

# CHEMISTRY (CHEM)

## CHEM 1014 Chemistry In Civilization (LN)

**Description:** A survey course presenting the concepts and principles of chemistry for students outside the health, science and engineering fields. This course covers the basics of chemistry and chemical contributions to society such as polymers, consumer chemicals, drugs, and radioactivity. May not be used for degree credit with CHEM 1215 or CHEM 1314.

**Credit hours:** 4

**Contact hours:** Lecture: 2 Lab: 2 Contact: 5 Other: 1

**Levels:** Undergraduate

**Schedule types:** Discussion, Lab, Lecture, Combined lecture lab & disc

**Department/School:** Chemistry

**General Education and other Course Attributes:** Laboratory-Based Inquiry, Natural Science Reasoning

## CHEM 1215 Chemical Principles I (LN)

**Prerequisites:** MATH 1483 or MATH 1513 or a higher level math course with a "C" or better or an acceptable math placement score (see placement.okstate.edu) or acceptable AP credit.

**Description:** The beginning chemistry course recommended for students in the applied biological sciences. This course covers chemical principles and their applications to their properties and transformations of matter, including periodic classification of the elements, laws of chemical combination, atomic and molecular structure, and chemical bonding. Course previously offered as CHEM 1015.

**Credit hours:** 5

**Contact hours:** Lecture: 3 Lab: 2 Contact: 6 Other: 1

**Levels:** Undergraduate

**Schedule types:** Discussion, Lab, Lecture, Combined lecture lab & disc

**Department/School:** Chemistry

**General Education and other Course Attributes:** Laboratory-Based Inquiry, Natural Science Reasoning

## CHEM 1225 Chemical Principles II (LN)

**Prerequisites:** Minimal grade of "C" in CHEM 1215 or CHEM 1314 or CHEM 1414 or acceptable AP credit.

**Description:** A continuation of Chemical Principles I for students in the applied biological sciences. Topics include gas laws, chemical equilibria, acid/base chemistry, oxidation/reduction, elementary chemical thermodynamics, and introduction to organic molecules.

**Credit hours:** 5

**Contact hours:** Lecture: 3 Lab: 2 Contact: 6 Other: 1

**Levels:** Undergraduate

**Schedule types:** Discussion, Lab, Lecture, Combined lecture lab & disc

**Department/School:** Chemistry

**General Education and other Course Attributes:** Laboratory-Based Inquiry, Natural Science Reasoning

## CHEM 1314 Chemistry I (LN)

**Prerequisites:** MATH 1483 or MATH 1513 or higher with a "C" or better or an acceptable math placement score (see placement.okstate.edu) or acceptable AP credit.

**Description:** The beginning chemistry course recommended for students in basic biological sciences (including pre-medical science and pre-veterinary sciences), physical sciences and engineering. This course covers chemical principles and their applications to the properties and transformations of matter, including periodic classification of the elements, laws of chemical combination, gas laws, atomic and molecular structure, and chemical bonding.

**Credit hours:** 4

**Contact hours:** Lecture: 3 Lab: 2 Contact: 5

**Levels:** Undergraduate

**Schedule types:** Lab, Lecture, Combined lecture and lab

**Department/School:** Chemistry

**General Education and other Course Attributes:** Laboratory-Based Inquiry, Natural Science Reasoning

## CHEM 1414 General Chemistry for Engineers (LN)

**Prerequisites:** MATH 1483 or MATH 1513 or higher with a "C" or better or an acceptable math placement score (see placement.okstate.edu) or acceptable AP credit.

**Description:** One seminar survey of general chemistry for engineering students. Topics include physical properties of states of matter, stoichiometry, atomic theory, periodic properties, bonding, thermodynamics, equilibrium, acid-base and redox reactions, electrochemistry. Topics will be discussed with respect to applications to materials, energy and environmental topics relevant to engineering students.

**Credit hours:** 4

**Contact hours:** Lecture: 3 Lab: 2 Contact: 5

**Levels:** Undergraduate

**Schedule types:** Lab, Lecture, Combined lecture and lab

**Department/School:** Chemistry

**General Education and other Course Attributes:** Laboratory-Based Inquiry, Natural Science Reasoning

## CHEM 1515 Chemistry II (LN)

**Prerequisites:** Minimum grade of "C" in CHEM 1314 or CHEM 1414 or acceptable AP credit.

**Description:** A continuation of Chemistry 1 for students in the basic biological sciences (including premedical science and pre-veterinary science), physical sciences, and engineering. Topics include, but not limited to, intermolecular forces, liquids and solids, chemical equilibria, acid/base chemistry, oxidation/reduction, electrochemistry, chemical kinetics, and elementary chemical thermodynamics.

