

DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY

College of Arts and Sciences

Department of Chemistry and Biochemistry
214 Williams Hall
Kent Campus
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Undergraduate Programs

- Biotechnology - B.S.
- Chemistry - B.A.
- Chemistry - B.S.

Minors

- Chemistry

Graduate Programs

- Chemistry - M.A.
- Chemistry - M.S.
- Chemistry - Ph.D.

Department of Chemistry and Biochemistry Faculty

- Abeyirigunawardena, Sanjaya C. (2015), Assistant Professor, Ph.D., Wayne State University, 2008
- Abraham, Ann C. (2004), Associate Professor, Ph.D., University of Pittsburgh, 1983
- Basu, Soumitra (2005), Associate Professor, Ph.D., Thomas Jefferson University, 1997
- Bos, Philip J. (1994), Professor, Ph.D., Kent State University, 1978
- Bowers, David J. (2013), Assistant Professor
- Bunge, Scott D. (2004), Associate Professor, Ph.D., Georgia Institute of Technology, 2001
- Burns, Andrew (1994), Professor, Ph.D., Brown University, 1990
- Chien, Liang-Chy (1988), Professor, Ph.D., University of Southern Mississippi, 1988
- Cubon-Bell, Valerie A. (2010), Assistant Professor, Ph.D., Princeton University, 2008
- Datta, Bansidhar (2000), Associate Professor, University of Nebraska-Lincoln, 1989
- Ding, Tang (2006), Associate Professor, Ph.D., University of Akron, 2006
- Dunietz, Barry (2012), Associate Professor
- Earley, Clarke W. (1995), Associate Professor, Ph.D., University of Illinois-Urbana, 1987
- Ekanayake, Sujeewani K. (2012), Associate Professor
- Fenk, Christopher J. (1990), Professor, Ph.D., University of Pittsburgh, 1987

- Fouad, Faid S. (2008), Associate Professor, Ph.D., Northeastern University, 2003
- Friedrich, Dirk (2016), Assistant Professor, Ph.D., Universitat Leipzig, 2013
- Hegmann, Torsten (2011), Associate Professor, Ph.D., Martin Luther University, 2001
- Jaroniec, Mietek (1988), Professor
- Khitrin, Anatoly K. (2002), Professor
- Lavrentovich, Oleg D. (1992), Trustees Research Professor, Kiev University, 1990
- Leslie, Margaret R. (2004), Professor, Ph.D., Rhodes University, 1995
- Mao, Hanbin (2005), Professor, Ph.D., Texas A&M University, 2003
- Mighion, Jeffrey D. (2017), Assistant Professor, Ph.D., Princeton University, 2014
- Motry, Douglas H. (1996), Associate Professor, Ph.D., Michigan State University, 1996
- Pal Chaudhuri, Urmila (2008), Associate Professor, Ph.D., Indian Institute of Technology Madras, 2004
- Palfy-Muhoray, Peter (1987), Professor
- Sampson, Paul (1985), Professor, Ph.D., University of Birmingham, 1983
- Seed, Alexander J. (1996), Associate Professor
- Selinger, Jonathan V. (2005), Professor, Ph.D., Harvard College, 1989
- Selinger, Robin L.B. (2005), Professor, Ph.D., Harvard College, 1989
- Shelley, Jacob T. (2014), Assistant Professor, Ph.D., Indiana University-Bloomington, 2011
- Shen, Hao, Assistant Professor
- Stroup, Diane (2000), Associate Professor, Ph.D., The Ohio State University, 1992
- Subramanian, Pritha (2006), Assistant Professor, Ph.D., Kent State University, 2013
- Tandon, Santokh S. (2004), Professor, Ph.D., Guru Nanak Dev University, 1979
- Tubergen, Michael J. (1995), Professor, Ph.D., University of Chicago, 1991
- Twieg, Robert J. (1997), Professor, Ph.D., University of California-Berkeley
- Wang, Zhiqiang (2007), Professor
- Wei, Qi-Huo (2006), Associate Professor
- Yang, Deng-Ke (1989), Professor, Ph.D., University of Hawaii at Manoa, 1989
- Zheng, Yaorong (2015), Assistant Professor, Ph.D., University of Utah, 2011

Chemistry (CHEM)

CHEM 00020 INTRODUCTION TO CHEMISTRY 2 Credit Hours

Problem-based introduction to the fundamentals of chemistry including significant figures, unit conversions, measurement, structure of matter, energy, composition of matter, atomic structure, the periodic table, introduction to bonding, and the formulas and names of both ionic and covalent compounds. Course does not count toward graduation.

Prerequisite: Math ACT score of 18; or ALEKS math assessment score of 45; or minimum C grade in MATH 00023 or higher.

Schedule Type: Lecture

Contact Hours: 2 lecture

Grade Mode: Standard Letter

CHEM 10030 CHEMISTRY IN OUR WORLD (KBS) 3 Credit Hours

A course for non-science majors that utilizes environmental and consumer topics to introduce chemical principles and develop critical-thinking skills.

Prerequisite: None.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

Attributes: Kent Core Basic Sciences, Transfer Module Natural Sciences

CHEM 10031 CHEMISTRY IN OUR WORLD LABORATORY (KBS) (KLAB) 1 Credit Hour

Discovery-based experiments to introduce chemical principles and develop critical-thinking skills. A course for non-science majors; includes chemistry that is related to environmental and consumer issues.

Pre/corequisite: CHEM 10030.

Schedule Type: Laboratory

Contact Hours: 3 lab

Grade Mode: Standard Letter

Attributes: Kent Core Basic Sciences, Kent Core Basic Sciences Lab, Transfer Module Natural Sciences

CHEM 10050 FUNDAMENTALS OF CHEMISTRY (KBS) 3 Credit Hours

Basic concepts of chemistry (including atomic structure, chemical bonding and reactions) necessary for courses in elementary organic chemistry and physiological chemistry. Students may only receive credit toward graduation for one of the following courses: CHEM 10050; or CHEM 10060 and 10061; or CHEM 10970 and 10971.

Prerequisite: Minimum 16 ACT math score or MATH 00023 or MATH 00024 or MATH 11009 or MATH 11010 or MATH 11012 or MATH 12002 or MATH 12011 or MATH 12021.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

Attributes: Kent Core Basic Sciences, Transfer Module Natural Sciences

CHEM 10052 INTRODUCTION TO ORGANIC CHEMISTRY (KBS) 2 Credit Hours

Chemistry of organic and biological molecules necessary for the study of physiological chemistry. Students may only receive credit toward graduation for one of the following courses: CHEM 10052; or CHEM 20481 and 20482; or CHEM 30481 and 30482.

Prerequisite: CHEM 10050 or 10060.

Schedule Type: Lecture

Contact Hours: 2 lecture

Grade Mode: Standard Letter

Attributes: Kent Core Basic Sciences, Transfer Module Natural Sciences

CHEM 10053 INORGANIC AND ORGANIC LABORATORY (KBS) (KLAB) 1 Credit Hour

Laboratory with experiments covering material from CHEM 10050 and 10052. Students may only receive credit toward graduation for one of the following courses: CHEM 10053; or CHEM 10062 and 10063.

Prerequisite: CHEM 10050.

Corequisite: CHEM 10052.

Schedule Type: Laboratory

Contact Hours: 3 lab

Grade Mode: Standard Letter

Attributes: Kent Core Basic Sciences, Kent Core Basic Sciences Lab, Transfer Module Natural Sciences

CHEM 10055 MOLECULES OF LIFE (KBS) 3 Credit Hours

An integrated introduction to molecular systems and their participation in the processes of life.

Prerequisite: None.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

Attributes: Kent Core Basic Sciences

CHEM 10060 GENERAL CHEMISTRY I (KBS) 4 Credit Hours

Chemistry for science majors, emphasizing stoichiometry, introduction to chemical reactions, thermochemistry, atomic structure, periodicity, molecular structure and chemical bonding. Students who register for this course must successfully complete the departmentally-approved placement assessment prior to the start of the term. Students who do not complete the placement assessment and associated modules will be deregistered. Students will be informed of the requirement by the Department of Chemistry and Biochemistry. Students may only receive credit toward graduation for one of the following courses: CHEM 10050 or CHEM 10055 or CHEM 10060 or CHEM 10970.

Prerequisite: Minimum 55 ALEKS math score; or minimum 22 ACT math score; or minimum 530 SAT math score; or minimum C grade in MATH 00024; or minimum C grade in MATH 10774 (taken as pre or corequisite); or minimum C grade in MATH 10775; or minimum C grade in any course MATH 11009 to MATH 49999.

