereochemistry and electronic properties of inorganic substances. Emphasis will be placed upon applications of group theory and upon spectroscopic and physical methods.

**CHEM-716. Selected Topics in Inorganic Chemistry** **Credit 3 (3-0)**

A lecture course on advanced topics of Inorganic Chemistry. Prerequisite: Chemistry 611 or permission of the instructor.

## ORGANIC CHEMISTRY

### Graduate Students Only

#### **CHEM-721. Elements of Organic Chemistry** **Credit 3 (2-3)**

A systematic study of the classes of aliphatic and aromatic compounds and individual examples of each. Structure, nomenclature, synthesis, and characteristic reactions will be considered. Illustration of the familiarity of organic substances in everyday life will be included. In the laboratory, preparation and characterization reactions will be performed.

#### **CHEM-722. Advanced Organic Chemistry** **Credit 3 (3-0)**

Recent developments in the areas of structural theory, stereochemistry, molecular rearrangement and mechanism of reactions of selected classes of organic compounds. Prerequisite: One year of Organic Chemistry or Chemistry 721.

#### **CHEM-723. Organic Chemistry** **Credit 2 (2-0)**

An advanced treatment of organic reactions designed to give students a working knowledge of the scope and limitations of the important synthetic methods of Organic Chemistry. Prerequisite: Chemistry 722.

#### **CHEM-726. Selected Topics in Organic Chemistry** **Credit 3 (3-0)**

A lecture course on advanced topics in Organic Chemistry.

#### **CHEM-727. Organic Preparations** **Credit 1-2 (0-2 to 4)**

An advanced laboratory course. Emphasis is placed on the preparation and purification of more complex organic compounds. Prerequisite: One year of Organic Chemistry.

## BIOCHEMISTRY

### Graduate Students Only

#### **CHEM-756. Selected Topics in Biochemistry** **Credit 3 (3-0)**

A lecture course on advanced topics in Biochemistry.

## ANALYTICAL CHEMISTRY

### Graduate Students Only

#### **CHEM-731. Modern Analytical Chemistry** **Credit 3 (2-3)**

The theoretical bases of Analytical Chemistry are presented in detail. In the laboratory, these principles, together with a knowledge of chemical properties, are used to identify substances and estimate quantities in unknown samples.

#### **CHEM-732. Advanced Analytical Chemistry** **Credit 3 (3-0)**

A lecture course in which the theoretical bases of Analytical Chemistry and their application in analysis will be reviewed with greater depth than is possible in the customary undergraduate courses. Equilibrium processes, including proton and electron transfer reactions and matter-energy interactions, will be considered. Prerequisite: One year of Analytical Chemistry or Chemistry 731.

#### **CHEM-736. Selected Topics in Analytical Chemistry** **Credit 3 (3-0)**

A lecture course on advanced topics in Analytical Chemistry

## PHYSICAL CHEMISTRY

### Graduate Students Only

#### **CHEM-741. Principles of Physical Chemistry I** **Credit 3 (3-0)**

A review of the fundamental principles of Physical Chemistry, including the derivation of the more important equations and their application to the solution of problems. Prerequisite: Mathematics 606 or 622.

#### **CHEM-742. Principles of Physical Chemistry II** **Credit 3 (3-0)**

A continuation of Chemistry 741. May be taken concurrently with Chemistry 741.

#### **CHEM-743. Chemical Thermodynamics** **Credit 3 (3-0)**

An advanced course in which the laws of thermodynamics will be considered in their application to chemical processes. Prerequisite: Chemistry 442 or 742.

**CHEM-744. Chemical Spectroscopy** **Credit 3 (2-3)**  
An advanced course in which the principles and applications of spectroscopy will be considered.  
Prerequisite: Chemistry 442 or 742.

**CHEM-746. Selected Topics in Physical Chemistry** **Credit 3 (3-0)**  
A lecture course on advanced topics in Physical Chemistry. Prerequisite: Chemistry 442 or 742.

**CHEM-748. Colloid Chemistry** **Credit 2 (2-0)**  
A study of the types of colloidal systems and the fundamental principles governing their preparation and behavior. Prerequisite: Chemistry 442 or 742.

**CHEM-749. Chemical Kinetics** **Credit 4 (4-0)**  
A study of the theory of rate processes; application to the study of reaction mechanisms.  
Prerequisites: Mathematics 222 and Chemistry 442 or 742.

### RESEARCH AND SPECIAL PROBLEMS

#### Graduate Students Only

**CHEM-663. Selected Topics in Chemistry Instruction I** **Credit 1 (1-0)**  
A study of the curriculum and educational materials developed for use in the Thirteen College Curriculum Program in Physical Science.

