

## DEPARTMENT OF CHEMISTRY

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### Faculty

Dr. Z. Arslan, Assistant Professor  
Dr. N. Campbell, Associate Professor  
Dr. A. Hamme, Assistant Professor  
Dr. G. Hill, Assistant Professor  
Dr. M. Huang, Assistant Professor  
Dr. K. Lee, Professor  
Dr. J. Leszczynski, Distinguished Professor  
Dr. Y. Liu, Associate Professor  
Dr. E. Noe, Professor  
Dr. P. Ray, Assistant Professor  
Dr. H. Tachikawa, Professor  
Dr. R. Venkatraman, Associate Professor  
Dr. J. Watts, Professor  
Dr. J. Zubkowski, Professor

The Department of Chemistry offers the Doctor of Philosophy degree and the Master of Science degree in Chemistry. The Ph.D. degree program in chemistry requires the existence of high quality scientific research and teaching in the department. It covers all modern areas of chemistry including analytical, biochemistry, computational, organic, inorganic, and physical.

### Program Mission

The Department of Chemistry seeks to provide comprehensive graduate programs in chemistry that aim for national distinction. The Department offers M.S. and Ph.D. degrees in all field of chemistry. These aim for intense graduate training through courses, hands-on experience of research methods, and development of an independent research thesis and dissertation. Graduates will be trained and capable of independent research in an academic or industrial setting.

### Program Objectives

- To provide students with an environment that is conducive to learning and scholarly activities.
- To provide opportunities in which students can develop methods of independent and systematic investigation.
- To prepare students to develop a successful career in chemistry.
- To promote the professional growth and development of the faculty.

## Doctoral Program in Chemistry

### Admission Requirements

In addition to the requirements of the Graduate School, applicants must:

1. The minimum requirement for admission is a B.S. degree in chemistry or related field. The student must have passed the following courses, with labs, with a passing grade, 'C' or better:
  - 2 semesters of General Chemistry
  - 2 semesters of Organic Chemistry
  - 1 semester of Analytical Chemistry
  - 1 semester of Physical Chemistry
  - 1 semester of Inorganic Chemistry
2. Submit an official GRE Score.
3. The M.S. degree is not a prerequisite for the Ph.D. degree.

### Degree Candidacy Requirements

The comprehensive examination and the independent research proposal are required for a student to be an official Ph.D. candidate. The comprehensive examination of 3 subjects must be taken and passed during the second year. The independent research proposal must be prepared and defended during the first semester of the third year.

### Graduation Requirements

The minimum number of credit hours for the Ph.D. in Chemistry is 60 credit hours.

1. 18 credit hours from graduate Chemistry lecture courses
2. 2 credit hours for Seminars
3. 40 credit hours for Dissertation

The 60 credit hours must include three out of five possible core courses for a total of 9 credit hours required in core courses. The core courses are:

|          |                               |
|----------|-------------------------------|
| CHEM 723 | Advanced Analytical Chemistry |
| CHEM 731 | Advanced Biochemistry I       |
| CHEM 736 | Physical Organic Chemistry    |
| CHEM 741 | Advanced Inorganic Chemistry  |
| CHEM 758 | Quantum Chemistry             |

The student will be required to teach at least one undergraduate laboratory course and must have a dissertation in chemistry, which has to be defended in public.

## Masters' Program in Chemistry

The M.S. degree is offered by the Department in the areas of analytical, biological, computational, inorganic, organic, and physical chemistry.

**Admission Requirements**

Applicants for the Master's Degree Program must meet the requirements of the Graduate School.

**Retention Requirements**

The student must satisfy the basic requirements of the Graduate School and must maintain GPA 3.00 or higher every semester. The chemistry department will calculate the GPA based on the 500 level chemistry lecture courses. Grades from the Thesis Research are excluded from calculating the GPA.

**Degree Requirements**

A student pursuing a M.S. degree in Chemistry is required to complete a minimum of 30 hours and a thesis in chemistry.

