CHE 100 General Chemistry Fundamentals (3)

The course is an examination of general chemistry principles, particularly those necessary for biological sciences and health sciences and assumes no previous background in chemistry. Topics will include dimensional analysis, energy, atomic structure, bonding, intermolecular forces, reactions, gas laws, solutions, and nuclear chemistry. Topics of relevance to chemistry in society will also be discussed. Three hours of lecture.

Student Learning Outcomes

Students will:

1. Gain a broad understanding of chemistry that supports their goals in the sciences or allied health sciences.
2. Develop a basic understanding of the nature of matter, properties of matter and the usefulness of the periodic table.
3. Understand the basic structure of the atom and its subatomic particles.
4. Develop an understanding of molecular bonding and chemical structure.
5. Explain why chemicals react and quantify changes in chemical reactions.
6. Communicate chemical concepts more effectively.
7. Develop and apply their problem-solving skills to solve quantitative problems.
8. Develop an understanding of how chemistry fits in to daily life and society.

Course Topics

1. Scientific Method
2. Measurement, Units, and Dimensional Analysis
3. Matter and Energy
4. Structure of the Atom
5. Periodic Table and Properties
6. Inorganic Nomenclature
7. Quantum Mechanics and Electron Configurations
8. Lewis Structures and Bonding, VSEPR
9. Intermolecular Forces
10. The mole and Stoichiometry
11. Gases
12. Solutions
13. Acids and Bases
14. Nuclear Chemistry

CHE 105 General Chemistry I (4)

Topics covered are: atomic theory and the electronic structure of atoms, molecules, and ions; the periodic table and chemical bonding; molecular geometry and molecular orbitals; physical properties in relation to structure; chemical formulas and equations; the ideal gas law and its uses; solutions (concentration units, principles of solubility); and reactions in aqueous solution (acid-base, precipitation, and redox reactions. Laboratory work is integrated with topics covered in lecture. Three lectures and one three-hour laboratory period per week. Not intended for non-science majors seeking fulfillment of the Science and Nature requirements of the general education program. Prerequisites: 1) Placement into MTH 133, 150, 170, or 210 2) One year of high school laboratory chemistry with a grade of B or better, CHE 100, or instructor consent. A student must pass the laboratory portion of any science course to pass the entire course. IAI-P1902/P1902L

Student Learning Outcomes

Students will:

1. Develop a basic understanding of the nature of matter, properties of matter and the usefulness of the periodic table.
2. Understand the basic structure of the atom and its subatomic particles.
3. Understand of molecular bonding and chemical structure.
4. Explain why chemicals react and quantify changes in chemical reactions.
5. Communicate chemical concepts more effectively.
6. Develop and apply their problem-solving skills to solve quantitative problems.
7. Develop basic laboratory skills, including the analysis and interpretation of experimental data.

Course Topics

1. Scientific Method
2. Measurement, Units, and Dimensional Analysis
3. Matter and Energy
4. Structure of the Atom
5. Periodic Table and Properties
6. Inorganic Nomenclature
7. Quantum Mechanics and Electron Configurations
8. Lewis Structures and Bonding, VSEPR
9. The mole and Stoichiometry
10. Gases
11. Intermolecular Forces

CHE 106 General Chemistry II (4)

Topics covered in this course are thermochemistry, spontaneity, and entropy, chemical equilibrium; kinetics; acid-base equilibria; solubility equilibria; liquids, solids, and intermolecular forces; phase behavior; and physical properties of solutions. Laboratory work is integrated with topics covered in lecture. Three lectures and one three-hour laboratory period per week. Not intended for non-science majors seeking fulfillment of the Science and Nature requirements of the general education program. Prerequisite: CHE 105 or equivalent with a grade of C- or better.

Student Learning Outcomes

Students will:

1. Develop a basic understanding of the nature of matter, properties of matter and the usefulness of the periodic table.
2. Understand the basic structure of the atom and its subatomic particles.
3. Develop an understanding of molecular bonding and chemical structure.
4. Explain why chemicals react and quantify changes in chemical reactions.
5. Communicate chemical concepts more effectively.
6. Develop and apply their problem-solving skills to solve quantitative problems.
7. Develop basic laboratory skills, including the analysis and interpretation of experimental data.