Schedule Type: Lecture

Contact Hours: 4 lecture

Grade Mode: Standard Letter

Attributes: Kent Core Basic Sciences, TAG Science

CHEM 10061 GENERAL CHEMISTRY II (KBS) 4 Credit Hours

Continuation of CHEM 10060, emphasizing intermolecular forces, properties of mixtures, main group chemistry, kinetics, equilibrium, acid-base chemistry, thermodynamics and electrochemistry. Students may only receive credit toward graduation for one of the following courses: CHEM 10050 or CHEM 10055 or CHEM 10061 or CHEM 10971.

Prerequisite: Minimum C grade in either CHEM 10060 or CHEM 10970.

Schedule Type: Lecture

Contact Hours: 4 lecture

Grade Mode: Standard Letter

Attributes: Kent Core Basic Sciences, TAG Science

CHEM 10062 GENERAL CHEMISTRY I LABORATORY (KBS) (KLAB) 1 Credit Hour

Laboratory covering pertinent aspects of CHEM 10060. Three hours weekly. Students may only receive credit toward graduation for one of the following courses: CHEM 10053 or CHEM 10062.

Pre/corequisite: CHEM 10060 or CHEM 10970.

Schedule Type: Laboratory

Contact Hours: 3 lab

Grade Mode: Standard Letter

Attributes: Kent Core Basic Sciences, Kent Core Basic Sciences Lab, TAG Science

CHEM 10063 GENERAL CHEMISTRY II LABORATORY (KBS) (KLAB) 1 Credit Hour

Laboratory covering pertinent aspects of CHEM 10061, including qualitative analysis. Students may only receive credit toward graduation for one of the following courses: CHEM 10053 or CHEM 10063.

Prerequisite: CHEM 10062.

Pre/corequisite: CHEM 10061 or CHEM 10971.

Schedule Type: Laboratory

Contact Hours: 3 lab

Grade Mode: Standard Letter

Attributes: Kent Core Basic Sciences, Kent Core Basic Sciences Lab, TAG Science

CHEM 10970 HONORS GENERAL CHEMISTRY I (KBS) 4 Credit Hours

Rigorous general chemistry course for qualified students. Stoichiometry, equilibrium, thermochemistry, atomic structure and chemical bonding, descriptive inorganic and nuclear chemistry.

Prerequisite: special approval.

Schedule Type: Lecture

Contact Hours: 4 lecture

Grade Mode: Standard Letter

Attributes: Kent Core Basic Sciences

CHEM 10971 HONORS GENERAL CHEMISTRY II (KBS) 4 Credit Hours

A continuation of CHEM 10970. Topics include properties of mixtures, properties of the elements, periodic patterns, organic compounds, kinetics, equilibrium, thermodynamics and electrochemistry.

Prerequisite: CHEM 10970 with minimum C grade.

Schedule Type: Lecture

Contact Hours: 4 lecture

Grade Mode: Standard Letter

Attributes: Kent Core Basic Sciences

CHEM 20050 CAREER PATHWAYS IN CHEMISTRY 1 Credit Hour

Designed to introduce students to the wide range of career pathways available in chemistry. Students will learn different strategies for identifying and pursuing career opportunities, and will develop their communication skills through writing assignments and oral presentations. Satisfactory/Unsatisfactory (S/U) graded.

Prerequisite: None.

Schedule Type: Lecture

Contact Hours: 1 lecture

Grade Mode: Satisfactory/Unsatisfactory

CHEM 20095 SPECIAL TOPICS 1-3 Credit Hours

(Repeatable for credit) Selected topics in chemistry.

Prerequisite: Special approval.

Schedule Type: Lecture

Contact Hours: 1-3 lecture

Grade Mode: Standard Letter

CHEM 20098 INTRODUCTION TO CHEMICAL RESEARCH (ELR) 1-3 Credit Hours

Research experience for freshmen and sophomores. Registration requires prior approval of the research director. Does not count toward the electives for the BS or BA chemistry degree. A written report is required.

Prerequisite: GPA of 2.500 in chemistry and special approval.

Schedule Type: Research

Contact Hours: 1-3 other

Grade Mode: Satisfactory/Unsatisfactory-IP

Attributes: Experiential Learning Requirement

CHEM 20284 PHYSIOLOGICAL CHEMISTRY 4 Credit Hours

Chemistry and metabolism of carbohydrates, lipids, nucleic acids and proteins; regulation of metabolism, nature of enzyme action, clinical aspects of biochemistry. Four hours of lecture weekly.

Prerequisite: CHEM 10052 or CHEM 20481.

Schedule Type: Lecture

Contact Hours: 4 lecture

Grade Mode: Standard Letter

CHEM 20481 BASIC ORGANIC CHEMISTRY I 4 Credit Hours

Survey of the structure, preparation and reactions (including mechanisms) of organic compounds emphasizing the chemistry of biologically important functional groups. Students may only receive credit toward graduation for one of the following courses: CHEM 10052 or CHEM 10055 or CHEM 20481 or CHEM 30481.

Prerequisite: Minimum C grade in CHEM 10061 or CHEM 10971.

Schedule Type: Lecture

Contact Hours: 4 lecture

Grade Mode: Standard Letter

Attributes: TAG Science

CHEM 20482 BASIC ORGANIC CHEMISTRY II 2 Credit Hours

Continuation of CHEM 20481, emphasizing the chemistry of functional groups prevalent in biological chemistry. Students may only receive credit toward graduation for one of the following courses: CHEM 10052 or CHEM 10055 or CHEM 20482 or CHEM 30482.

Prerequisite: CHEM 20481 with a minimum C grade.

Schedule Type: Lecture

Contact Hours: 2 lecture

Grade Mode: Standard Letter

Attributes: TAG Science

CHEM 30050 INTRODUCTION TO MATERIALS CHEMISTRY 2 Credit Hours

This course provides an introduction to materials and their applications. It serves as the initiation for the materials chemistry concentration.

Prerequisite: CHEM 10061 or CHEM 10971; and CHEM 30481 and PHY 23101.

Schedule Type: Lecture

Contact Hours: 2 lecture

Grade Mode: Standard Letter

CHEM 30105 ANALYTICAL CHEMISTRY I 3 Credit Hours

Covers the fundamental theory, experimental methods, and applications of analytical chemistry principles in chemistry as well as other related disciplines such as life sciences and environmental science. It covers analytical measurements, experimental error, statistics, chemical equilibrium and titration, spectrometry as well as analytical separation techniques.

Prerequisite: CHEM 10061.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 30106 ANALYTICAL CHEMISTRY II 2 Credit Hours

Covers the theoretical basis and experimental methods of analytical chemistry not considered in Analytical Chemistry I (CHEM 30105), such as noise reduction, advanced chemical equilibria and titrations, electrochemistry, atomic spectroscopy, instrumental design, and sample preparation.

Prerequisite: CHEM 30105.

Schedule Type: Lecture

Contact Hours: 2 lecture

Grade Mode: Standard Letter

CHEM 30107 ANALYTICAL CHEMISTRY LABORATORY I (WIC) 1 Credit Hour

Fundamental laboratory class for analytical chemistry. Provides hands-on experience to students on the subjects including data treatment, volumetric analysis, spectrophotometry, separation techniques and mass spectroscopy.

Prerequisite: CHEM 10063.

Pre/corequisite: CHEM 30105.

Schedule Type: Laboratory

Contact Hours: 3 lab

Grade Mode: Standard Letter

Attributes: Writing Intensive Course

CHEM 30108 ANALYTICAL CHEMISTRY LABORATORY II (WIC) 2 Credit Hours

Advanced analytical chemistry laboratory class which covers a broad range of modern analytical techniques, including ion-selective electrodes, voltammetry, atomic spectroscopy, mass-spectrometry and capillary electrophoresis. Unlike Analytic Chemistry Laboratory I (CHEM 30107) this class focuses on forensic rather than bioanalytical applications.

Prerequisite: CHEM 30105.

Pre/corequisite: CHEM 30107.

Schedule Type: Laboratory

Contact Hours: 6 lab

Grade Mode: Standard Letter

Attributes: Writing Intensive Course

CHEM 30284 INTRODUCTORY BIOLOGICAL CHEMISTRY 4 Credit Hours

Chemistry and metabolism of biochemically important compounds; nature of enzyme action; metabolic regulation and bioenergetics.

Prerequisite: CHEM 20481; or CHEM 30481 and CHEM 30482.

Schedule Type: Lecture

Contact Hours: 4 lecture

Grade Mode: Standard Letter

CHEM 30301 INORGANIC CHEMISTRY I 2 Credit Hours

Chemistry of hydrogen, ions in aqueous solution, redox reactions, coordination complexes: d-block chemistry, crystal field model, electronic spectra and magnetism, introduction to organometallic chemistry, periodic trends for p-block elements.

Prerequisite: CHEM 10061.

Schedule Type: Lecture

Contact Hours: 2 lecture

Grade Mode: Standard Letter

CHEM 30475 ORGANIC CHEMISTRY LABORATORY I (ELR) 1 Credit Hour

Practical experience in organic laboratory techniques on both micro- and macroscale: physical methods for purification and characterization of organic compounds, introduction to organic reactions.