1. Within the 30 hours, the student must complete three (3) out of five (5) possible core courses for a total of nine (9) hours required in the core courses, and two semesters of seminar. The core courses are:
 

|          |                               |
|----------|-------------------------------|
| CHEM 523 | Advanced Analytical Chemistry |
| CHEM 541 | Advanced Inorganic Chemistry  |
| CHEM 531 | Biochemistry                  |
| CHEM 558 | Quantum Chemistry             |
| CHEM 536 | Physical Organic Chemistry    |
2. The student will fulfill the remaining 20 hours from Chemistry electives with no more than 11 hours in CHEM 580 - Thesis Research. It is possible to take some courses in related fields upon recommendation of the advisor.
3. Pass the Graduate Area Comprehensive Examination in three core areas.
4. The student must participate as a teaching assistant in the chemistry department for at least one semester.

**Non-Thesis Masters' Degree**

Graduate students who fulfill the following requirements will be awarded a non-thesis masters' degree in Chemistry.

1. A minimum of 36 credit hours, including at least 18 hours of graduate level lecture courses and two hours of seminar with a GPA of 3.0 or better. The graduate lecture courses should include at least three of the five core courses: Advanced Analytical Chemistry, Advance Inorganic Chemistry, Biochemistry, Quantum Chemistry, and Physical Organic Chemistry.
2. Pass the Graduate Area Comprehensive Examination in three core areas.
3. Pass an oral defense covering the student's research before a committee of four faculty members.

**DESCRIPTION OF COURSES****Master-level Courses**

**CHEM 511 Chemistry Seminar.** (1 Hour) Presentation and discussion of current chemical topics and

research by students, faculty and visiting speakers. Prerequisite: Permission of instructor.

**CHEM 523 Advanced Analytical Chemistry.** (3 Hours) Prerequisites: Courses in Analytical Chemistry and Physical Chemistry. Principles and application of selected analytical methods including electrochemistry, spectroscopy and selected topics of unusual current interest.

**CHEM 526 Electroanalytical Chemistry.** (3 Hours) Prerequisite: Advanced Analytical Chemistry. Discussion of potentiometric, conductometric, polarographic, amperometric, coulometric, controlled potential and stepping analysis and related techniques. Emphasis is also placed on theoretical considerations and applications to studies of chemical and charge transfer equilibria and kinetics.

**CHEM 531, 532 Biochemistry.** (3 Hours) Prerequisite: One year of Organic Chemistry. The chemical composition of living matter and the chemical mechanics of life processes.

**CHML 531, 532 Biochemistry Laboratory.** (1 Hour) Prerequisite: Chemistry 531 and 532. Basic purification and characterization techniques in Biochemistry.

**CHEM 536 Physical Organic Chemistry.** (3 Hours) Prerequisites: Physical Chemistry and Organic Chemistry. A study of organic molecular structure, Woodward Hoffmann Rules, substituents effects, intra- and intermolecular forces, kinetics and stereochemistry.

**CHEM 541 Advanced Inorganic Chemistry.** (3 Hours) Prerequisite: An undergraduate course in Physical Chemistry. A study of inorganic compounds with the application of Physical Chemistry principles to thermodynamic, kinetic and structural problems.

**CHEM 553 Thermodynamics.** (3 Hours) Prerequisite: Physical Chemistry. Principles of thermodynamics and their application to chemical and phase equilibria.

**CHEM 558 Quantum Chemistry.** (3 Hours) Prerequisite: Physical Chemistry. Principles and applications of quantum theory.

**CHEM 580 Thesis Research.** (Variable 1-6 Hours) Prerequisite: Permission of adviser. Selected topics arranged in consultation with the staff; includes literature, research, and laboratory investigation of a problem.

**Doctoral-level Courses**

**CHEM 711 Seminar** (0.5 Hour) Presentation and discussion of current chemical topics and research by visiting speakers, faculty and students.

**CHEM 721 Advanced Instrumental Analysis** (3 Hours). Prerequisite: Analytical Chemistry and Physical Chemistry (two semesters). Theoretical principles and laboratory techniques involved in characterization of chemical systems using instrumental methods. This one semester course will present the following topics of interest: absorption and emission spectrometry, mass spectrometry, liquid and gas chromatography, and

electrophoresis. A laboratory series on spectrophotometry, fluorometry, atomic absorption spectrometry, inductively coupled plasma atomic emission spectrometry, FT-IR, gas chromatography-mass spectroscopy, and high performance liquid chromatography are included in this

**CHEM 723 Advanced Analytical Chemistry** (3 hours) Prerequisite: Analytical Chemistry and Physical Chemistry (two semesters). Principles and application of analytical methods including acid-base titrations, redox titrations, titrations which involve metal-ligand complexes, gravimetric analysis, separation methods (chromatography), and electroanalytical chemistry.