Course Topics

1. Solutions
2. Chemical Kinetics
3. Equilibrium
4. Acids and Bases
5. Aqueous Equilibria
6. Thermochemistry
7. Entropy and Free Energy
8. Electrochemistry
9. Nuclear Chemistry

CHE 205 Organic Chemistry I (4)

This course is a foundational survey of general organic chemistry and is concerned with the properties, structure, nomenclature, and reactions of compounds belonging to the major organic chemical families. The functional group approach is used with an emphasis on those of importance in biochemistry. The laboratory component focuses on common techniques used in organic chemistry, as well as elementary organic syntheses and qualitative analysis. Three hours of lecture and three hours of laboratory per week. Prerequisites: CHE 105, 106, or equivalent, with a grade of C- or better. A student must pass the laboratory portion of any science course to pass the entire course.

Student Learning Outcomes

Students will:

1. Have increasing chemical knowledge and building problem-solving and reasoning skills.
2. Develop problem-solving and reasoning skills through proposing logical, realistic solutions for problems involving chemical phenomena.
3. Gain knowledge of the key role organic chemistry plays in biology and practical life
4. Understand common functional groups and reactivity
5. Appreciate mechanisms as a systematic learning tool
6. Understand the importance of 3-dimensional shape of molecules and its relationship to function
7. Understand the uniqueness of carbon and carbon-based structures.

Course Topics

1. Atomic Structure and Bonding
2. Acids and Bases
3. Hydrocarbons and Organic Nomenclature
4. Unsaturated Compounds and Electrophilic Addition
5. Stereochemistry
6. Substitution and Elimination
7. Alcohols and Ethers
8. Aromatic Compounds
9. Amines
10. Aldehydes and Ketones
11. Carboxylic Acids and their Derivatives

CHE 206 Organic Chemistry II (4)

The course focuses on more advanced aspects of the materials surveyed in CHE205. Greater emphasis will be placed on reaction mechanisms, the use of spectroscopic techniques such as IR and NMR for structure determination, synthetic methods, and physical organic concepts and phenomena. The laboratory component focuses on the use of spectroscopic methods of analysis, more advanced syntheses, and more advanced laboratory techniques. The course is designed for chemistry majors and minors and pre-professional students seeking more advanced study. Prerequisite: CHE 205 with a grade of C- or better. A student must pass the laboratory portion of any science course to pass the entire course.

Student Learning Outcomes

Students will:

1. Have increased chemical knowledge, preparing students for success in graduate or professional fields, and building problem-solving and reasoning skills.
2. Develop problem-solving and reasoning skills through proposing logical, realistic synthetic schemes for a variety of molecules.
3. Possess knowledge of the key role organic chemistry plays in biology and practical life
4. Understand common functional groups and reactivity
5. Appreciate mechanisms as a systematic learning tool
6. Understand the importance of 3-dimensional shape of molecules and its relationship to function
7. Understand the uniqueness of carbon and carbon-based structures

Course Topics

1. Acids and Bases
2. Thermodynamics and Equilibrium of Organic Compounds
3. Molecular Orbital Theory in Organic Chemistry
4. Hydrocarbons and Conformational Analysis
5. Electrophilic Addition of Unsaturated Compounds
6. Stereochemistry
7. Substitution and Elimination
8. Alcohols, Ethers, and Epoxides
9. Conjugation and Aromatic Compounds
10. Electrophilic Aromatic Substitution Reactions
11. Aldehydes and Ketones and Carbonyl Addition Reactions
12. Carboxylic Acids and their Derivatives and Nucleophilic Acyl Substitution
13. Enolates and a-Substitution Reactions
14. Organometallics

CHE 300 Analytical Chemistry (4)

Classical and instrumental methods are applied to chemical analysis. Classical methods are gravimetric, volumetric, and chromatographic. Instrumental methods are spectroscopic (IR, UV/VIS, and laser methods), chromatographic (HPLC and GC/MS), and electrochemical (conductometry and potentiometry). Three lectures and one three-hour laboratory period per week. Prerequisites: CHE 105, 106, MTH 210. A student must pass the laboratory portion of any science course to pass the entire course.