Prerequisite: CHEM 10063.

Pre/corequisite: CHEM 20481 or 30481.

Schedule Type: Laboratory

Contact Hours: 1 lab

Grade Mode: Standard Letter

Attributes: Experiential Learning Requirement, TAG Science

CHEM 30476 ORGANIC CHEMISTRY LABORATORY II 1 Credit Hour

Continuation of CHEM 30475, involving multi-step organic experiments that utilize techniques introduced in CHEM 30475.

Prerequisite: CHEM 30475.

Pre/corequisite: CHEM 20482 or 30482.

Schedule Type: Laboratory

Contact Hours: 1 lab

Grade Mode: Standard Letter

Attributes: TAG Science

CHEM 30481 ORGANIC CHEMISTRY I 3 Credit Hours

Introduction to organic chemistry from structural, mechanistic and synthetic viewpoints with an emphasis on the chemistry of biologically relevant functional groups. Students may only receive credit toward graduation for one of the following courses: CHEM 10052 or CHEM 10055 or CHEM 20481 or CHEM 30481.

Prerequisite: CHEM 10061 or CHEM 10971 with a minimum C grade.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 30482 ORGANIC CHEMISTRY II 3 Credit Hours

Continuation of CHEM 30481; organic chemistry from mechanistic and synthetic viewpoints; IR and NMR spectroscopy; mass spectrometry. Students may only receive credit toward graduation for one of the following courses: CHEM 10052 or CHEM 10055 or CHEM 20482 or CHEM 30482.

Prerequisite: CHEM 30481 with a minimum C grade.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 40053 MATERIALS CHEMISTRY LABORATORY 2 Credit Hours

Exploration of the synthesis, characterization and application of inorganic and organic materials.

Prerequisite: CHEM 30050.

Schedule Type: Laboratory

Contact Hours: 2 lab

Grade Mode: Standard Letter

CHEM 40092 INTERNSHIP IN CHEMISTRY AND BIOCHEMISTRY (ELR) 1-9 Credit Hours

Workplace experience in chemistry or biochemistry relevant to a student's career objectives. Includes career advising and job search strategies. Comprehensive written report and presentation of activities required after completion of internship.

Prerequisite: Junior standing and special approval.

Schedule Type: Practicum or Internship

Contact Hours: 3-27 other

Grade Mode: Satisfactory/Unsatisfactory-IP

Attributes: Experiential Learning Requirement

CHEM 40093 VARIABLE TITLE WORKSHOP IN CHEMISTRY 1-6 Credit Hours

(Repeatable for credit) Variable titled workshop in chemistry.

Prerequisite: special approval.

Schedule Type: Workshop

Contact Hours: 1-6 other

Grade Mode: Satisfactory/Unsatisfactory

CHEM 40099 SENIOR HONORS THESIS (ELR) 1-10 Credit Hours
(Repeatable for credit) For departmental honors may be started summer prior to senior year. Register each semester during senior year. Minimum total credit 5-hours.

Prerequisite: Departmental and honors college approval.

Schedule Type: Senior Project/Honors Thesis

Contact Hours: 1-10 other

Grade Mode: Standard Letter-IP

Attributes: Experiential Learning Requirement

CHEM 40109 BIOANALYTICAL CHEMISTRY 3 Credit Hours
(Cross-listed with CHEM 50109 and CHEM 70109) Covers traditional as well as newly emerging topics in the field of bioanalytical chemistry.

Provides an overview of the fundamental biological targets for bioanalytical assays, such as lipids, peptides, proteins, nucleic acids and cells. Briefly introduces traditional tools, such as chromatography, electrophoresis, mass spectrometry, fluorescence techniques, immunoassays, and biosensors. Discusses approaches most recently developed in the field, which include lab-on-a-chip and single molecule techniques.

Prerequisite: CHEM 30105.

Pre/corequisite: CHEM 30284 or CHEM 40245 or CHEM 40261.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 40110 ANALYTICAL MASS SPECTROMETRY 3 Credit Hours

(Slashed with CHEM 50110 and CHEM 70110) Survey of modern techniques in and associated with mass spectrometry, including historical perspectives, strengths and weaknesses, detection and quantification of analytes, ionization source and mass analyzer design, as well as construction of associated technologies including vacuum systems, ion detection, and ion optics. Ion formation processes will also be discussed.

Prerequisite: CHEM 30105 with minimum C grade; and MATH 12002 or MATH 12021 with minimum C grade.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 40113 CHEMICAL SEPARATIONS 3 Credit Hours

(Cross-listed with CHEM 50113 and CHEM 70113) Theory, instrumentation and applications of chemical separations for chemical analysis with an emphasis on gas and liquid chromatography.

Prerequisite: CHEM 30106.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 40116 SPECTROCHEMICAL METHODS OF ANALYSIS 3 Credit Hours

(Slashed with CHEM 50116 and CHEM 70116) Presented material is designed to familiarize students with fundamental concepts in spectrochemical analyses, mainly in the form of optical spectroscopic methods. Design and construction of spectroscopic instruments, detection and quantification of analytes, interaction of electromagnetic radiation with molecules, as well as collection and processing of analytical signals will be presented.

Prerequisite: CHEM 30105 with minimum C grade; and MATH 12002 or MATH 12021 with minimum C grade.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 40195 SPECIAL TOPICS IN ANALYTICAL CHEMISTRY 1-3 Credit Hours

(Repeatable for credit) Selected topics in analytical chemistry.

Prerequisite: special approval.

Schedule Type: Lecture

Contact Hours: 1-3 lecture

Grade Mode: Standard Letter

CHEM 40245 BIOCHEMICAL FOUNDATIONS OF MEDICINE 4 Credit Hours

(Slashed with CHEM 50245) Chemistry and metabolism of biologically important compounds; enzyme catalysis; metabolic regulation, inborn and induced errors of metabolism. For students in integrated life science (ILS) program.

Prerequisite: CHEM 30481.

Pre/corequisite: CHEM 30482.

Schedule Type: Lecture

Contact Hours: 4 lecture

Grade Mode: Standard Letter

CHEM 40248 ADVANCED BIOLOGICAL CHEMISTRY 3 Credit Hours

(Cross-listed with CHEM 50248 and CHEM 70248) Chemistry of biologically important molecules. Advanced topics in metabolic and enzyme regulation; enzyme kinetics and mechanism; DNA replication, recombination and repair; gene transcription and translation; recombinant DNA technology; selected areas in molecular physiology. Three hours weekly.

Prerequisite: CHEM 30284 or CHEM 40245 or CHEM 40247.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 40251 ADVANCED BIOLOGICAL CHEMISTRY LABORATORY (WIC) 2 Credit Hours

Practical experience in the chemistry of biologically important molecules. Properties of proteins, lipids and nucleic acids. Recombinant DNA technology. Six hours weekly.

Prerequisite: CHEM 30284 or CHEM 40245 or CHEM 40247.

Schedule Type: Lecture

Contact Hours: 2 lab

Grade Mode: Standard Letter

Attributes: Writing Intensive Course

CHEM 40261 PRINCIPLES OF BIOCHEMISTRY I 3 Credit Hours

(Cross-listed with CHEM 50261 and CHEM 70261) Introduction to biochemical principles regarding the structure and function of biomolecules including water, amino acids, proteins, carbohydrates and lipids; emphasis on enzymes, membranes and bioenergetics. 000) grade in MATH 12002

Prerequisite: CHEM 20481 or CHEM 30482; and CHEM 40555 or CHEM 40567 or a minimum C (2.000) grade in MATH 12021 or a minimum C (2.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 40262 PRINCIPLES OF BIOCHEMISTRY II 3 Credit Hours

(Cross-listed with CHEM 50262 and CHEM 70262) Aspects of biochemistry focusing on information, chemical and energy flow, including: integration of metabolic pathways; DNA replication, repair, recombination and modification; transcription and translation; signal transduction, post-translational modification.

Prerequisite: CHEM 40261.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 40263 PHYSICAL BIOCHEMISTRY 3 Credit Hours

(Slashed with CHEM 50263 and CHEM 70263) Principles and techniques of physical chemistry used in studying biomacromolecules and biological systems, spectroscopy, structure and properties of biological molecules.

Prerequisite: CHEM 40555 or CHEM 40567; and CHEM 30284 or CHEM 40245 or CHEM 40261.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 40295 SPECIAL TOPICS IN BIOCHEMISTRY 1-3 Credit Hours

(Repeatable for credit) Selected topics in biochemistry.

Prerequisite: special approval.

