

**Master of Science in Chemistry**  
**Program code: 042010**

**INTRODUCTION**

The Department of Chemistry (College of Science) offers a Master of Science program in **Chemistry**. The program is designed to prepare individuals for a career in: College or University teaching, a leadership role in secondary school science education, employment in government or industrial laboratories, or technically oriented positions in government and business. A wide range of potential areas for research is available for students to choose from. Among the current areas of faculty research are the following: Physical Chemistry, Organic Chemistry, and Inorganic and Analytical Chemistry. Only thesis option is offered.

*According to the University Council decision dated 4/2/2007, Thesis students admitted with effect from September 2007 are exempted from the comprehensive examination.*

**PROGRAM REQUIREMENTS****31 TOTAL COURSE CREDITS****10 COMPULSORY (credits in parenthesis)**

0420-512	Advanced Thermodynamics	(3)
0420-541	Advanced Inorganic Chemistry	(3)
0420-552	Advanced Organic Chemistry I	(3)
0420-591	Seminar	(1)

**12 ELECTIVES\* (3 Credits each)**

0420-521	Surface Chemistry & Heterogeneous Catalysis
0420-522	Advanced Electrochemistry
0420-523	Physico-chemical Aspects of Analytical Separations
0420-524	Advanced Quantum Chemistry
0420-525	Structure and Properties of High Polymers
0420-530	Selected Topics in Applied Physical Chemistry
0420-532	Chemical Application of Group Theory
0420-542	Selected Topics in Inorganic Chemistry
0420-543	Selected Topics in Analytical Chemistry
0420-544	Advanced Environmental Chemistry
0420-561	The Chemistry of Heterocyclic Compounds
0420-562	Synthetic Organic Chemistry
0420-563	Physical Methods in Organic Chemistry
0420-564	Selected Topics in Organic Chemistry

0420-565 Topical Organic Chemistry

\*Students may substitute up to 6 credit hours from the (400 level) elective chemistry undergraduate courses with the approval of the Program Director.

## 9 COMPULSORY COURSES

0420-597	Thesis	(0)
0420-598	Thesis	(0)
2000-599	Thesis	(9)

### *COURSE DESCRIPTION*

**0420-512: ADVANCED THERMODYNAMICS  
CR: 3**

Equilibria, solution, separation techniques and molecular interpretation of the properties of chemical system. These include: homogeneous and heterogeneous equilibria, thermodynamics of mixtures, activity and fugacity, Raoultian and Henryan scales, distillation and statistical thermodynamics.

**0420-521: SURFACE CHEMISTRY &  
HETEROGENEOUS CATALYSIS  
CR: 3**

Capillarity; electrical aspects of surface chemistry; long-range forces; surfaces of solids; physisorption and surface texture; spectroscopy and surface structure; chemisorptions and surface catalysis.

**0420-522: ADVANCED  
ELECTROCHEMISTRY  
CR: 3**

Electrode/electrolyte interface & structure of the double layer; mechanistic information through electrochemical techniques; corrosion & passivation; electrochemical energy conversion & fuel cells.

**0420-523: PHYSICO-CHEMICAL ASPECTS OF  
ANALYTICAL SEPARATIONS  
CR: 3**

Classification of separation methods; thermodynamic and kinetic aspects; chromatographic methods and selection procedures and optimization.

**0420-524: ADVANCED QUANTUM  
CHEMISTRY  
CR: 3**

Quantum mechanical aspects of molecular stability; modern concepts of chemical bonds; relations between theoretical predictions and experimental findings.

**0420-525: STRUCTURE AND PROPERTIES  
OF HIGH POLYMERS  
CR: 3**

Structure and classification of polymers; structure of polymers in condensed states; rheology of polymers; mechanical properties and strength; chemical reactions of macromolecules; possibilities and limitations of chemical modification.

**0420-530: SELECTED TOPICS IN APPLIED  
PHYSICAL CHEMISTRY  
CR: 3**

Colloids and surfaces; Magnetic resonance spectroscopy, Advanced chemical Kinetics; Application of surface active agents; Applied polymer science; Hybrid and composite materials; Applied catalysis Nanomaterials; Material characterization; Other applied topics.

