

Undergraduate Courses in Chemistry
Catalogue Descriptions and Course Syllabi

This document presents the formal Undergraduate Catalog course description and the topic syllabus for each course in the Chemistry curriculum. Please note that the “topic syllabus” will differ from the detailed course syllabus provided to students at the beginning of a course. The detailed syllabus will describe specific topic coverage that may differ slightly from the topics shown in these syllabi, as well as policies and procedures specific to the particular course semester and instructor, such as textbooks, assignments, exams, and grading. The University allows instructors to deviate from the official “topic syllabus” by up to 30%.

1015-1016: INTRODUCTION TO CHEMISTRY

For students enrolled in curricula other than science or engineering. Chemical principles applied to material, environmental, and life sciences. (Duplicates 1035-1036.) (3H,3C)

CHEM 1015	%
Atoms & Atomic Structure	14
Periodic Table	7
Nuclear Chemistry	15
Bonding	7
Solutions	5
Nomenclature	4
Stoichiometry	7
Gas Laws	5
Acids & Bases; Titrations	7
Oxidation/Reduction	15
Metals & Ores	7
Electrochemistry	7
Total	100

CHEM 1016	%
Organic Chemistry	15
Polymers	15
Air	7
Water	7
Energy	7
Household Chemicals	15
Fitness/Health	7
Poisons	7
Drugs	20
Total	100

1025-1026: INTRODUCTION TO CHEMISTRY LABORATORY

Accompanies 1015-1016, where lab work is required in a student's curriculum. Must be taken concurrently and in phase with lecture sequence, 1015-1016. In both semesters, experiments illustrate principles covered in lecture. (Duplicates 1045-1046.) Co: 1015 for 1025; 1016 for 1026. (3L,1C)

1035-1036: GENERAL CHEMISTRY

Principles of the science, character of the elements and their more important compounds, solution of chemical problems, and important applications. (Duplicates 1015-1016.) (3H,3C)

1035H,1036H: HONORS GENERAL CHEMISTRY

More in-depth treatment of the principles of the science, character of the elements and their more important compounds, solution of chemical problems, and important applications. (Duplicates 1015-1016) (3H,3C)

CHEM 1035 / 1035H	%
Elements/Periodic Table	7
Nomenclature	3
Mass Relationships	7
Chemical Reactions	7
Stoichiometry	14
Gases	7
Thermochemistry	7
Electronic Structure	7
Periodicity	7
Chemical Bonds	7
Molecular Structure	7
Liquids & Solids	7
Solutions	13
Total	100

CHEM 1036 / 1036H	%
Chemical Kinetics	13
Chemical Equilibrium	13
Acid-Base Equilibrium	13
Buffers & Solubility Equilibria	7
Thermodynamics	7
Electrochemistry	7
Metals	3
Nonmetals	9
Transition Metals	7
Complex Ions	7
Nuclear Chemistry	7
Organic Chemistry	13
Total	100

1045-1046: GENERAL CHEMISTRY LAB

Accompanies 1035-1036. Selected experiments illustrate principles taught in lecture. (Duplicates 1025-1026). Co: 1035H, 1035 for 1045; 1036 for 1046. (3L,1C)

1055-1056: GENERAL CHEMISTRY FOR CHEMISTRY MAJORS

In depth treatment of chemical bonding, thermodynamics, chemical equilibrium, reaction kinetics, descriptive chemistry of the elements, acid-base chemistry, chemistry of gases, liquids and solids, and other topics. This class is restricted to chemistry majors. Co: 1065 for 1055; 1066, 1066 for 1056. (4H,4C)

1055H-1056H: HONORS GENERAL CHEM FOR MAJORS

Co: 1065 for 1055H; 1066, 1066 for 1056H. (4H,4C)

1065-1066: GENERAL CHEMISTRY FOR CHEMISTRY MAJORS LAB

Accompanies 1055-1056. Selected experiments illustrate principles taught in lecture. This class is restricted to chemistry majors. Co: 1055 for 1065; 1056 for 1066. (3L,1C)

2114: ANALYTICAL CHEMISTRY

A first course in analytical chemistry. Topics covered include volumetric and gravimetric analysis, and elementary spectroscopy. Pre: 1036 or 1056. Co: 2124. (3H,3C)