Student Learning Outcomes

Students will:

1. Distinguish between quantitative and qualitative chemical analysis.
2. Apply statistical methods to evaluate laboratory data.
3. Develop an understanding of calibration methods related to chemical analysis goals.
4. Use chemical equilibrium theory to design quantitative analyses and interpret results.
5. Have the ability to perform graphical analysis to analyze laboratory results.
6. Apply analytical methods based on titrations, separations, and spectroscopy at an introductory level.

Course Topics

1. Experimental error
2. Statistics
3. Chemical equilibrium
4. Titrations
5. Systematic treatment of equilibrium
6. Spectrophotometry
7. Monoprotic Acid-Base Equilibria
8. Polyprotic Acid-Base Equilibria

CHE300L Analytical Chemistry Lab (0)

Course Topics

1. Error Propagation Dry Lab
2. Accuracy and Precision of Glassware
3. Sampling in Analytical Chemistry
4. Preparation of a Standard Sodium Hydroxide Solution
5. Determination of Aspirin Using Back Titration
6. Buffers In Context: Baby Wipes as a Buffer System
7. Potentiometric Analysis of Acid in Soft Drinks
8. Potentiometric Analysis of Acid in Soft Drinks
9. EDTA Determination of Total Water Hardness
10. Determination of Vitamin C in a Tablet
11. Spectrophotometric Determination of Iron in Drinking Water

CHE 303 Principles of Biochemistry (4)

This course is designed to give an overall understanding and integration of the biochemical principles involved in the structure/function relationships of biological molecules and their interactions in the intermediary metabolism in eukaryotic cells with special emphasis on human metabolism. Four hours lecture. Prerequisite: CHE 206 with a grade of C- or better.

Student Learning Outcomes

Students will:

1. Master the general concepts for each of the four biochemical macromolecular classes: Nucleic acids, Proteins, Lipids, and Carbohydrates
2. Learn about current techniques and analysis of the four classes of biomolecules.
3. Apply knowledge of chemical kinetics to enzyme kinetic analysis.
4. Learn the basic principles of signal transduction and the major categories of signal transduction systems.
5. Gain a basic understanding of the core metabolical pathways in introductory metabolism.
6. Master the analysis of thermodynamics applied to biochemical systems as well as the uses of acids, bases, and buffers in those systems.
7. Gain experience in critical analysis of biochemical problems and their biomedical applications. 8. Learn about the relevance of biochemistry to everyday life and its pertinence in many contemporary issues.
8. Practice written communication of complex scientific concepts in layman's terms.

Course Topics

1. Water, Acids and Bases, Buffers
2. Thermodynamics and Equilibrium in Biological Systems
3. Nucleic Acids
4. Protein Structure
5. Protein Experimental Techniques
6. Hemoglobin and Protein Cooperativity
7. Enzymes and Kinetics
8. Carbohydrates
9. Lipids and Membranes
10. Signal Transduction Methods
11. Metabolism of Carbohydrates
    a. Glycolysis/Gluconeogenesis
    b. Citric Acid Cycle
    c. Electron Transport and Oxidative Phosphorylation
    d. Glycogenolysis, Glycogenesis, Pentose Phosphate Pathway
12. Fatty Acid Metabolism

CHE 305 Physical Chemistry I (4)

A course that develops, in detail, many of the fundamental concepts used in chemistry. Topics include the study of gases, thermodynamics, thermodynamic properties of liquids and solids, the nature of electrolytes, phase equilibria, and chemical equilibria. Three lectures and one three-hour laboratory period per week. Prerequisites: CHE 105, 106, MTH 211, PHY 211, 212, or concurrent enrollment. A student must pass the laboratory portion of any science course to pass the entire course.

Student Learning Outcomes

Students will:

1. Explain and predict physical and chemical equilibria in terms of thermodynamic quantities.
2. Develop quantitative descriptions of the energies and rates associated with chemical and physical transformations of matter.
3. Derive new thermodynamic results from the basic laws of thermodynamics.
4. Learn to express a physical question as a mathematical problem and use methods up to and including multivariable calculus to solve that problem.
5. Gain appreciation on how the physical chemistry principles underlie modern chemical research.