**CHEM-664. Selected Topics in Chemistry Instruction II** **Credit 1 (1-0)**  
A continuation of Chemistry 663

**CHEM-701. Seminar** **Credit 1 (1-0)**  
Presentation and discussion of library or laboratory research problems.

**CHEM-702. Chemical Research** **Credit 2-5 (0.6 to 15)**  
A course designed to permit qualified students to do original research in chemistry under the supervision of a senior staff member. May be taken for credit more than once.

**CHEM-703. Masters Project Research** **Credit 3 (3-0)**  
The student will conduct advanced research of interest to the student and the instructor. A written proposal, which outlines the nature of the project and the deliverables, must be submitted for approval. This course is only available to project option students. Prerequisite: Graduate standing.

**CHEM-715. Special Problems in Inorganic Chemistry** **Credit 1 (0-2)**  
A laboratory course designed to introduce the student to the techniques of chemical research by solving minor problems in Inorganic Chemistry. May be taken for credit more than once.

**CHEM-725. Special Problems in Organic Chemistry** **Credit 1 (0-2)**  
A laboratory course designed to introduce the student to the techniques of chemical research by solving minor problems in Organic Chemistry. May be taken for credit more than once.

**CHEM-735. Special Problems in Analytical Chemistry** **Credit 1 (0-2)**  
A laboratory course designed to introduce the student to the techniques of chemical research by solving minor problems in Analytical Chemistry. May be taken for credit more than once.

**CHEM-745. Special Problems in Physical Chemistry** **Credit 1 (0-2)**  
A laboratory course designed to introduce the student to the techniques of chemical research by solving minor problems in Physical Chemistry. May be taken for credit more than once.

**CHEM-755. Special Problems in Biochemistry** **Credit 1 (0-2)**

A laboratory course designed to introduce the student to the techniques of chemical research by solving minor problems in Biochemistry. May be taken for credit more than once.

**CHEM-765. Special Problems in Chemistry Instruction I** **Credit 3 (3-0)**

A course designed to introduce students to techniques of Chemistry instruction at the college level.

**CHEM-766. Special Problems in Chemistry Instruction II** **Credit 3 (3-0)**

A continuation of Chemistry 765.

**CHEM-767. Special Problems in Chemistry Instruction III** **Credit 3 (3-0)**

A continuation of Chemistry 766.

**CHEM-768. Special Problems in Chemistry Instruction IV** **Credit 3 (3-0)**

A continuation of Chemistry 767.

**CHEM-799. Thesis Research I** **Credit 3 (3-0)**

A course designed for conducting thesis research under the supervision of the thesis committee chairperson leading to the completion of the master's thesis. This course is only available to thesis option students. Prerequisite: Permission of advisor.

**CHEM-999. Thesis Research II** **Credit 0 (0-0)**

A continuation of Chemistry 799. A written thesis must be produced and an oral thesis defense is required.

**Directory of Faculty**

**William Adeniyi**, B.A., Hampton University; M.S., Loyola University; Ph.D., Baylor University, Analytical Chemistry; Associate Professor

**Zerihun Assefa**, B. S., Addis Ababa University (Ethiopia); Ph.D., University of Maine, Inorganic Chemistry; Associate Professor

**Mufeed Basti**, B.S., Baath University (Homs, Syria); Ph.D., North Illinois University, Physical Chemistry; Associate Professor

**Marion Franks**, B.S., Clark-Atlanta University, Ph.D., Virginia Polytechnic Institute and State University, Organic Chemistry, Associate Professor

**Etta Gravely**, B.S., Howard University; M.S., North Carolina A&T State University; Ed.D., UNC-Greensboro; Associate Professor

**Vallie Guthrie**, B.S., North Carolina A&T State University; M.A., Fisk University; Ed.D., American University; Associate Professor

**Julius Harp**, B.S., York College (Jamaica, NY); Ph.D., Howard University, Organic Chemistry, Associate Professor

**Margaret Kanipes**, B.S., North Carolina A&T State University, Ph.D., Carnegie-Mellon University, Associate Professor

**Debasish Kuila**, B.Sc. (Hons.), Calcutta University, India; M.Sc., Indian Institute of Technology, Madras, Ph.D., The City University of New York; Professor

**Claude N. Lamb**, B.S., Mount Union College; M.S., North Carolina Central University; Ph.D., Howard University; Organic Chemistry, Associate Professor

**Divi Venkateswarlu**, B.S., Sri Venkateswara University, M.S., Kakatiya University, M.Phil. University of Hyderabad, Ph.D., North Eastern Hill University, Associate Professor

**Alex N. Williamson**, B.S., Jackson State University; Ph.D., University of Illinois; Inorganic Chemistry, Associate Professor