CHEM 2114	%
Review of Kinetics and Equilibria	14
Acid-Base Equilibrium	7
Buffers	7
Polyprotic Acids	7
Alpha Fractions; Activity	7
Titrations; Redox Chemistry	7
Electrochemistry	14
Solubility; Solubility Product	7
Complexation	7
Spectroscopy	14
Chromatography	9
Total	100

2124: ANALYTICAL CHEMISTRY LABORATORY TECHNIQUES AND PRACTICE

Practical introduction to wet methods of quantitative chemical analysis based on fundamental chemical principles. CHEM 2124 may be substituted for CHEM 3124. Pre: (1046 or 1066), 2114. Co: 2114. (3L,1C)

2154: ANALYTICAL CHEMISTRY FOR CHEMISTRY MAJORS

A one-semester course in analytical chemistry emphasizing the principles of equilibrium with examples from acid-base, complexation, solubility, and redox chemistry. The course also introduces the principles of spectroscopic, electrochemical, and chromatographic instrumentation. Pre: 1036 or 1036H or 1056 or 1056H. Co: 2164. (4H,4C)

2164: ANALYTICAL CHEMISTRY FOR CHEMISTRY MAJORS LAB

A one-semester laboratory course in analytical chemistry that provides practical training in wet chemical methods, atomic and molecular spectroscopy, electrochemistry, and separations. Pre: 1046 or 1066. Co: 2154. (3L,1C)

2424: DESCRIPTIVE INORGANIC CHEMISTRY

Application of fundamental principles in a systematic study of bonding and reactivity of the elements and their compounds. Pre: 1036 or 1056. (3H,3C)

CHEM 2424	%
Atomic and Molecular Structure	20
Alkalis, Alkaline Earths & Hydrogen	10
Metals & Transition Metals	35
Nonmetals	35
Total	100

2514: SURVEY OF ORGANIC CHEMISTRY

Fundamentals of organic chemistry with emphasis on nomenclature, isomerism, and properties of organic compounds. Compounds of importance to biology and biochemistry stressed. (Prior credit for 2535 precludes credit for this course.) One year of Chemistry required. (3H,3C)

CHEM 2514	%
Structure - Property Relationships	10
Alkanes & Cycloalkanes	7
Alkenes & Alkynes	7
Aromatic Compounds	7
Stereochemistry	7
Nucleophilic Substitution & Elimination	7
Alcohols & Phenols	7
Ethers & Epoxides	7
Aldehydes & Ketones	14
Acids and Acid Derivatives	14
Fats, Oils, & Waxes	3
Total	100

2535-2536: ORGANIC CHEMISTRY

Structure, stereochemistry, reactions, and synthesis of organic compounds. Pre: 1036 or 1056 or 1056H or 1036H for 2535; 2535 or (2565 or 2565H) for 2536. (3H,3C)

CHEM 2535	%
Bonding	7
Alkanes & Cycloalkanes	20
Stereochemistry	10
Substitution Reactions	10
Elimination Reactions	6
Alcohols	10
Ethers	7
Nuclear Magnetic Resonance	8
Alkenes	22
Total	100

CHEM 2536	%
Alkynes	6
Delocalized Pi Systems	6
Aromaticity; Chemistry of Benzene	12
Aldehydes & Ketones	8
Enols and Enones	8
Carboxylic Acids	8
Acid Derivatives	6
Mass Spectrometry	6
Amines	6
Phenols; Aromatic Amines	6
beta-Dicarbonyl Compounds	8
Carbohydrates	6
Heterocycles	4
Amino Acids, Peptides, Proteins	10
Total	100

2545-2546: ORGANIC CHEMISTRY LABORATORY

The laboratory accompanies lectures in organic chemistry 2535 and 2536. Pre: 1046 or 1066 for 2545; 2545 for 2546. Co: 2565, 2535 for 2545; 2536 for 2546. (3L,1C)

2555-2556: ORGANIC SYNTHESIS AND TECHNIQUES LAB

Synthesis and characterization of organic compounds using modern laboratory techniques. Pre: 2566 for 2555; 2555 for 2556. (6L,2C)