**Credit hours:** 5

**Contact hours:** Lecture: 3 Lab: 2 Contact: 6 Other: 1

**Levels:** Undergraduate

**Schedule types:** Discussion, Lab, Lecture, Combined lecture lab & disc

**Department/School:** Chemistry

**General Education and other Course Attributes:** Laboratory-Based Inquiry, Natural Science Reasoning

**CHEM 2113 Principles of Analytical Chemistry****Prerequisites:** A grade of "C" or better in CHEM 1515.**Description:** Statistical analysis of analytical data, acid-base equilibria, acid-base titrations, electrochemistry, analytical separations, as well as atomic and molecular optical spectroscopy.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 2122 Quantitative Analysis Laboratory****Prerequisites:** CHEM 2113 or concurrent enrollment.**Description:** Laboratory exercises related to theoretical principles in CHEM 2113.**Credit hours:** 2**Contact hours:** Lab: 4 Contact: 4**Levels:** Undergraduate**Schedule types:** Lab**Department/School:** Chemistry**CHEM 2890 Honors Experience in Chemistry****Prerequisites:** Honors Program participation and concurrent enrollment in designated course(s).**Description:** A supplemental Honors experience in Chemistry to partner concurrently with designated lower-division CHEM course(s). This course adds a different intellectual dimension to designated course(s). Offered for fixed credit, 1 credit hour, maximum of 6 credit hours.**Credit hours:** 1**Contact hours:** Lecture: 1 Contact: 1**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemistry**General Education and other Course Attributes:** Honors Credit**CHEM 2980 Current Topics for Chemical Professionals****Prerequisites:** Current enrollment in CHEM 1314 or higher chemistry course.**Description:** Current topics for pre-chemical professionals which may include, but are not limited to; Chemistry of Life; Energy; Environmental; Materials; Energy, What's that Stuff?, and Teaching/Learning. The course is intended to provide interested undergraduates with a broader introduction to topics relevant to future trends in chemistry and chemically-related fields. Discussion will be directed by faculty members with expertise in the identified area. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.**Credit hours:** 1-6**Contact hours:** Lecture: 1-6 Contact: 1-6**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 2990 Special Problems in Chemistry****Prerequisites:** CHEM 1314 or concurrent enrollment.**Description:** Training in independent work, study of relevant literature and experimental investigation of an assigned problem at the lower-division level. Offered for variable credit, 1-3 credit hours, maximum of 3 credit hours.**Credit hours:** 1-3**Contact hours:** Lab: 2-6 Contact: 2-6**Levels:** Undergraduate**Schedule types:** Lab**Department/School:** Chemistry**CHEM 3012 Survey of Organic Chemistry Laboratory****Prerequisites:** CHEM 3013 or concurrent enrollment.**Description:** Laboratory exercises related to theoretical principles covered in CHEM 3013.**Credit hours:** 2**Contact hours:** Lab: 3 Contact: 4 Other: 1**Levels:** Undergraduate**Schedule types:** Discussion, Lab, Combined Lab & Discussion**Department/School:** Chemistry**CHEM 3013 Survey of Organic Chemistry****Prerequisites:** Minimum grade of "C" in CHEM 1225 or CHEM 1515 or acceptable AP credit.**Description:** Terminal, one-semester organic chemistry lecture course covering the general principles of nomenclature, structure, bonding, methods of preparation, reactions and use of acyclic, cyclic, and aromatic compounds.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 3053 Organic Chemistry I****Prerequisites:** CHEM 1515 with a "C" or better or acceptable AP credit.**Description:** This course is the first of the in-depth sequence of organic chemistry. Topics include nomenclature, structure, stereochemistry, reactivity, properties, and synthesis of organic molecules with an emphasis on reaction mechanisms. This course is required for many life and physical science majors and pre-health students. Consult your degree requirements and professional school admission requirements.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 3112 Organic Chemistry Laboratory****Prerequisites:** Completion of CHEM 3153 or concurrent enrollment.**Description:** Laboratory exercises related to theoretical principles covered in CHEM 3053 and 3153.**Credit hours:** 2**Contact hours:** Lab: 3 Contact: 4 Other: 1**Levels:** Undergraduate**Schedule types:** Discussion, Lab, Combined Lab & Discussion**Department/School:** Chemistry**CHEM 3153 Organic Chemistry II****Prerequisites:** A grade of "C" or higher in CHEM 3053.**Description:** This course is the second of the in-depth sequence of organic chemistry starting with CHEM 3053.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemistry

**CHEM 3353 Descriptive Inorganic Chemistry****Prerequisites:** A grade of "C" or higher in CHEM 1515, CHEM 1225.**Description:** Structures and properties of the elements and their many compounds in the broadest sense which includes the modern technologically important materials, organometallics, and inorganic substances of biological significance.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 3363 Bioinorganic Chemistry****Prerequisites:** Grade of "C" or higher in CHEM 1225 or CHEM 1515 or acceptable AP credit.**Description:** Discusses the structural and functional roles of main group and transition metals within biological systems. Topics may include: the transport, distribution and properties of metals in biological systems, the coordination chemistry of biologically active metals, physical methods for determining metalloprotein structure and reactivity, chemical processes including redox processes and long-range electron transfer reactions and metal cofactors and metal clusters.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 3413 Physical Chemistry Applications****Prerequisites:** Minimum grade of "C" or higher in both CHEM 1515 and MATH 2144.**Description:** A practical and applied approach to key topics in physical chemistry, including thermodynamics, chemical equilibria, and chemical kinetics, and how they relate to general chemical and biological processes on a molecular and macroscopic level.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 3433 Physical Chemistry I****Prerequisites:** Minimum grade of "C" or higher in: CHEM 1515 and MATH 2153 and PHYS 2114.**Description:** Introductory theoretical analysis of molecular structure, chemical bonding and macroscopic chemical systems using quantum theory, classical and statistical thermodynamics, and kinetics. Previously offered as CHEM 3434.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 3532 Physical Chemistry Laboratory****Prerequisites:** A grade of "C" or better in CHEM 2122 and CHEM 3433.**Description:** Modern laboratory instrumentation, experimental techniques, and computational methods in physical chemistry.**Credit hours:** 2**Contact hours:** Lab: 3 Contact: 4 Other: 1**Levels:** Undergraduate**Schedule types:** Discussion, Lab, Combined Lab & Discussion**Department/School:** Chemistry**CHEM 3553 Physical Chemistry II****Prerequisites:** A grade of "C" or higher in CHEM 3433.**Description:** A continuation of CHEM 3433.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 3890 Advanced Honors Experience in Chemistry****Prerequisites:** Honors Program participation and concurrent enrollment in designated course(s).**Description:** A supplemental Honors experience in Chemistry to partner concurrently with designated upper-division CHEM course(s). This course adds a different intellectual dimension to designated course(s). Offered for fixed credit, 1 credit hour, maximum of 6 credit hours.**Credit hours:** 1**Contact hours:** Lecture: 1 Contact: 1**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemistry**General Education and other Course Attributes:** Honors Credit**CHEM 4022 Modern Methods of Chemical Analysis Laboratory****Prerequisites:** CHEM 4023 or concurrent enrollment.**Description:** Laboratory exercises related to theoretical principles covered in CHEM 4023. May not be used for degree credit with CHEM 4020.**Credit hours:** 2**Contact hours:** Lab: 4 Contact: 4**Levels:** Undergraduate**Schedule types:** Lab**Department/School:** Chemistry**CHEM 4023 Modern Methods of Chemical Analysis****Prerequisites:** A grade of "C" or better in CHEM 2122; and CHEM 3413 or CHEM 3433.**Description:** The design, operational principles and practical application of modern instrumental methods used in chemical analysis of natural and artificial materials. Covers the reagents and instruments used in the separation, identification and quantification of the chemical components. May not be used for degree credit with CHEM 4020.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 4123 Biomolecular Chemistry and Function****Prerequisites:** Minimum grade of "C" in CHEM 3153 and CHEM 3112.**Description:** The class is designed to use examples from classic and current literature to expand the student's knowledge of the chemical techniques required to understand the structure and function of macromolecules in solution. These topics include chemical forces that stabilize macromolecular and supramolecular structure, thermodynamics and statistical mechanics of macromolecular and polymer folding, diffusional processes, kinetics, and the relationship of these principles to practical application in experimental design and interpretation. May not be used for degree credit with CHEM 6650.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemistry

**CHEM 4312 Inorganic Chemistry Laboratory****Prerequisites:** Minimum grade of "C" or better in CHEM 3112.**Description:** Course will provide students with practical knowledge and experimental techniques commonly used in inorganic and organometallic chemistry.**Credit hours:** 2**Contact hours:** Lab: 2 Contact: 3 Other: 1**Levels:** Undergraduate**Schedule types:** Discussion, Lab, Combined Lab & Discussion**Department/School:** Chemistry**CHEM 4313 Medicinal Organic Chemistry****Prerequisites:** Minimum grade of "C" in CHEM 3153 and CHEM 3112.**Description:** This course looks at the development of new organic molecules for use in the pharmaceutical industry and investigates their pathway from the design stage to eventual introduction to the market. This course explores a range of important techniques necessary for the synthesis of complex organic architectures, an introduction to asymmetric synthesis, and polymer-supported synthesis of biomolecules including peptides and nucleic acids. This course also introduces various classes of drugs, mechanisms of action, drug metabolism and structure activity relationships.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 4320 Chemical and Spectrometric Identification of Organic Compounds****Prerequisites:** A grade of "C" or higher in CHEM 3112 and CHEM 3153.**Description:** Theory and practice in separating mixtures of organic compounds and some theory and practice in identifying organic compounds by spectroscopic methods. Offered for variable credit, 1-3 credit hours, maximum of 3 credit hours.**Credit hours:** 1-3**Contact hours:** Lab: 2-6 Contact: 2-6**Levels:** Undergraduate**Schedule types:** Lab**Department/School:** Chemistry**CHEM 4322 Advanced Organic Chemistry Laboratory****Prerequisites:** Minimum grade of "C" in both CHEM 3153 and CHEM 3112.**Description:** Training in the art of chemical synthesis, phenomena surrounding molecular interactions, separation strategies, and spectroscopic analysis of organic molecules. Same course as CHEM 4320.**Credit hours:** 2**Contact hours:** Lab: 4 Contact: 4**Levels:** Undergraduate**Schedule types:** Lab**Department/School:** Chemistry**CHEM 4333 Inorganic Chemistry I****Prerequisites:** CHEM 1515 with minimum grade of "C."**Description:** Bonding theory, molecular symmetry and its applications to structure, bonding and spectroscopy, structures of simple solids, inorganic acids and bases, oxidation and reduction, and industrial production of elements, coordination chemistry, crystal field theory, ligand field theory, introduction to organometallic chemistry. May not be used for degree credit with CHEM 5260.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 4433 Computational Chemistry and Molecular Modeling****Prerequisites:** Grade of "C" or better in either CHEM 3413 or CHEM 3433.**Description:** This course introduces the concepts, tools, and possibilities for computational modeling of molecular systems. Primary topics of study include classical molecular mechanics simulations, quantum mechanical calculations, and molecular graphics & visualization. One key effort will be introduction into the usage of high performance computing systems. Such instruction on the use of the computational resources available at OSU will be provided in hands-on computer exercises that involve constructing, performing, and analyzing molecular simulations and calculations. May not be used for degree credit with CHEM 5433.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 4650 Selected Topics in Chemistry****Description:** Supervised study of selected topics and fields not otherwise covered. Offered for variable credit, 1-6 credit hours, maximum of 12 credit hours.**Credit hours:** 1-6**Contact hours:** Contact: 1-6 Other: 1-6**Levels:** Undergraduate**Schedule types:** Independent Study**Department/School:** Chemistry**CHEM 4990 Special Problems in Chemistry****Prerequisites:** Instructor permission required.**Description:** Training in independent work, study of relevant literature and experimental investigation of an assigned problem culminating in a written and oral report. Offered for variable credit, 1-3 credit hours, maximum of 9 credit hours.**Credit hours:** 1-3**Contact hours:** Contact: 1-3 Other: 1-3**Levels:** Undergraduate**Schedule types:** Independent Study**Department/School:** Chemistry**CHEM 4993 Senior Thesis in Chemistry****Prerequisites:** Instructor permission required.**Description:** Capstone undergraduate research project and laboratory skills development in a discipline of chemistry. Guided reading and research program under the direction of a faculty member culminating in a senior research thesis and oral report.**Credit hours:** 3**Contact hours:** Contact: 3 Other: 3**Levels:** Undergraduate**Schedule types:** Independent Study**Department/School:** Chemistry

**CHEM 5000 Thesis**

**Description:** Familiarizes the student with methods used in research in chemistry. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.