Schedule Type: Lecture

Contact Hours: 1-3 lecture

Grade Mode: Standard Letter

CHEM 40302 INORGANIC CHEMISTRY II 2 Credit Hours

(Cross-listed with CHEM 50302) Physical techniques in inorganic chemistry, molecular structure and bonding, metallic and ionic solids, organometallic chemistry, homogeneous and heterogeneous catalysis; solid-state and materials chemistry, nanomaterials, nanoscience and nanotechnology.

Prerequisite: CHEM 30301.

Schedule Type: Lecture

Contact Hours: 2 lecture

Grade Mode: Standard Letter

CHEM 40303 INORGANIC CHEMISTRY III 2 Credit Hours

(Cross-listed with CHEM 50303) Molecular symmetry, molecular orbital theory of polyatomic molecules and octahedra complexes, electronic spectra and reaction mechanisms of d-block complexes, periodic trends Groups 1 and 2 and d-block, bioinorganic chemistry.

Prerequisite: CHEM 40302.

Schedule Type: Lecture

Contact Hours: 2 lecture

Grade Mode: Standard Letter

CHEM 40352 INORGANIC MATERIALS CHEMISTRY 3 Credit Hours

(Slashed with CHEM 50352 and CHEM 70352) Broad survey of the synthesis, properties, characterization and applications of inorganic materials.

Prerequisite: CHEM 30050 and CHEM 40361.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 40364 INTERMEDIATE INORGANIC CHEMISTRY LAB 1 Credit Hour

A laboratory course providing experience in the synthesis of significant inorganic compounds and the techniques of various experimental and spectroscopic methods and chromatographic separations.

Prerequisite: CHEM 40303.

Schedule Type: Laboratory

Contact Hours: 3 lab

Grade Mode: Standard Letter

CHEM 40365 BIOLOGICAL INORGANIC CHEMISTRY 3 Credit Hours

(Slashed with CHEM 50365 and CHEM 70365) Physical methods, s-block metals, metal ion-induced folding, electron transfer proteins, oxidoreductases, substrate binding and activation by non-redox mechanisms, biomineralization, group-atom transfer and metals in medicine.

Prerequisite: CHEM 30301.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 40395 SPECIAL TOPICS IN INORGANIC CHEMISTRY 1-3 Credit Hours

(Repeatable for credit) Selected topics in inorganic chemistry.

Prerequisite: Special approval.

Schedule Type: Lecture

Contact Hours: 1-3 lecture

Grade Mode: Standard Letter

CHEM 40451 ORGANIC MATERIALS CHEMISTRY 3 Credit Hours

(Slashed with CHEM 50451 and CHEM 70451) Broad survey of the synthesis, properties, characterization and applications of organic and polymeric materials.

Prerequisite: CHEM 30482.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 40476 SPECTROSCOPIC IDENTIFICATION OF ORGANIC COMPOUNDS 2 Credit Hours

(Slashed with CHEM 50476 and CHEM 70476) Strategies for structural elucidation of organic compounds from analysis of infrared, proton and carbon NMR, and mass spectrometric data through lectures and problem solving.

Prerequisite: CHEM 30482.

Schedule Type: Lecture

Contact Hours: 2 lecture

Grade Mode: Standard Letter

CHEM 40477 INTERMEDIATE ORGANIC CHEMISTRY LABORATORY 1 Credit Hour

Continuation of CHEM 30476, including hands-on use of a high-field NMR spectrometer; single and multistep organic syntheses.

Prerequisite: CHEM 30476.

Schedule Type: Laboratory

Contact Hours: 1 lab

Grade Mode: Standard Letter

CHEM 40478 SYNTHESIS OF ORGANIC LIQUID CRYSTALS 3 Credit Hours

(Slashed with CHEM 50478 and CHEM 70478) Synthesis of organic thermotropic liquid crystals including nematic, smectic and discotic variants. Evaluation of the phase types using polarizing microscopy and DSC. Brief introduction into their use in display devices.

Prerequisite: CHEM 30482.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 40483 INTERMEDIATE ORGANIC CHEMISTRY 1 Credit Hour

Continuation of CHEM 30482; organic chemistry from mechanistic and synthetic viewpoints, including synthetic design, organotransition metal chemistry and free radical chemistry.

Prerequisite: A minimum C grade in CHEM 30482.

Schedule Type: Lecture

Contact Hours: 1 lecture

Grade Mode: Standard Letter

CHEM 40495 SPECIAL TOPICS IN ORGANIC CHEMISTRY 1-3 Credit Hours

(Repeatable for credit) Selected topics in organic chemistry.

Prerequisite: special approval.

Schedule Type: Lecture

Contact Hours: 1-3 lecture

Grade Mode: Standard Letter

CHEM 40555 PHYSICAL CHEMISTRY I 3 Credit Hours

(Slashed with CHEM 50555 and CHEM 70555) Fundamental concepts of physical chemistry, with example problems chosen emphasizing applications in chemistry and the biological sciences.

Prerequisite: CHEM 10061 or CHEM 10971 with a minimum C grade; MATH 12003 with a minimum C grade; and PHY 23102.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 40556 PHYSICAL CHEMISTRY II 3 Credit Hours

(Slashed with CHEM 50556 and CHEM 70556) A continuation of CHEM 40555. Areas covered include quantum mechanics, atomic and molecular structure, spectroscopy, statistical mechanics, theories of reaction rates and the solid state.

Prerequisite: CHEM 40555 or PHY 45301.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 40557 PHYSICAL CHEMISTRY LABORATORY 2 Credit Hours

(Slashed with CHEM 50557 and CHEM 70557) Experiments in numerous areas of physical chemistry, including the interpretation and reporting of obtained experimental data, correlation of results with theory and an introduction to the computer treatment of data.

Prerequisite: CHEM 40556.

Schedule Type: Laboratory

Contact Hours: 3 lab

Grade Mode: Standard Letter

CHEM 40559 NANOMATERIALS 3 Credit Hours

(Slashed with CHEM 50559 and CHEM 70559) Fundamental aspects of nanomaterials ranging from nanoparticles to three-dimensional (3D) nanostructures emphasizing their synthesis, chemistry and applications.

Prerequisite: CHEM 10061.

Pre/corequisite: CHEM 40555 or CHEM 40567.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 40567 PHYSICAL CHEMISTRY FOR LIFE SCIENCES 4 Credit Hours

Traditional aspects of physical chemistry with minimal calculus treatment. Applications to the health sciences emphasized.

Prerequisite: CHEM 10061 or CHEM 10971 with minimum C grade; and MATH 12002 or MATH 12021.

Pre/corequisite: PHY 13002 or PHY 23102.

Schedule Type: Lecture

Contact Hours: 4 lecture

Grade Mode: Standard Letter

CHEM 40568 ELEMENTARY PHYSICAL CHEMISTRY LABORATORY 1 Credit Hour

Provides hands-on experience with calorimetry, viscosimetry and spectroscopic techniques.

Prerequisite: CHEM 40555 or CHEM 40567.

Schedule Type: Laboratory

Contact Hours: 1 lab

Grade Mode: Standard Letter

CHEM 40571 SURFACE CHEMISTRY 2 Credit Hours

(Slashed with CHEM 50571 and CHEM 70571) Treatment of basic principles and concepts in surface and colloid chemistry. Relationship to practical systems emphasized. Two hours lecture weekly.

Prerequisite: CHEM 40555 or CHEM 40567.

Schedule Type: Lecture

Contact Hours: 2 lecture

Grade Mode: Standard Letter

CHEM 40575 MOLECULAR SPECTROSCOPY 3 Credit Hours

(Slashed with CHEM 50575 and CHEM 70575) Survey of the fundamental principles of the interaction of radiation with matter, with an emphasis on the interpretation of microwave, infrared and ultraviolet-visible spectra. Introduction to group theory and its application to spectroscopic interpretation. Description of modern experimental techniques.

Prerequisite: CHEM 40556.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 40595 SPECIAL TOPICS IN PHYSICAL CHEMISTRY 1-3 Credit Hours

(Repeatable for credit) Selected topics in physical chemistry.

Prerequisite: special approval.

Schedule Type: Lecture

Contact Hours: 1-3 lecture

Grade Mode: Standard Letter

CHEM 40795 CURRENT TOPICS IN CHEMICAL EDUCATION 1-3 Credit Hours

(Repeatable for credit) (Cross-listed with CHEM 50795) Recent advances in chemical research, instrumentation and theory important to chemical educators.

Prerequisite: Permission.

Schedule Type: Lecture

Contact Hours: 1-3 lecture

Grade Mode: Satisfactory/Unsatisfactory

CHEM 40796 INDIVIDUAL INVESTIGATION 1-8 Credit Hours

(Repeatable for credit) Registration requires prior approval of the research director. Written report required. Maximum of two hours may be applied to the four hour CHEM 40000 elective requirement for the chemistry concentration within the B.S. in Chemistry.

Prerequisite: 2.500 GPA in chemistry and special approval.