2565-2566: PRINCIPLES OF ORGANIC CHEMISTRY

Organic chemistry for chemistry majors. Structure and reactions of organic compounds, with emphasis on fundamental principles, theories, synthesis, and reaction mechanisms. The subject matter partially duplicates that of 2535-2536; no credit will be given for the duplicated courses. Pre: 1036 or 1056 or 1036H or 1056H for 2565; 2565 for 2566. (3H,3C)

2565H-2566H: PRINCIPLES OF ORGANIC CHEMISTRY HONORS

More in-depth treatment of organic chemistry for chemistry majors. Structure and reactions of organic compounds, with emphasis on fundamental principles, theories, synthesis, and reaction mechanisms. The subject matter partially duplicates that of 2535-2536; no credit will be given for the duplicated courses. (3H,3C)

CHEM 2565 / 2565H	%
Atomic and Molecular Structure	7
Alkanes	7
Alkenes and Alkynes	7
Stereochemistry	14
Rings	7
Substitution & Elimination Reactions	20
Equilibria	7
Addition Reactions: Alkenes	14
Radical Reactions	10
Dienes	7
Total	100

CHEM 2566 / 2566H	%
Benzene and Benzene Derivatives	20
Spectroscopy	15
Carbonyl Chemistry	20
Alcohols	5
Carboxylic Acids	15
Derivatives of Acids	15
Nitrogen Compounds	10
Total	100

Variable-Credit Courses at the 2000 Level

2964: FIELD STUDY

2974: INDEPENDENT STUDY

2984: SPECIAL STUDY

3114: ANALYTICAL CHEMISTRY FOR LIFE SCIENCES (DISCONTINUED)

Introduction to methods of quantitative analysis for students in life sciences curricula. Topics include classical wet methods of gravimetry and titrimetry (acid-base, redox, and complexometric), and instrumental methods of electrochemistry, spectroscopy, and chromatography. Also included are sampling theory and statistical treatment of data. Partially duplicates 2114. Pre: 1036, 1046. (3H,3C)

3124: ANALYTICAL CHEMISTRY LABORATORY FOR LIFE SCIENCES (DISCONTINUED)

Accompanies 3114. Laboratory stresses use of wet methods and instrumental techniques for quantitative chemical analysis. CHEM 3124 may be substituted for CHEM 2124. Pre: 1036, 1046. Co: 3114. (3L,1C)

3615-3616: PHYSICAL CHEMISTRY

Principles of thermodynamics, kinetics, and quantum mechanics applied to chemical equilibria, reactivity, and structure. Partly duplicates 4615, cannot receive credit for both 3615 and 4615. Pre: (1036 or 1056), PHYS 2306, MATH 2224 for 3615; 3615, 1036, MATH 2214, (PHYS 2306 or PHYS 2176) for 3616. (3H,3C)

3615H-3616H: HONORS PHYSICAL CHEMISTRY

Principles of thermodynamics, kinetics, and quantum mechanics applied to chemical equilibria, reactivity, and structure. Partially duplicates 4615, cannot receive credit for both 3615H and 4615. 3615H requires additional work; consult the instructor. Pre: 1036, (PHYS 2306 or PHYS 2176) for 3615H; 3615, 1036, MATH 2214, (PHYS 2306 or PHYS 2176) for 3616H. (3H,3C)

CHEM 3615	%
Gases	10
First Law; Work and Heat	15
First Law; State Functions	10
Second Law; Spontaneous Change	15
Combining First and Second Laws	15
Change of Phase; Surface Effects	10
Mixtures, Solutions; Activity	10
Phase Diagrams; the Phase Rule	5
Chemical Equilibrium	10
Total	100

CHEM 3616	%
Quantum Theory	20
Atomic Structure and Spectra	10
Structure: VB and MO Theories	15
Rotational & Vibrational Spectra	15
Electronic Spectroscopy	10
Magnetic Resonance Spectroscopy	15
Chemical Kinetics	15
Total	100

3625-3626: PHYSICAL CHEMISTRY LABORATORY

Laboratory study of selected physico-chemical principles and methods. Data acquisition, data analysis, and report writing are stressed. Pre: 3615 or 4615 for 3625; 3616, 3625 for 3626. (3L,1C) 3625: I,II; 3626:

4014: SURVEY OF CHEMICAL LITERATURE

Use of the chemical literature as an aid to professional activities. Pre: Junior Major Standing. (1H,1C) I,II.