**CHEM 726 Electroanalytical Chemistry** (4 hours) Prerequisite: Advanced Analytical Chemistry. Principles and application of all modern electrochemical methods such as voltammetrics, chronoamperometry, spectroelectrochemistry, and thin layer electrochemistry etc. Electrode kinetics and mass transfer are discussed in detail.

**CHEM 729 Spectroscopic Methods** (3 hours) Prerequisite: Analytical Chemistry. Study of the theoretical principles of advanced spectroscopic topics used in analytical chemistry. Some examples of the topics to be covered are: X-ray methods (absorption, fluorescence, diffraction), surface spectroscopy and chemical analysis of surfaces, (Ion Scattering Spectroscopy, ISS), Auger Emission Spectroscopy (AES), electron Spectroscopy for chemical analysis (ESCA), Secondary Ion Mass Spectrometry (SIMS), Electron Spin Spectroscopy (ESR), Nuclear Magnetic Resonance Spectroscopy (NMR).

**CHEM 731 Advanced Biochemistry I** (3 hours) Prerequisite: Organic Chemistry (two semesters). Comprehensive coverage of major areas of biochemistry. Topics covered include proteins, enzymology, bioenergetics, the chemistry and intermediary metabolism of carbohydrates, lipids, proteins and nucleic acids.

**CHEM 732 Advanced Biochemistry II** (3 hours) Prerequisite: Advanced Biochemistry I. Comprehensive coverage of major areas of biochemistry. Topics covered include storage, transmission, and expression of genetic information, molecular immunology, membrane transport and hormone action.

**CHML 731 Advanced Biochemistry Laboratory** (1 hour) Corequisite: Advanced Biochemistry I. Selected techniques in areas covered in CHEM 731.

**CHML 732 Advanced Biochemistry Laboratory** (1 hour) Corequisite: Advanced Biochemistry II. Selected techniques in areas covered in CHEM 732.

**CHEM 733 Advanced Molecular Biology** (3 hours) Molecular mechanisms involved in replication, expression and regulation of prokaryotic genes. Topics include: DNA replication, repair, recombination, restriction-modification, recombinant DNA technology, plasmids and transposons, RNA transcription, processing and message splicing.

**CHEM 734 Physical Biochemistry** (3 hours) Characterization of macromolecules, hydrodynamic methods, multiple equilibria, macromolecule-ligand interactions.

**CHEM 736 Physical Organic Chemistry** (3 hours) Prerequisite: Organic Chemistry (two semesters). A study of organic molecular structure, Woodward Hoffmann Rules, substituents effects, intra- and intermolecular forces, kinetics and stereochemistry.

**CHEM 738 Organic Synthesis** (3 hours) Prerequisite: Organic Chemistry (two semesters). The course covers the formation of carbon-carbon and carbon-heteroatom bonds, functionalization and interconversion of functional groups, reactions of organic reagents, protective groups, total synthesis and asymmetric synthesis in organic synthesis.

**CHEM 741 Advanced Inorganic Chemistry** (3 hours) Prerequisite: Advanced Inorganic Chemistry (CHEM 441). A study of symmetry and group theory, bonding and structures of inorganic compounds, coordination chemistry and acid-base chemistry.

**CHEM 743 Structural Inorganic Chemistry** (3 hours) Prerequisite: Any 700 level course. A study included concepts of the solid state as explored by crystallography. It covers symmetry, polyhedra, sphere packing, tetrahedral and octahedral structures of inorganic compounds.

**CHEM 747 Inorganic Reaction Mechanisms** (3 hours) Prerequisite: Any 700 level course. The topics include mechanism of reactions of certain inorganic compounds, stereochemical changes in complexes, redox reactions, homogeneous and heterogeneous catalysts.

**CHEM 749 Organometallic Chemistry** (3 hours) Prerequisite: Physical Organic Chemistry (CHEM 736) or equivalent. A study of formation, stability, and reactivity of metal-carbon bond of main group and transition metal. It will cover the usage of organometallics in organic synthesis and catalysis.