Schedule Type: Individual Investigation

Contact Hours: 1-8 other

Grade Mode: Satisfactory/Unsatisfactory-IP

CHEM 41010 BIOPHOTONICS 3 Credit Hours

(Slashed with CHEM 51010; Cross-listed with BSCI 41110 and BSCI 51110 and PHY 41010 and PHY 51010) Interdisciplinary overview of the basics of biophotonics; application of biophotonic techniques to probe biological samples. Introduction to the foundations of optics and photonics and how the molecular structure of organic molecules translates into unique photonic properties and targeting in biological cells or tissue. Preparation of fluorescent materials, advanced spectroscopy and cell visualization using regular and confocal fluorescence microscopy.

Prerequisite: Special approval.

Schedule Type: Combined Lecture and Lab

Contact Hours: 1 lecture, 6 lab

Grade Mode: Standard Letter

CHEM 50093 VARIABLE TITLE WORKSHOP IN CHEMISTRY 1-6 Credit Hours

(Repeatable for credit) Variable titled workshop in chemistry.

Prerequisite: Graduate standing and special approval.

Schedule Type: Workshop

Contact Hours: 1-6 other

Grade Mode: Satisfactory/Unsatisfactory

CHEM 50109 BIOANALYTICAL CHEMISTRY 3 Credit Hours

(Cross-listed with CHEM 40109 and CHEM 70109) Covers traditional as well as newly emerging topics in the field of bioanalytical chemistry. The course will provide an overview of the fundamental biological targets for the bioanalytical assays, such as lipids, peptides, proteins, nucleic acids, and cells. The course will then briefly introduce traditional tools, such as chromatography, electrophoresis, mass spectrometry, fluorescence techniques, immunoassays, and biosensors. Finally, the course will discuss approaches most recently developed in the field, which include lab-on-a-chip and single molecule techniques.

Prerequisite: CHEM 30105; and Graduate standing; and special approval.

Corequisite: CHEM 30284 or 40245 or 40261.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 50110 ANALYTICAL MASS SPECTROMETRY 3 Credit Hours

(Slashed with CHEM 40110 and CHEM 70110) Survey of modern techniques in and associated with mass spectrometry, including historical perspectives, strengths and weaknesses, detection and quantification of analytes, ionization source and mass analyzer design, as well as construction of associated technologies including vacuum systems, ion detection, and ion optics. Ion formation processes will also be discussed.

Prerequisite: Graduate standing in Chemistry.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 50113 CHEMICAL SEPARATIONS 3 Credit Hours

(Cross-listed with CHEM 40113 and CHEM 70113) Theory, instrumentation and applications of chemical separations for chemical analysis. Emphasis on gas and liquid chromatography.

Prerequisite: CHEM 30106 and Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 50116 SPECTROCHEMICAL METHODS OF ANALYSIS 3 Credit Hours

(Slashed with CHEM 40116 and CHEM 70116) Presented material is designed to familiarize students with fundamental concepts in spectrochemical analyses, mainly in the form of optical spectroscopic methods. Design and construction of spectroscopic instruments, detection and quantification of analytes, interaction of electromagnetic radiation with molecules, as well as collection and processing of analytical signals will be presented.

Prerequisite: Graduate standing in Chemistry.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 50245 BIOCHEMICAL FOUNDATIONS OF MEDICINE 4 Credit Hours

(Cross-listed with CHEM 40245) Introduction to chemistry and metabolism of important compounds in biological systems; enzymes and characteristics of enzyme catalysis; regulation of metabolism at molecular, cellular and organism levels; inborn and induced errors of metabolism. Designed and scheduled for and priority given to students in integrated life sciences program.

Prerequisite: CHEM 30481 and Graduate standing.

Schedule Type: Lecture

Contact Hours: 4 lecture

Grade Mode: Standard Letter

CHEM 50248 ADVANCED BIOLOGICAL CHEMISTRY 3 Credit Hours

(Cross-listed with CHEM 40248 and CHEM 70248) Chemistry of biologically important molecules. Advanced topics in: metabolic and enzyme regulation; enzyme kinetics and mechanism; DNA replication, recombination and repair; gene transcription and translation; recombinant DNA technology; selected areas in molecular physiology. Three hours weekly.

Prerequisite: CHEM 30284 or CHEM 40245 or CHEM 40247 and Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 50261 PRINCIPLES OF BIOCHEMISTRY I 3 Credit Hours
 (Cross-listed with CHEM 40261 and CHEM 70261) Introduction to biochemical principles regarding the structure and function of biomolecules including water, amino acids, proteins, carbohydrates and lipids; emphases on enzymes, membranes and bioenergetics.
Prerequisite: Graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

CHEM 50262 PRINCIPLES OF BIOCHEMISTRY II 3 Credit Hours
 (Cross-listed with CHEM 40262 and CHEM 70262) Aspects of biochemistry focusing on information, chemical and energy flow, including: integration of metabolic pathways; DNA replication, recombination and modification; transcription and translation; signal transduction, and post-translational modification. Prerequisites: CHEM 50261 or CHEM 70261 and Graduate standing
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

CHEM 50263 PHYSICAL BIOCHEMISTRY 3 Credit Hours
 (Slashed with CHEM 40263 and CHEM 70263) Principles and techniques of physical chemistry used in studying biomacromolecules and biological systems. Topics covered are thermodynamics, spectroscopy, structure and properties of biological molecules.
Prerequisite: Graduate standing in chemistry.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

CHEM 50302 INORGANIC CHEMISTRY II 2 Credit Hours
 (Cross-listed with CHEM 40302) Physical techniques in inorganic chemistry, molecular structure and bonding, metallic and ionic solids, organometallic chemistry, homogeneous and heterogeneous catalysis; solid-state and materials chemistry, nanomaterials, nanoscience and nanotechnology.
Prerequisite: CHEM 30301 and Graduate standing.
Schedule Type: Lecture
Contact Hours: 2 lecture
Grade Mode: Standard Letter

CHEM 50303 INORGANIC CHEMISTRY III 2 Credit Hours
 (Slashed with CHEM 40303) Molecular symmetry, molecular orbital theory of polyatomic molecules and octahedral complexes, electronic spectra and reaction mechanisms of d-block complexes, periodic trends Groups 1 and 2 and d-block, bioinorganic chemistry.
Prerequisite: CHEM 50302 and Graduate standing.
Schedule Type: Lecture
Contact Hours: 2 lecture
Grade Mode: Standard Letter

CHEM 50352 INORGANIC MATERIALS CHEMISTRY 3 Credit Hours
 (Cross-listed with CHEM 40352 and CHEM 70352) Broad survey of the synthesis, properties, characterization and applications of inorganic materials.
Prerequisite: Graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

CHEM 50365 BIOLOGICAL INORGANIC CHEMISTRY 3 Credit Hours
 (Cross-listed with CHEM 40365 and CHEM 70365) Physical methods, s-block metals, metal-induced stabilization, electron transfer proteins, oxidoreductases, hydrolases and lyases, metal transport and storage, nitrogenases, group-atom transfer and metals in medicine.
Prerequisite: CHEM 30360 and Graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

CHEM 50451 ORGANIC MATERIALS CHEMISTRY 3 Credit Hours
 (Cross-listed with CHEM 40451 and CHEM 70451) Broad survey of the synthesis, properties, characterization and applications of organic and polymeric materials.
Prerequisite: Graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

CHEM 50476 SPECTROSCOPIC IDENTIFICATION OF ORGANIC COMPOUNDS 2 Credit Hours
 (Cross-listed with CHEM 40476 and CHEM 70476) Strategies for structural elucidation of organic compounds from analysis of infrared, proton and carbon NMR and mass spectrometric data through lectures and problem solving.
Prerequisite: CHEM 30482 and graduate standing.
Schedule Type: Lecture
Contact Hours: 2 lecture
Grade Mode: Standard Letter

CHEM 50478 SYNTHESIS OF ORGANIC LIQUID CRYSTALS 3 Credit Hours
 (Cross-listed with CHEM 40478 and CHEM 70478) Synthesis of organic thermotropic liquid crystals including nematic, smectic and discotic variants. Evaluation of the phase types using polarizing microscopy and DSC. Brief introduction into their use in display devices.
Prerequisite: CHEM 30482; graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

CHEM 50555 PHYSICAL CHEMISTRY I 3 Credit Hours
 (Slashed with CHEM 40555 and CHEM 70555) Fundamental concepts of physical chemistry, with example problems chosen emphasizing application in chemistry and the biological sciences.
Prerequisite: Graduate standing in chemistry.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

CHEM 50556 PHYSICAL CHEMISTRY II 3 Credit Hours
 (Slashed with CHEM 40556 and CHEM 70556) A continuation of CHEM 50555. Areas covered are chemical kinetics, quantum chemistry and the solid state.
Prerequisite: CHEM 50555 or PHY 45301 and Graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

CHEM 50557 PHYSICAL CHEMISTRY LABORATORY 2 Credit Hours
(Slashed with CHEM 40557 and CHEM 70557) Experiments in numerous areas of physical chemistry, including the interpretation and reporting of obtained experimental data, correlation of results with theory and an introduction to the computer treatment of data.