4074 (MSE 4544): LABORATORY IN POLYMER SCIENCE

Experimental techniques used in the synthesis of various linear polymers, copolymers, and crosslinked networks. Determination of polymer molecular weights and molecular weight distribution. Methods used in the thermal, mechanical, and morphological characterization of polymeric systems. Graduate students in chemistry, P/F only. Pre: 3616, 4534. (1H,3L,2C)

4114: INSTRUMENTAL ANALYSIS

Principles of instrumental methods including data analysis, phase equilibrium, spectroscopy, and electrochemistry. Applications of modern instrumentation to chemical analyses using chromatography, electrophoresis, atomic and molecular spectroscopy, potentiometry, and voltammetry. The laboratory portion of the course contains experiments in spectroscopy, chromatography, electrochemistry, and mass spectrometry. Note: Graduate students will not be expected to take the co-requisite lab 4124. Pre: 3616. Co: 4124. (3H,3C)

4114H: HONORS INSTRUMENTAL ANALYSIS

Pre: 3616. Co: 4124. (3H,3C)

CHEM 4114	%
Statistics	7
Spectroscopy	8
Atomic Spectroscopy	8
Molecular Spectroscopy	8
Fluorescence	7
Chromatography	20
Electrophoresis	7
Electrochemistry	20
Mass Spectrometry	15
Total	100

4124: INSTRUMENTAL ANALYSIS LABORATORY

Hands-on experience with modern instrumental methods of analysis. Experiments use spectroscopy, electrochemistry, and separations. Co: 4114. (3L,1C)

4404: PHYSICAL INORGANIC CHEMISTRY

A study of spectroscopic, bonding, and structural properties of inorganic compounds. I Co: 3616. (3H,3C)

CHEM 4404	%
Symmetry and Bonding	33
Coordination Chemistry	33
Fundamental Topics	34
Organometallics	
Bioinorganic	
Solid State	
Total	100

4414: INORGANIC CHEMISTRY LAB

Synthesis and characterization of inorganic compounds using modern laboratory techniques. Pre: 4404. Co: 4424, 3616. (6L,2C) II.

4514: GREEN CHEMISTRY

Green chemistry applies the principles of prevention of toxic and hazardous waste, and energy efficiency to real world chemical products and processes. Emphasis is on case studies, problem solving, and life cycle analysis. Pre: 2536 or 2566. (3H,3C)

4524: IDENTIFICATION OF ORGANIC COMPOUNDS

Structure determination of organic compounds by spectroscopic methods, with an emphasis on mass spectrometry and nuclear magnetic resonance. Course will emphasize problem-solving skills. I. Pre: (2536 or 2566), (3616 or 4616). (3H,3C)

CHEM 4524	%
Infrared Spectroscopy	14
Mass Spectrometry	14
Proton NMR	15
Carbon-13 NMR	15
Correlation NMR Spectroscopy	14
NMR of Other Important Nuclei	14
Misc Topics, NIR, UV, X-ray	14
Total	100

4534: ORGANIC CHEMISTRY OF POLYMERS

Structure, synthesis, and basic characteristics of the major classes of polymerization reactions including step-growth (condensation) and chain growth (addition), free radical, and ionic mechanisms. Pre: 2536 or 2566. (3H,3C)

CHEM 4534	%
Introduction to Polymers	7
Step (Condensation) Polymerization	25
Radical Chain (Addition) Polymerization	15
Free Radical Copolymerization	4
Emulsion Free Radical Polymerization	4
Anionic Polymerization	7
Cationic Polymerization	4
Ring Opening Polymerization	7
Coordination Polymerization	7
Conducting Polymerization	4
Cellulose & Proteins	7
Block & Graft Copolymers	4
Polymer Reactions	4
Total	100

4554: DRUG CHEMISTRY

Structure, synthesis, and physiological effects of major classes of pharmaceutical agents including CNS depressants and stimulants, analgesics, anesthetics, cardiovascular agents, chemotherapeutic drugs, and oral contraceptives. Pre: 2536 or 2566. (3H,3C) II.