**Credit hours:** 1-6

**Contact hours:** Contact: 1-6 Other: 1-6

**Levels:** Graduate

**Schedule types:** Independent Study

**Department/School:** Chemistry

**CHEM 5001 Introduction to Chemistry Research**

**Prerequisites:** Graduate standing.

**Description:** Introduction to chemical research topics of interest to the department. Special emphasis placed on ethics, plagiarism, codes of conduct, research notebooks, publishing, and presentations.

**Credit hours:** 1

**Contact hours:** Lecture: 1 Contact: 1

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemistry

**CHEM 5011 Graduate Seminar**

**Description:** Preparation and presentation of seminars usually on subjects of current interest taken from the literature. Completion of 1 credit hour required for MS degree.

**Credit hours:** 1

**Contact hours:** Contact: 1 Other: 1

**Levels:** Graduate

**Schedule types:** Discussion

**Department/School:** Chemistry

**CHEM 5053 Foundations of Physical Chemistry**

**Prerequisites:** CHEM 3433 and CHEM 3153, or equivalent.

**Description:** This course provides the foundations of physical chemistry required for all disciplines of chemistry to understand the underlying principles necessary to advance at the graduate level.

This core treatment will address thermodynamics and equilibria, chemical kinetics, quantum mechanics, spectroscopy, and statistical thermodynamics. These topics will provide the conceptual learning critical for interdisciplinary applications of physical chemistry.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemistry

**CHEM 5063 Foundations of Organic Chemistry**

**Prerequisites:** BS/BA in chemistry, CHEM 3153, or equivalent.

**Description:** This course provides the basic principles of organic chemistry necessary to advance at the graduate level in all disciplines of chemistry. This treatment will address bonding and its consequences, stereochemistry and conformational analysis, functional groups and their interconversions, reaction mechanisms, reactive intermediates and catalysis, synthesis and retrosynthetic analysis, and modern characterization. These topics will provide the conceptual background for interdisciplinary applications of organic chemistry.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemistry

**CHEM 5073 Foundations of Analytical Chemistry**

**Prerequisites:** CHEM 4023 and CHEM 4022, or equivalent.

**Description:** This course provides the basic principles of analytical chemistry necessary to advance at the graduate level in all disciplines of chemistry. Subject matter includes the underlying principles of chemical analyses with emphasis on chemical and biological reactions (equilibrium, reaction rate, chemical labeling), instrumentation and instrumental design, sampling, sample preparation and method validation. These topics will provide the conceptual foundation critical for interdisciplinary applications of analytical chemistry.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemistry

**CHEM 5103 Physical and Chemical Separations**

**Prerequisites:** One year of physical chemistry.

**Description:** Principles of bulk and multi-stage separation methods: chromatography, liquid-liquid extraction, and zone melting.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemistry

**CHEM 5113 Equilibrium and Kinetics in Analytical Chemistry**

**Prerequisites:** One year of physical chemistry.

**Description:** Physical and chemical principles of equilibrium and kinetics as applied to analytical problems.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemistry

**CHEM 5213 Innovations in Chemistry and STEM Education**

**Description:** This course will train students on evidence-based instructional classroom practices relevant for improving student persistence and performance in chemistry and other STEM courses and conducting discipline-based education research in STEM.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Chemistry

**CHEM 5220 Topics For Teachers**

**Prerequisites:** Teaching experience.

**Description:** Designed to help elementary and secondary science teachers improve their subject matter competence in chemistry. Content varies depending on the needs of specific groups of teachers. Offered for variable credit, 1-9 credit hours, maximum of 9 credit hours.