Prerequisite: Graduate standing.

Pre/corequisite: CHEM 50555 and CHEM 50556.

Schedule Type: Laboratory

Contact Hours: 4 lab

Grade Mode: Standard Letter

CHEM 50559 NANOMATERIALS 3 Credit Hours

(Slashed with CHEM 40559 and CHEM 70559). Fundamental aspects of nanomaterials ranging from nanoparticles to three-dimensional (3D) nanostructures emphasizing their synthesis, chemistry and applications.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 50571 SURFACE CHEMISTRY 2 Credit Hours

(Cross-listed with CHEM 40571 and CHEM 70571) Treatment of basic principles and concepts in surface and colloid chemistry. Relationship to practical systems emphasized.

Prerequisite: CHEM 40555 or 40567 and Graduate standing.

Schedule Type: Lecture

Contact Hours: 2 lecture

Grade Mode: Standard Letter

CHEM 50575 MOLECULAR SPECTROSCOPY 3 Credit Hours

(Slashed with CHEM 40575 and CHEM 70575) Survey of the fundamental principles of the interaction of radiation with matter, with an emphasis on the interpretation of microwave, infrared and ultraviolet-visible spectra. Introduction to group theory and its application to spectroscopic interpretation. Description of modern experimental techniques.

Prerequisite: CHEM 40556 and Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 50795 CURRENT TOPICS IN CHEMICAL EDUCATION 1-3 Credit Hours

(Repeatable for credit) (Cross-listed with CHEM 40795) Designed to present recent advances in chemical research, instrumentation and theory to chemistry educators.

Prerequisite: Graduate standing and special approval.

Schedule Type: Lecture

Contact Hours: 1-3 lecture

Grade Mode: Satisfactory/Unsatisfactory

CHEM 51010 BIOPHOTONICS 3 Credit Hours

(Slashed with CHEM 41010; Cross-listed with BSCI 41110 and BSCI 51110 and PHY 41010 and PHY 51010) Interdisciplinary overview of the basics of biophotonics; application of biophotonic techniques to probe biological samples. Introduction to the foundations of optics and photonics and how the molecular structure of organic molecules translates into unique photonic properties and targeting in biological cells or tissue. Preparation of fluorescent materials, advanced spectroscopy and cell visualization using regular and confocal fluorescence microscopy.

Prerequisite: Graduate standing and special approval.

Schedule Type: Combined Lecture and Lab

Contact Hours: 1 lecture, 6 lab

Grade Mode: Standard Letter

CHEM 60199 THESIS I 2-6 Credit Hours

Thesis students must register for a total of 6 hours, 2 to 6 hours in single semester distributed over several semesters if desired.

Prerequisite: Graduate standing.

Schedule Type: Masters Thesis

Contact Hours: 2-6 other

Grade Mode: Satisfactory/Unsatisfactory-IP

CHEM 60254 BIOMEMBRANES 2 Credit Hours

(Slashed with CHEM 70254) Biological membranes; composition, structure, dynamics and biogenesis; structure/function of protein mediated membrane transport.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 2 lecture

Grade Mode: Standard Letter

CHEM 60291 SEMINAR: RECENT DEVELOPMENTS IN BIOCHEMISTRY 1 Credit Hour

(Repeatable for credit) (Cross-listed with CHEM 70291) Presentation and discussion of research papers from current biochemistry literature. Participation by students and faculty.

Prerequisite: Graduate standing.

Schedule Type: Seminar

Contact Hours: 1 other

Grade Mode: Standard Letter-IP

CHEM 60299 THESIS II 2 Credit Hours

Thesis students must continue registration until all degree requirements are met.

Prerequisite: CHEM 60199 and Graduate standing.

Schedule Type: Masters Thesis

Contact Hours: 2 other

Grade Mode: Satisfactory/Unsatisfactory-IP

CHEM 60327 MODERN INORGANIC CHEMISTRY 3 Credit Hours

(Slashed with CHEM 70327) Synthesis, structure and reactivity of inorganic compounds including transition metal and organometallic complexes.

Prerequisite: CHEM 40362 and Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 60347 CHEMICAL CRYSTALLOGRAPHY 3 Credit Hours

(Cross-listed with CHEM 70347) Structure solution and refinement methods of X-ray diffraction data. Emphasis will be placed on single crystal techniques.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 60391 SEMINAR: RECENT DEVELOPMENTS IN INORGANIC CHEMISTRY 1 Credit Hour

(Repeatable for credit) (Cross-listed with CHEM 70391) Presentation and discussion of research papers from current inorganic chemistry literature. Participation by students and faculty.

Prerequisite: Graduate standing.

Schedule Type: Seminar

Contact Hours: 1 other

Grade Mode: Standard Letter-IP

CHEM 60472 ADVANCED ORGANIC CHEMISTRY-SYNTHETIC ASPECTS 3 Credit Hours

(Cross-listed with CHEM 70472) Disconnection approach to organic synthesis. Modern methods for carbon-carbon bond formation and functional group interconversion, and their application to natural product synthesis. Graduate standing.

Prerequisite: CHEM 30482.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 60473 STEREOSELECTIVE ORGANIC SYNTHESIS 3 Credit Hours

(Slashed with CHEM 70473) Modern methods of asymmetric synthesis; introduction to selected methods for stereoselective N-heterocycle synthesis; application of these methods in natural product synthesis.

Prerequisite: CHEM 30482 and Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 60541 ADVANCED PHYSICAL CHEMISTRY 3 Credit Hours

(Slashed with CHEM 70541) Covers basic materials of modern physical chemistry in two broad areas: thermodynamics and introductory quantum mechanics.

Prerequisite: CHEM 50556 and Graduate standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 60591 SEMINAR: RECENT DEVELOPMENTS IN PHYSICAL CHEMISTRY 1 Credit Hour

(Repeatable for credit) (Slashed with CHEM 70591) Presentation and discussion of research papers from current physical chemistry literature. Participation by students and faculty.

Prerequisite: Graduate standing.

Schedule Type: Seminar

Contact Hours: 1 other

Grade Mode: Standard Letter-IP

CHEM 60894 COLLEGE TEACHING OF CHEMISTRY 1 Credit Hour

(Repeatable for credit) (Slashed with CHEM 70894) Experience in teaching of chemistry at college level.

Prerequisite: Graduate standing.

Schedule Type: Lecture

Contact Hours: 1 lecture

Grade Mode: Satisfactory/Unsatisfactory

CHEM 60898 MASTERS RESEARCH 1-15 Credit Hours

(Repeatable for credit) Research for master's students. Credits earned may be applied toward degree if department approves.

Prerequisite: Graduate standing.

Schedule Type: Research

Contact Hours: 1-15 other

Grade Mode: Satisfactory/Unsatisfactory-IP

CHEM 61191 SEMINAR: PROBLEM SOLVING IN ANALYTICAL CHEMISTRY 1 Credit Hour

(Repeatable for credit) (Slashed with CHEM 71191) Problem solving in analytical chemistry, including chemical analysis methods, instrumentation, sample preparation, and data handling.

Prerequisite: Graduate standing.

Schedule Type: Seminar

Contact Hours: 1 other

Grade Mode: Standard Letter-IP

CHEM 61491 SEMINAR: PROBLEM SOLVING IN ORGANIC CHEMISTRY 1 Credit Hour

(Repeatable for credit) (Slashed with CHEM 71491) Practical experience in the solving of current problems of synthesis, spectroscopy, and mechanism in organic chemistry.

Prerequisite: Graduate standing.

Schedule Type: Seminar

Contact Hours: 1 other

Grade Mode: Standard Letter-IP

CHEM 62191 SEMINAR: ANALYTICAL CHEMISTRY 1 Credit Hour

(Repeatable for credit) (Slashed with CHEM 72191) Student and faculty presentations on topics in analytical chemistry.

Prerequisite: Graduate standing.

Schedule Type: Seminar

Contact Hours: 1 other

Grade Mode: Standard Letter-IP

CHEM 62291 SEMINAR: BIOCHEMISTRY 1 Credit Hour

(Repeatable for credit) (Slashed with CHEM 72291) Student and faculty presentations on topics in biochemistry

Prerequisite: Graduate standing.

Schedule Type: Seminar

Contact Hours: 1 other

Grade Mode: Standard Letter-IP

CHEM 62391 SEMINAR: INORGANIC CHEMISTRY 1 Credit Hour

(Repeatable for credit) (Cross-listed with CHEM 72391) Student and faculty presentations on topics in inorganic chemistry.