CHEM 4554	%
Medicinal Chemistry and Drug Action	7
CNS Pharmacology and Physiology	7
Sedative-Hypnotics	7
Anticonvulsant Drugs	7
Anxiolytic and Neuroleptic Drugs	8
Antidepressants	8
CNS Stimulants and Anorectics	8
Parkinsonism and Alzheimer's Disease	8
Narcotic Analgesics and Antagonists	8
NSAIDs	8
Antihistamines	8
Antiulcer Drugs	8
Antibiotics, Anticancers, Antivirals	8
Total	100

4615-4616: PHYSICAL CHEMISTRY FOR THE LIFE SCIENCES

Principles of thermodynamics, chemical kinetics, and chemical bonding for students in the life sciences. 4615: Laws and applications of thermodynamics. 4616: Chemical kinetics and chemical bonding including spectroscopy. Partly duplicates 3615, cannot receive credit for 3615 and 4615. Pre: One year of chemistry, physics, and calculus. (3H,3C) I,II.

CHEM 4615	%
Gas Laws and Gas Kinetics	14
First Law of Thermodynamics	16
Second Law of Thermodynamics	14
Free Energy and the Second Law	14
Equilibrium	14
Solutions	14
Electrochemistry	14
Total	100

CHEM 4616	%
Rates of Reaction	20
Michaelis-Menton Kinetics	10
Atomic Structure	20
The Chemical Bond	20
Molecular Spectroscopy	30
Total	100

4634 (MSE 4534): POLYMER AND SURFACE CHEMISTRY

Physical chemical fundamentals of polymers and surfaces including adhesives and sealants. Pre: 3615 or 4615. (3H,3C) II.

CHEM 4634	%
Adhesives & Sealants	10
Chemical Composition	10
Molecular Weight	10
Stereochemistry	5
Topology	10
Morphology	10
Surface Free Energy	10
Spread Monolayers	10
Absorption & Surface Area	10
Contact Angle	10
Electrical Double Layer	5
Total	100

4654: ADHESIVE AND SEALANT SCIENCE

Introduction to the fundamental and practical aspects of adhesives and sealants. Emphasis on synthesis of polymeric adhesive and sealant molecules, determination of physical properties of adhesives and sealants, chemical and physical characteristics of adherend surfaces, and mechanical behavior and durability of bonded systems – including metals, composites, polymers, and wood. I Pre: (3615 or 4615). (3H,3C)

CHEM 4654	%
Synthesis of Polymeric Materials	15
Polymer Physical & Thermal Properties	25
Surface Chemistry & Analysis	20
Fracture Mechanics & Durability	25
Wood Chemistry & Adhesion	15
Total	100

4734 (CSES 4734) (ENSC 4734): ENVIRONMENTAL SOIL CHEMISTRY

Chemistry of inorganic and organic soil components with emphasis on environmental significance of soil solution-solid phase equilibria, sorption phenomena, ion exchange processes, reaction kinetics, redox reactions, and acidity and salinity processes. I Pre: CSES 3114, CSES 3124, CHEM 2514 or CHEM 2535, CHEM 3114, MATH 2015. (3H,3C)

CHEM 4734	%
Soil Chemical Reactions	5
Inorganic Soil Components	10
Soil Organic Matter	15
Soil/Solution Equilibria	10
Sorption Phenomena on Soils	15
Ion Exchange Processes	10
Kinetics of Soil Chemical Processes	10
Redox Chemistry of Soils	10
The Chemistry of Acidity	10
Saline and Sodic Soils	5
Total	100

4754 (CSES 4754) (ENSC 4754): INSTRUMENTAL ANALYSIS FOR AGRICULTURAL AND ENVIRONMENTAL SCIENCES

Theory and principles of common analytical instruments and their applications to agriculture and environmental science research. Topics include atomic absorption and emission spectroscopy, spectrophotometric methods (UV, visible, luminescence, and automation), chromatography, ion-selective electrodes, and microwave digestion. Infrared spectroscopy, atomic ratio and molecular mass spectroscopy, nuclear magnetic resonance will also be included. Provides hands-on experience with modern analytical instruments. Prerequisites or graduate standing required. Pre: (3114, 3124) or (CSES 3114, CSES 3124). (3H,3L,4C) II.

Variable-Credit Courses at the 4000 Level

4964: FIELD STUDY

4974: INDEPENDENT STUDY

4984: SPECIAL STUDY

4994: UNDERGRADUATE RESEARCH