Course Topics

1. Gases
2. Thermodynamics
3. Thermodynamic properties of liquids and solids
4. The nature of electrolytes
5. Phase equilibria
6. Chemical equilibria

CHE 305L Physical Chemistry I Lab (0)

Student Learning Outcomes

Students will:

1. Explain and predict physical and chemical equilibria in terms of thermodynamic quantities.
2. Develop quantitative descriptions of the energies and rates associated with chemical and physical transformations of matter.
3. Derive new thermodynamic results from the basic laws of thermodynamics.
4. Express a physical question as a mathematical problem and use methods up to and including multivariable calculus to solve that problem.
5. Gain appreciation on how the physical chemistry principles underlie modern chemical research.

Course Topics

1. Using Volumetric Glassware_ Volumetric Flasks Pipets and Burets
2. Constant Pressure Calorimetry- Determining Solution Enthalpies
3. The Enthalpy of Formation of Camphor by Bomb Calorimetry
4. Iodometric Determination of Vitamin C
5. Phase Diagram for a Three-Component System
6. Spectrophotometric Determination of Manganese in Steel Method of Standard Addition

CHE 306 Physical Chemistry II (4)

A continuation of Chemistry 305 discussing theories of chemical bonding and molecular structure, spectroscopy, chemical kinetics, quantum mechanics, and molecular energies. The laboratory component includes laser methods to confirm the predictions of quantum mechanics about chemical bonding and molecular energy levels. Three lectures and one three-hour laboratory period per week. Prerequisites: CHE 305, MTH 212, or concurrent enrollment. A student must pass the laboratory portion of any science course to pass the entire course.

Student Learning Outcomes

Students will:

1. Be able to observe, explain and predict physical and chemical equilibria in terms of Quantum Mechanics and Spectroscopy.
2. Develop quantitative descriptions of the energies and rates associated with chemical and physical transformations of matter on the subatomic level.
3. Derive new Quantum Mechanical results from the basic laws of Classical and Quantum Mechanics.
4. Learn to express a physical question as a mathematical problem and use methods up to and including multivariable calculus to solve that problem.
5. Gain an appreciation on how the physical chemistry principles underlie modern chemical research.

Course Topics

1. Classical and Quantum Mechanics
2. Schrodinger's equation
3. Quantum-Mechanical Postulates
4. Applying quantum-mechanical principles to simple systems
5. Particle in the box model and applications
6. Commuting and non-computing operators and Entanglement
7. Quantum mechanical model for vibration and rotation of molecules
8. Vibrational and rotational spectroscopy of diatomic molecules
9. Hydrogen atom
10. Many electron atoms
11. Chemical bond in diatomic molecules
12. Molecular structure and energy levels for polyatomic molecules

CHE 306L Physical Chemistry II Lab (0)

Course Topics

1. Double Slit Physics
2. Schrodinger
3. Math Essentials
4. Particles in a Box
5. Functional Waves and Entanglement
6. Molecular Spectroscopy Chemistry
7. Diatomics
8. The Hydrogen Atom
9. Atoms with Many Electrons
10. Quantum Mechanic States
11. Bonds in Diatomics

CHE 455 Chemistry Research Methods (W) (3)

This is the capstone course in chemistry. An overview of current chemistry research areas will be examined, and students will develop the scientific reasoning and critical thinking skills necessary to communicate effectively science using a variety of formats. The focus will be on critical analysis of primary literature and data, scientific writing, and scientific presentations. Prerequisites: Chemistry major and senior standing.

Student Learning Outcomes

Students will:

1. Learn how to search information needed for research
2. Determine how the chemical literature fits with the act of doing research
3. Utilize software for drawing molecules
4. Evaluate sources of information, prepare posters, presentations, and written examinations of the literature.
5. Have increased chemical knowledge
6. Be prepared for success in graduate or professional fields
7. Build problem-solving and reasoning skills

Course Topics

1. Structure of the Chemical Literature
2. Library Searching and Databases
3. Chemical Structure Analysis and Drawing with Computers
4. Selecting a Research Topic
5. Writing Scientific Papers
6. Resume/CV Preparation in Chemistry
7. Writing Abstracts
8. Chemical Literature Review Preparation
9. Analysis of Research Articles and the Publication Process
10. Analyzing Sources
11. Giving Scientific Presentations and Communicating Chemistry
    a. General Chemistry in the Public
    b. Research Paper Analysis
    c. Chemistry Seminar
12. Poster Preparation
13. Scientific Meetings