**Credit hours:** 1-9

**Contact hours:** Contact: 1-9 Other: 1-9

**Levels:** Graduate

**Schedule types:** Independent Study

**Department/School:** Chemistry



**CHEM 5223 Polymer Chemistry****Prerequisites:** CHEM 3153 and CHEM 3433 or equivalent.**Description:** Preparation and polymerization of organic monomers; properties and uses of resulting high polymers; theories of polymerization; inorganic and natural organic polymers.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 5263 Foundations of Inorganic Chemistry****Prerequisites:** CHEM 1515 with minimum grade of "C."**Description:** Bonding theory, molecular symmetry and its applications to structure, bonding and spectroscopy, structures of simple solids, inorganic acids and bases, oxidation and reduction, and industrial production of elements, coordination chemistry, crystal field theory, ligand field theory, introduction to organometallic chemistry. May not be used for degree credit with CHEM 4333. Previously offered as CHEM 5260.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 5283 Solid State Chemistry****Prerequisites:** CHEM 5263.**Description:** Structure, bonding, and properties of crystalline and amorphous inorganic solids. Emphasis on the characterization of inorganic solids and phase transitions in inorganic solids.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 5323 Reactions of Organic Compounds****Prerequisites:** CHEM 3153.**Description:** Products and mechanisms of reactions of importance in organic synthesis.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 5373 Spectrometric Identification of Organic Compounds****Prerequisites:** CHEM 4320.**Description:** Lectures on ultraviolet, circular dichroism, infrared, nuclear magnetic resonance (NMR) and mass spectrometry (MS). More advanced techniques in NMR and MS stressed. Hands-on training and use of modern spectroscopic instrumentation in laboratory.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 5433 Computational Chemistry and Molecular Modeling****Prerequisites:** CHEM 3433 or equivalent.**Description:** This course introduces the concepts, tools, and possibilities for computational modeling of molecular systems. Primary topics of study include classical molecular mechanics simulations, quantum mechanical calculations, and molecular graphics & visualization. One key effort will be introduction into the usage of high performance computing systems. Such instruction on the use of the computational resources available at OSU will be provided in hands-on computer exercises that involve constructing, performing, and analyzing molecular simulations and calculations. May not be used for degree credit with CHEM 4433.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 5443 Mechanism and Structure in Organic Chemistry****Prerequisites:** CHEM 3153 and CHEM 3553.**Description:** Relationship of properties of organic compounds to their structure; mechanisms of organic reactions.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 5563 Chemical Thermodynamics I****Prerequisites:** CHEM 3553.**Description:** Statistical and classical thermodynamics applied to chemical systems.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 5623 Quantum Chemistry I****Prerequisites:** CHEM 3553.**Description:** Fundamentals of quantum mechanics, including classical mechanics, wave representation of matter, the Schrodinger equation, and atomic structure.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 5650 Selected Topics in Chemistry****Description:** Supervised study of selected topics and fields not otherwise covered. Offered for variable credit, 1-6 credit hours, maximum of 12 credit hours.**Credit hours:** 1-6**Contact hours:** Contact: 1-6 Other: 1-6**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Chemistry

**CHEM 5963 Advanced Inorganic Chemistry****Prerequisites:** CHEM 5263.**Description:** Inorganic reaction mechanisms, catalysis, electronic spectra of complexes, luminescence of inorganic compounds, lanthanide and actinide chemistry, introduction to biological inorganic chemistry. Previously offered as CHEM 5960.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 6000 Doctoral Dissertation Research****Prerequisites:** MS degree in chemistry or consent of instructor.**Description:** Independent investigation under the direction and supervision of a major professor. Offered for variable credit, 1-15 credit hours, maximum of 60 credit hours.**Credit hours:** 1-15**Contact hours:** Contact: 1-15 Other: 1-15**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Chemistry**CHEM 6010 Research Seminar****Prerequisites:** Consent of instructor.**Description:** Participation in departmental seminars on current topics in chemistry. One credit hour each fall and spring required for MS and PhD candidates with the exception of the first semester. Offered for variable credit, 1-20 credit hours, maximum of 20 credit hours.**Credit hours:** 1-20**Contact hours:** Contact: 1-20 Other: 1-20**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Chemistry**CHEM 6011 Advanced Seminar****Prerequisites:** CHEM 5011 or MS degree.**Description:** Preparation and oral presentation of critical reviews on chemical subjects. Usually related to the student's research area. Completion of one credit hour required for the PhD degree.**Credit hours:** 1**Contact hours:** Contact: 1 Other: 1**Levels:** Graduate**Schedule types:** Discussion**Department/School:** Chemistry**CHEM 6050 Special Topics in Analytical Chemistry****Description:** Supervised study of topics and fields not otherwise covered. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.**Credit hours:** 1-6**Contact hours:** Contact: 1-6 Other: 1-6**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Chemistry**CHEM 6103 Electroanalytical Chemistry****Prerequisites:** CHEM 4024.**Description:** The theory, practice and instrumentation in various areas of modern electroanalytical chemistry.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 6113 Analytical Spectroscopy****Prerequisites:** CHEM 4024.**Description:** Survey of selected topics in analytical applications of spectroscopic techniques. Fundamental concepts as well as current trends in research, including instrumentation.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 6223 Physical Polymer Science****Prerequisites:** CHEM 5223 or equivalent.**Description:** A study of the physical properties of macromolecular systems including polymer solutions, gels, bulk polymers and rubbers. The characterization of polymers based on their thermal, spectroscopic, microstructure and molecular masses is also discussed.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 6303 Physical Organic Chemistry****Prerequisites:** BS/BA in chemistry, CHEM 3153, or equivalent.**Description:** This course is an examination of the methods used in organic chemistry to probe mechanisms and reactive intermediates. Topics will include isotope effects, kinetics, linear free energy relationships, an introduction of orbital symmetry, rearrangements, stereo electronic effects, the generation and chemistry of carbenium ions, carbanions, carbenes, radicals, excited states, and strained molecules.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 6420 Special Topics in Organic Chemistry****Prerequisites:** CHEM 3153.**Description:** Deals with topics not covered in other courses. Offered for variable credit, 1-9 credit hours, maximum of 9 credit hours.**Credit hours:** 1-9**Contact hours:** Contact: 1-9 Other: 1-9**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Chemistry**CHEM 6453 Chemical Kinetics****Prerequisites:** CHEM 3553.**Description:** The kinetics of chemical reactions and their theoretical interpretation.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 6553 Molecular Spectroscopy****Prerequisites:** CHEM 5623.**Description:** Spectra and structure of molecules.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemistry

**CHEM 6650 Selected Topics in Chemistry****Prerequisites:** Consent of instructor.**Description:** Supervised study of selected topics and fields not otherwise covered. Offered for variable credit, 1-6 credit hours, maximum of 12 credit hours.**Credit hours:** 1-6**Contact hours:** Contact: 1-6 Other: 1-6**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Chemistry**CHEM 6803 Photonics I: Advanced Optics****Prerequisites:** ECEN 3813 or PHYS 3213, or consent of instructor.**Description:** Advanced optics, including spectral and time characteristics of detectors, characteristics of lasers, time, spectral and spatial parameters of laser emission, interferometric techniques, and nonlinear effects such as two-photon absorption and second and third harmonic generations. Ultra short laser pulses. Same course as ECEN 6803 & PHYS 6803. Offered for fixed credit, maximum of 9 credit hours.**Credit hours:** 3**Contact hours:** Lab: 6 Contact: 6**Levels:** Graduate**Schedule types:** Lab**Department/School:** Chemistry**CHEM 6810 Photonics II: THz photonics and THz time-domain spectroscopy****Prerequisites:** CHEM 6803.**Description:** THz photonics and THz time-domain spectroscopy (THz-TDS). Concepts and techniques of driving electronic circuitry with ultra short laser pulses to generate and detect freely propagating pulses of THz electromagnetic radiation using several operational research systems. Same course as ECEN 6810 & PHYS 6810. Offered for fixed credit, maximum of 4 credit hours.**Credit hours:** 1**Contact hours:** Lab: 2 Contact: 2**Levels:** Graduate**Schedule types:** Lab**Department/School:** Chemistry**CHEM 6811 Photonics II: THz Photonics and THz - TDS****Prerequisites:** CHEM 6803.**Description:** THz photonics and THz time-domain spectroscopy (THz-TDS). Concepts and techniques of driving electronic circuitry with ultrashort laser pulses to generate and detect freely propagating pulses of THz electromagnetic radiation using several operational research systems. Same course as ECEN 6811 and PHYS 6811.**Credit hours:** 1**Contact hours:** Lecture: 1 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Chemistry**CHEM 6820 Photonics II: Spectroscopy II****Prerequisites:** CHEM 6803.**Description:** Operating principles and applications of laser spectroscopy of atoms, molecules, solids and complex fluids. Absorption, emission, photon correlation, coherence, time resolved Fourier transform. Raman spectroscopy and non-linear optical. Same course as ECEN 6820 & PHYS 6820. Offered for fixed credit, 1 credit hour(s), maximum of 4 credit hours.**Credit hours:** 1**Contact hours:** Lab: 2 Contact: 2**Levels:** Graduate**Schedule types:** Lab**Department/School:** Chemistry**CHEM 6830 Photonics II: Spectroscopy III****Prerequisites:** CHEM 6803.**Description:** Advanced spectroscopic instruments and methods used for investigation of semi-conductors and solid state material. Stimulated emission characterized both in wavelength and in time. Time-resolved fluorescence measurements. Multiphotonic excitations. Fast measuring techniques, including subnanosecond detectors, picosecond streak cameras, and ultra fast four-wave mixing and correlation techniques. Time-dependent photoconductivity measurements. Same course as ECEN 6830 & PHYS 6830. Offered for fixed credit, 1 credit hour(s), maximum of 4 credit hours.**Credit hours:** 1**Contact hours:** Lab: 2 Contact: 2**Levels:** Graduate**Schedule types:** Lab**Department/School:** Chemistry**CHEM 6840 Photonics III: Microscopy II****Prerequisites:** CHEM 3553 or consent of instructor.**Description:** The structure and imaging of solid surfaces. Basics of scanning probe microscopy (SPM). Contact and noncontact atomic force microscopy (AFM). Scanning tunneling microscopy (STM) in air. Same course as ECEN 6840 & PHYS 6840. Offered for fixed credit, 1 credit hour(s), maximum of 4 credit hours.**Credit hours:** 1**Contact hours:** Lab: 2 Contact: 2**Levels:** Graduate**Schedule types:** Lab**Department/School:** Chemistry**CHEM 6850 Photonics III: Microscopy II****Prerequisites:** CHEM 3553 or consent of instructor.**Description:** Advanced techniques of scanning probe microscopy (SPM). Magnetic force microscopy, Kelvin force microscopy, scanning tunneling microscopy (STM) in vacuum. Characterization of materials with SPM. Nanolithography with SPM. Device manufacturing and analysis. Same course as ECEN 6850 & PHYS 6850. Offered for fixed credit, 1 credit hour(s), maximum of 4 credit hours.**Credit hours:** 1**Contact hours:** Lab: 2 Contact: 2**Levels:** Graduate**Schedule types:** Lab**Department/School:** Chemistry