**0420-532: CHEMICAL APPLICATION OF  
GROUP THEORY  
CR: 3**

Definitions and theorems of group theory; molecular symmetry and the symmetry groups; representations of groups. Applications: Hybrid orbitals and molecular orbitals for AB<sub>n</sub> type molecules; ligand field theory; molecular vibrations.

**0420-541:    ADVANCED INORGANIC  
                  CHEMISTRY  
                  CR: 3**

Inorganic reaction mechanisms; bioinorganic reactions and nuclear chemistry.

**0420-542:    SELECTED TOPICS IN  
                  INORGANIC CHEMISTRY  
                  CR: 3**

Physical methods in inorganic chemistry; advanced aspects in boron chemistry; inorganic chains, rings and metal clusters; crown ethers, macro cycles and cryptands; advanced treatment of solid state chemistry and inorganic photochemistry.

**0420-543:    SELECTED TOPICS IN  
                  ANALYTICAL CHEMISTRY  
                  CR: 3**

Equilibria in aqueous and non-aqueous media; instrumental and miscellaneous methods of analysis.

**0420-544:    ADVANCED ENVIRONMENTAL  
                  CHEMISTRY  
                  CR: 3**

Chemical pollutants and their effect on the environment; analytical chemistry applied to environmental samples.

**0420-552:    ADVANCED ORGANIC  
                  CHEMISTRY I  
                  CR: 3**

Linear free energy relationships; molecular rearrangements: (i) 1,2-shifts to electron deficient carbon, nitrogen and oxygen, (ii) pericyclic rearrangements.

Reduction. Hydroboration. Oxidation.

**0420-561:    THE CHEMISTRY OF  
                  HETEROCYCLIC COMPOUNDS  
                  CR: 3**

Nomenclature rules; heterocyclic analogues of cyclopropane, cyclobutane and cyclopenta-dienes; chemistry of pyridine and quinolines; monocyclic compounds; fused ring systems; Compounds with two or more heteroatoms; natural occurrence.

**0420-562:    SYNTHETIC ORGANIC  
                  CHEMISTRY  
                  CR: 3**

Functionalization and interconversion of functional groups; formation of carbon-carbon bonds: the principles and reactions of organometallic compounds; use of stabilized carbanions and related nucleophiles; formation of carbon-heteroatom bonds: the principles; ring closure and ring opening; protective groups; phosphorus reagents; silicon reagents; asymmetric synthesis; selected syntheses.

**0420-563:    PHYSICAL METHODS IN  
                  ORGANIC CHEMISTRY  
                  CR: 3**

The application of physical methods for the elucidation of structure of organic compounds: U.V., visible, Raman and NMR spectroscopy; mass spectrometry; optical rotation, optical rotatory dispersion and circular dichroism.

**0420-564:    SELECTED TOPICS IN ORGANIC  
                  CHEMISTRY  
                  CR: 3**

Carbenes, nitrenes, arynes, carbocations, and carbanions; M.O. method and organic reactions: electrophilic substitutions, sigmatropic rearrangements, electrocyclic and pericyclic reactions; organic electrochemical and polarographic reactions; organometallic reactions, ylides; photophysical processes.

**0420-565:    TOPICAL ORGANIC CHEMISTRY  
                  CR: 3**

Molecular recognition processes and supramolecular assemblies; fullerenes; nanotechnology materials and devices; organic reactions in unusual solvents (including room-temperature reactions in ionic liquids and supercritical fluids); solid-supported reagents and catalysts in organic chemistry; green chemistry organic reactions under extreme conditions.

**0420-591:    SEMINAR  
                  CR: 1**

Library-based review of an advanced topic or recent development in chemistry to be presented in dissertation form and as a departmental seminar.

**0420-597: THESIS  
CR: 0**

**0420-598: THESIS  
CR: 0**

**2000-599: THESIS  
CR: 9**