**CHEM 752 Atomic and Molecular Spectroscopy** (3 hours) Prerequisite: Physical Chemistry (two semesters). A comprehensive course covering concepts and methods of modern atomic and molecular spectroscopy. Subjects covered include electric phenomena, absorption and emission of radiation, atomic spectroscopy, rotational spectroscopy, vibrational spectroscopy, electronic spectroscopy, and magnetic resonance spectroscopy.

**CHEM 753 Thermodynamics** (3 hours) Prerequisite: Physical Chemistry (two semesters). Laws of thermodynamics and their chemical applications. Introduction to chemical kinetics and statistical mechanics.

**CHEM 754 Kinetics** (3 hours) Prerequisite: Physical Chemistry (two semesters). Mechanics of chemical reactions, cross sections, and rate constants. Elastic, inelastic, and rearrangement channels are discussed, using quantum and semiclassical techniques.

**CHEM 755 Mechanisms of Organic Chemistry** (3 hours) Prerequisite: Organic Chemistry (two semesters). A study of mechanistic aspects of organic reactions included the rate theory, and reaction mechanism, experimental methods and treatment of data.

**CHEM 758 Quantum Chemistry** (3 hours) Prerequisite: Physical Chemistry (two semesters). (Computational Chemistry) Important concepts of quantum chemistry at the intermediate level, including angular momentum, perturbation theory, electronic structure of molecules, and radiation matter interaction. Applications will vary from year to year.

**CHEM 763 Statistical Mechanics** (3 hours) Prerequisite: Physical Chemistry (two semesters) A study of statistical mechanical ensembles, partition functions and their relationship to thermodynamics, lattice statistics, molecular distribution and correlation functions, the theories of liquids and solutions, phase transitions, and cluster theory.

**CHEM 780 Dissertation** - (1 - 9 hours)

**CHEM 782 Special Topics in Analytical Chemistry** - (3 hours) Selected topics not covered in regularly scheduled courses, and current research topics in analytical chemistry.

**CHEM 783 Special Topics in Biochemistry** - (3 hours) Selected topics not covered in regularly scheduled courses, and current research topics in biochemistry.

**CHEM 784 Special Topics in Organic Chemistry** - (3 hours) A course in a specific area of organic chemistry such as structure determination in organic chemistry, or current research subject not covered in regularly scheduled courses presented to fit the interests of advanced students.

**CHEM 785 Special Topics in Inorganic Chemistry** - (3 hours) Topics include subjects of current research in inorganic chemistry, but not covered in regularly scheduled courses.

**CHEM 786 Special Topics in Physical Chemistry** - (3 hours) Topics vary from year to year will include subjects such as photochemistry, solid state, surface chemistry, and radiation chemistry.

## DEPARTMENT OF MATHEMATICS

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### Faculty

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Ms. E. Holbrook, Assistant Professor

Dr. M. R. Khadivi, Professor

Dr. Y. Pan, Professor

The Department of Mathematics in the School of Science and Technology in cooperation with the School of Education offers a program leading to the Master of Science in Teaching (MST) degree, in mathematics. This department also offers a master of Science (MS) degree in pure mathematics for students who seek careers in college or university teaching, government, industry, business, etc.

Based on the certification requirements of the State of Mississippi as stated in *Bulletin 130*, and upon the stated principles and guidelines of The National Council of Teachers of Mathematics, The Mathematics Association of America, and The Mississippi Council of Teachers-Mathematics, the successful candidate for graduation with the MST degree should be able to perform the following competencies:

1. Expose students to various teaching aids in teaching and learning of mathematics at the junior high, high school, and college levels.
2. Show the basic structure of an idea by means of displays and examples.
3. Explain abstract ideas and relate them to concrete models by using the most modern techniques.
4. Bring ideas together to form new concepts in mathematics.
5. Turn ideas into words by means of displays, diagrams, and examples. Improve the oral and written expression of students in mathematics.
6. Stimulate a greater interest in mathematics to improve the performance of students. Share the idea of teaching and learning with other teachers in the field of mathematics by being active in professional organizations.
7. Properly counsel students in the field of mathematics.
8. Supervise programs in mathematics education.
9. Provide the kind of experiences in mathematics that will be relevant to the needs of today's youth.