Prerequisite: Graduate standing.

Schedule Type: Seminar

Contact Hours: 1 other

Grade Mode: Standard Letter-IP

CHEM 62491 SEMINAR: ORGANIC CHEMISTRY 1 Credit Hour

(Repeatable for credit) (Slashed with CHEM 72491) Presentation of topics from the recent literature on aspects of organic chemistry including synthesis, spectroscopy, mechanism, and materials properties.

Prerequisite: Graduate standing.

Schedule Type: Seminar

Contact Hours: 1 other

Grade Mode: Standard Letter-IP

CHEM 62591 SEMINAR: PHYSICAL CHEMISTRY 1 Credit Hour

(Repeatable for credit) (Slashed with CHEM 72591) Student and faculty presentations on topics in physical chemistry.

Prerequisite: Graduate standing.

Schedule Type: Seminar

Contact Hours: 1 other

Grade Mode: Standard Letter-IP

CHEM 70093 VARIABLE TITLE WORKSHOP IN CHEMISTRY 1-6 Credit Hours

(Repeatable for credit) Variable title workshop in Chemistry.

Prerequisite: Special approval and doctoral standing.

Schedule Type: Workshop

Contact Hours: 1-6 other

Grade Mode: Satisfactory/Unsatisfactory

CHEM 70109 BIOANALYTICAL CHEMISTRY 3 Credit Hours

(Slashed with CHEM 40109 and CHEM 50109) Covers traditional as well as newly emerging topics in the field of bioanalytical chemistry. The course will provide an overview of the fundamental biological targets for the bioanalytical assays, such as lipids, peptides, proteins, nucleic acids, and cells. The course will then briefly introduce traditional tools, such as chromatography, electrophoresis, mass spectrometry, fluorescence techniques, immunoassays, and biosensors. Finally, the course will discuss approaches most recently developed in the field, which include lab-on-a-chip and single molecule techniques.

Prerequisite: CHEM 30105; and Doctoral standing; and special approval.

Corequisite: CHEM 30284 or CHEM 40245 or CHEM 40261.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 70110 ANALYTICAL MASS SPECTROMETRY 3 Credit Hours

(Slashed with CHEM 40110 and CHEM 50110) Survey of modern techniques in and associated with mass spectrometry, including historical perspectives, strengths and weaknesses, detection and quantification of analytes, ionization source and mass analyzer design, as well as construction of associated technologies including vacuum systems, ion detection, and ion optics. Ion formation processes will also be discussed.

Prerequisite: Doctoral standing in chemistry.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 70113 CHEMICAL SEPARATIONS 3 Credit Hours

(Slashed with CHEM 40113 and CHEM 50113) Theory, instrumentation and applications of chemical separations for chemical analysis. Emphasis on gas and liquid chromatography.

Prerequisite: CHEM 30106 and Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 70116 SPECTROCHEMICAL METHODS OF ANALYSIS 3 Credit Hours

(Slashed with CHEM 40116 and CHEM 50116) Presented material is designed to familiarize students with fundamental concepts in spectrochemical analyses, mainly in the form of optical spectroscopic methods. Design and construction of spectroscopic instruments, detection and quantification of analytes, interaction of electromagnetic radiation with molecules, as well as collection and processing of analytical signals will be presented.

Prerequisite: Doctoral standing in chemistry.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 70195 ADVANCED TOPICS, ANALYTICAL 1-3 Credit Hours

(Repeatable for credit) Advanced topics in analytical chemistry.

Prerequisite: Doctoral standing and special approval.

Schedule Type: Lecture

Contact Hours: 1-3 lecture

Grade Mode: Standard Letter

CHEM 70248 ADVANCED BIOLOGICAL CHEMISTRY 3 Credit Hours

(Slashed with CHEM 40248 and CHEM 50248) Chemistry of biologically important molecules. Advanced topics in: metabolic and enzyme regulation; enzyme kinetics and mechanism; DNA replication; recombination and repair; gene transcription and translation; recombinant DNA technology; selected areas in molecular physiology. Three hours weekly.

Prerequisite: CHEM 30284 or CHEM 40245 or CHEM 40247 and Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 70254 BIOMEMBRANES 2 Credit Hours

(Cross-listed with CHEM 60254) Biological membranes; composition, structure, dynamics and biogenesis; structure/function of protein mediated membrane transport.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 2 lecture

Grade Mode: Standard Letter

CHEM 70261 PRINCIPLES OF BIOCHEMISTRY I 3 Credit Hours

(Slashed with CHEM 40261 and CHEM 50261) Introduction to biochemical principles regarding the structure and function of biomolecules including water, amino acids, proteins, carbohydrates and lipids; emphases on enzymes, membranes and bioenergetics.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 70262 PRINCIPLES OF BIOCHEMISTRY II 3 Credit Hours

(Slashed with CHEM 40262 and CHEM 50262) Aspects of biochemistry focusing on information, chemical and energy flow, including: integration of metabolic pathways; DNA replication, repair, recombination and modification; transcription and translation; signal transduction, and post-translational modification.

Prerequisite: CHEM 50261 or CHEM 70261; and Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 70263 PHYSICAL BIOCHEMISTRY 3 Credit Hours

(Slashed with CHEM 40263 and CHEM 50263) Principles and techniques of physical chemistry used in studying biomacromolecules and biological systems. Topics covered are thermodynamics, spectroscopy, structure and properties of biological molecules.

Prerequisite: Doctoral standing in chemistry.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 70291 SEMINAR:RECENT DEVELOPMENTS IN BIOCHEMISTRY 1 Credit Hour

(Repeatable for credit) Presentation and discussion of research papers from current biochemistry literature. Participation by students and faculty.

Prerequisite: Doctoral standing.

Schedule Type: Seminar

Contact Hours: 1 other

Grade Mode: Standard Letter-IP

CHEM 70295 ADVANCED TOPICS IN BIOCHEMISTRY 1-3 Credit Hours

(Repeatable for credit) Advanced topics in biochemistry.

Prerequisite: Doctoral standing and special approval.

Schedule Type: Lecture

Contact Hours: 1-3 lecture

Grade Mode: Standard Letter

CHEM 70327 MODERN INORGANIC CHEMISTRY 3 Credit Hours

(Slashed with CHEM 60327) Synthesis, structure and reactivity of inorganic compounds including transition metal and organometallic complexes. Doctoral standing.

Prerequisite: CHEM 40362.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 70347 CHEMICAL CRYSTALLOGRAPHY 3 Credit Hours

(Slashed with CHEM 60347) Structure solution and refinement methods of X-ray diffraction data. Emphasis will be placed on single-crystal techniques.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 70352 INORGANIC MATERIALS CHEMISTRY 3 Credit Hours

(Slashed with CHEM 40352 and CHEM 50352) Broad survey of the synthesis, properties, characterization and applications of inorganic materials.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 70365 BIOLOGICAL INORGANIC CHEMISTRY 3 Credit Hours

(Slashed with CHEM 40365 and CHEM 50365) Physical methods, s-block metals, metal-induced stabilization, electron transfer proteins, oxidoreductases, hydrolases and lyases, metal transport and storage, nitrogenases, group-atom transfer and metals in medicine.

Prerequisite: CHEM 30360 and Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 70391 SEMINAR:RECENT DEVELOPMENTS IN INORGANIC CHEMISTRY 1 Credit Hour

(Repeatable for credit) (Slashed with CHEM 60391) Presentation and discussion of research papers from current inorganic chemistry literature. Participation by students and faculty.

Prerequisite: Doctoral standing.

Schedule Type: Seminar

Contact Hours: 1 other

Grade Mode: Standard Letter-IP

CHEM 70395 ADVANCED TOPICS, INORGANIC 1-3 Credit Hours

(Repeatable for credit) Advanced topics in inorganic chemistry.

Prerequisite: Doctoral standing and special approval.

Schedule Type: Lecture

Contact Hours: 1-3 lecture

Grade Mode: Standard Letter

CHEM 70451 ORGANIC MATERIALS CHEMISTRY 3 Credit Hours

(Slashed with CHEM 40451 and CHEM 50451) Broad survey of the synthesis, properties characterization and applications of organic and polymeric materials.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 70472 ADVANCED ORGANIC CHEMISTRY-SYNTHETIC ASPECTS 3 Credit Hours

(Slashed with CHEM 60472) Disconnection approach to organic synthesis. Modern methods for carbon-carbon bond formation and functional group interconversion, and their application to natural product synthesis. Doctoral standing.

Prerequisite: CHEM 30482.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 70473 STEREOSELECTIVE ORGANIC SYNTHESIS 3 Credit Hours

(Slashed with CHEM 60473) Modern methods of asymmetric synthesis; introduction to selected methods for stereoselective N-heterocycle synthesis; application of these methods in natural product synthesis.