**CHEM 6860 Photonics III: Microscopy III and Image Processing****Prerequisites:** ECEN 5793.**Description:** Digital image processing, including projects. Image acquisition and display, image enhancement, geometric operations, linear and nonlinear filtering, image restoration, edge detection, image analysis, morphology, segmentation, recognition, and coding/compression. Same course as ECEN 6860 & PHYS 6860. Offered for fixed credit, 1 credit hour(s), maximum of 4 credit hours.**Credit hours:** 1**Contact hours:** Lab: 2 Contact: 2**Levels:** Graduate**Schedule types:** Lab**Department/School:** Chemistry**CHEM 6870 Photonics IV: Synthesis and Devices I****Prerequisites:** CHEM 6803 and CHEM 6840.**Description:** Preparation of functional nanostructures and related optical and electronic devices. Physical and chemical methods of thin film deposition. Engineering of prototypes of light emitting diodes, sensors, optical limiting coatings, lithographic patterns. Same course as ECEN 6870 & PHYS 6870. Offered for variable credit, 1 credit hour(s), maximum of 4 credit hours.**Credit hours:** 1**Contact hours:** Lab: 2 Contact: 2**Levels:** Graduate**Schedule types:** Lab**Department/School:** Chemistry**CHEM 6880 Photonics IV: Semiconductor Devices, Testing and Characterization****Prerequisites:** CHEM 6803.**Description:** Test and characterization of semiconductor and optoelectronic devices. Hall Effect, four point probe, CV and IV measurements, optical pump-probe, photoluminescence and electro-optics sampling. Same course as ECEN 6880 & PHYS 6880. Offered for fixed credit, 1 credit hour(s), maximum of 4 credit hours.**Credit hours:** 1**Contact hours:** Lab: 2 Contact: 2**Levels:** Graduate**Schedule types:** Lab**Department/School:** Chemistry**CHEM 6890 Photonics IV: Semiconductor Synthesis and Devices III****Prerequisites:** CHEM 6803.**Description:** Processing, fabrication and characterization of semiconductor optoelectronic devices in class 100/10000 clean rooms. Clean room operation, including general procedure for material processing and device fabrication. Device processing using a variety of processing such as mask aligner, vacuum evaporators and rapid thermal annealer. Testing using optical and electrical testing apparatus such as I-V, C-V, Hall and optical spectral measurement systems. Same course as ECEN 6890 & PHYS 6890. Offered for variable credit, 1 credit hour(s), maximum of 4 credit hours.**Credit hours:** 1**Contact hours:** Lab: 2 Contact: 2**Levels:** Graduate**Schedule types:** Lab**Department/School:** Chemistry