Prerequisite: CHEM 30482 and Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 70476 SPECTROSCOPIC IDENTIFICATION OF ORGANIC COMPOUNDS 2 Credit Hours

(Slashed with CHEM 40476 and CHEM 50476) Strategies for structural elucidation of organic compounds from analysis of infrared, proton and carbon NMR, and mass spectrometric data through lectures and problem solving.

Prerequisite: CHEM 30482 and Doctoral standing.

Schedule Type: Lecture

Contact Hours: 2 lecture

Grade Mode: Standard Letter

CHEM 70478 SYNTHESIS OF ORGANIC LIQUID CRYSTALS 3 Credit Hours

(Slashed with CHEM 40478 and CHEM 70478) Synthesis of organic thermotropic liquid crystals including nematic, smectic and discotic variants. Evaluation of the phase types using polarizing microscopy and DSC. Brief introduction into their use in display devices.

Prerequisite: CHEM 30482; Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 70495 ADVANCED TOPICS, ORGANIC 1-3 Credit Hours

(Repeatable for credit) Advanced topics in organic chemistry.

Prerequisite: Permission.

Schedule Type: Lecture

Contact Hours: 1-3 lecture

Grade Mode: Standard Letter

CHEM 70541 ADVANCED PHYSICAL CHEMISTRY 3 Credit Hours
(Slashed with CHEM 60541) Covers basic materials of modern physical chemistry in two broad areas: thermodynamics and introductory quantum mechanics.

Prerequisite: CHEM 50556 and Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 70555 PHYSICAL CHEMISTRY I 3 Credit Hours
(Slashed with CHEM 40555 and CHEM 50555) Fundamental concepts of physical chemistry, with example problems chosen emphasizing applications in chemistry and the biological sciences.

Prerequisite: Doctoral standing in chemistry.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 70556 PHYSICAL CHEMISTRY II 3 Credit Hours
(Slashed with CHEM 40556 and CHEM 50556) Fundamental concepts of physical chemistry of current interest. Included are biological and medical aspects of physical chemistry. Graduate credit given to nonchemistry and nonphysics majors and with permission to certain chemistry majors.

Prerequisite: CHEM 50555 or 70555 and Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 70557 PHYSICAL CHEMISTRY LABORATORY 2 Credit Hours
(Slashed with CHEM 40557 and CHEM 50557) Experiments in numerous areas of physical chemistry, including the interpretation and reporting of obtained experimental data correlation of results with theory and an introduction to the computer treatment of data.

Prerequisite: Doctoral standing.

Pre/corequisite: CHEM 70555 and CHEM 70556.

Schedule Type: Laboratory

Contact Hours: 4 lab

Grade Mode: Standard Letter

CHEM 70559 NANOMATERIALS 3 Credit Hours
(Slashed with CHEM 40559 and CHEM 50559) Fundamental aspects of nanomaterials ranging from nanoparticles to three-dimensional (3D) nanostructures emphasizing their synthesis, chemistry and applications.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 70571 SURFACE CHEMISTRY 2 Credit Hours
(Slashed with CHEM 40571 and CHEM 50571) Treatment of basic principles and concepts in surface and colloid chemistry. Relationship to practical systems emphasized.

Prerequisite: CHEM 40555 or CHEM 40567 and Doctoral standing.

Schedule Type: Lecture

Contact Hours: 2 lecture

Grade Mode: Standard Letter

CHEM 70575 MOLECULAR SPECTROSCOPY 3 Credit Hours
(Cross-listed with CHEM 40575 and CHEM 50575) Survey of the fundamental principles of the interaction of radiation with matter, with an emphasis on the interpretation of microwave, infrared and ultraviolet-visible spectra. Introduction to group theory and its application to spectroscopic interpretation. Description of modern experimental techniques.

Prerequisite: CHEM 40556 and doctoral standing.

Schedule Type: Lecture

Contact Hours: 3 lecture

Grade Mode: Standard Letter

CHEM 70591 SEMINAR:RECENT DEVELOPMENTS IN PHYSICAL CHEMISTRY 1 Credit Hour

(Repeatable for credit) (Slashed with CHEM 60591) Presentation and discussion of research papers from current physical chemistry literature. Participation by students and faculty.

Prerequisite: Doctoral standing.

Schedule Type: Seminar

Contact Hours: 1 other

Grade Mode: Standard Letter-IP

CHEM 70595 ADVANCED TOPICS, PHYSICAL 1-3 Credit Hours
(Repeatable for credit) Advanced topics in physical chemistry.

Prerequisite: Doctoral standing and special approval.

Schedule Type: Lecture

Contact Hours: 1-3 lecture

Grade Mode: Standard Letter

CHEM 70894 COLLEGE TEACHING OF CHEMISTRY 1 Credit Hour
(Repeatable for credit) (Cross-listed with CHEM 60894) Experience in teaching of chemistry at college level.

Prerequisite: Doctoral standing.

Schedule Type: Lecture

Contact Hours: 1 lecture

Grade Mode: Satisfactory/Unsatisfactory

CHEM 71191 SEMINAR:PROBLEM SOLVING IN ANALYTICAL CHEMISTRY 1 Credit Hour

(Repeatable for credit) (Cross-listed with CHEM 61191) Problem solving in analytical chemistry, including chemical analysis methods, instrumentation, sample preparation, and data handling.

Prerequisite: Doctoral standing.

Schedule Type: Seminar

Contact Hours: 1 other

Grade Mode: Standard Letter-IP

CHEM 71491 SEMINAR:PROBLEM SOLVING IN ORGANIC CHEMISTRY 1 Credit Hour

(Repeatable for credit) (Cross-listed with CHEM 61491) Practical experience in the solving of current problems of synthesis, spectroscopy, and mechanism in organic chemistry.

Prerequisite: Doctoral standing.

Schedule Type: Seminar

Contact Hours: 1 other

Grade Mode: Standard Letter-IP

CHEM 72191 SEMINAR: ANALYTICAL CHEMISTRY 1 Credit Hour
(Repeatable for credit) (Cross-listed with CHEM 62191) Student and faculty presentations on topics in analytical chemistry.

Prerequisite: Doctoral standing.

Schedule Type: Seminar

Contact Hours: 1 other

Grade Mode: Standard Letter-IP

CHEM 72291 SEMINAR: BIOCHEMISTRY 1 Credit Hour

(Repeatable for credit) (Cross-listed with CHEM 62291) Student and faculty presentations on topics in biochemistry.

Prerequisite: Doctoral standing.

Schedule Type: Seminar

Contact Hours: 1 other

Grade Mode: Standard Letter-IP

CHEM 72391 SEMINAR: INORGANIC CHEMISTRY 1 Credit Hour

(Repeatable for credit) (Cross-listed with CHEM 62391) Student and faculty presentations on topics in inorganic chemistry.

Prerequisite: Doctoral standing.

Schedule Type: Seminar

Contact Hours: 1 other

Grade Mode: Standard Letter-IP

CHEM 72491 SEMINAR: ORGANIC CHEMISTRY 1 Credit Hour

(Repeatable for credit) (Slashed with CHEM 62491) Presentation of topics from the recent literature on aspects of organic chemistry including synthesis, spectroscopy, mechanism, and materials properties.

Prerequisite: Doctoral standing.

Schedule Type: Seminar

Contact Hours: 1 other

Grade Mode: Standard Letter-IP

CHEM 72591 SEMINAR: PHYSICAL CHEMISTRY 1 Credit Hour

(Repeatable for credit) (Slashed with CHEM 62591) Student and faculty presentations on topics in physical chemistry.

Prerequisite: Doctoral standing.

Schedule Type: Seminar

Contact Hours: 1 other

Grade Mode: Standard Letter-IP

CHEM 80199 DISSERTATION I 15 Credit Hours

(Repeatable for credit) Doctoral dissertation, for which registration in two semesters is required, first of which will be semester in which dissertation work is begun and continuing until the completion of 30 hours.

Prerequisite: Doctoral standing and special approval.

Schedule Type: Dissertation

Contact Hours: 15 other

Grade Mode: Satisfactory/Unsatisfactory-IP

CHEM 80299 DISSERTATION II 15 Credit Hours

(Repeatable for credit) Continuing registration required of doctoral students who have completed the initial 30 hours of dissertation and continuing until all degree requirements are met.

Prerequisite: CHEM 80199 and Doctoral standing.

Schedule Type: Dissertation

Contact Hours: 15 other

Grade Mode: Satisfactory/Unsatisfactory-IP

CHEM 80898 RESEARCH 1-15 Credit Hours

(Repeatable for credit) Research for doctoral students. Credits earned may be applied toward degree if department approves.

Prerequisite: Doctoral standing.

Schedule Type: Research

Contact Hours: 1-15 other

Grade Mode: Satisfactory/Unsatisfactory-IP