CHEM - 1013 Introductory Chemistry, 3.00 Credits
Level: Lower
Gen Ed - Natural Sciences, Liberal Arts and Science
This non-laboratory course is designed for students who need to understand the basic concepts of chemistry. Students will explore mathematical relationships using the factor labeling (conversion factor method), atomic and molecular structures (with emphasis on the special nature of carbon), pH, essential building block molecules, water, ions and ionization, and other topics of interest to those who live in our chemical world. Students cannot receive credit for CHEM 1013 if CHEM 1114 or CHEM 1984 is concurrently or previously taken.

CHEM - 1023 Foundations in Chemistry, 3.00 Credits
Level: Lower
Liberal Arts and Science
The course is specifically designed to service students who need more preparation to be successful in chemistry courses required for science majors including General Chemistry (CHEM 1114) and Chemical Principles (CHEM 1984). The class will provide a primer in the concepts, terminology and mathematics which are most commonly utilized in chemistry coursework. This course does not fulfill the Gen Ed - Natural Sciences requirement. Students cannot receive credit for CHEM 1023 if CHEM 1013, CHEM 1114 or CHEM 1984 is concurrently or previously taken.

CHEM - 1114 General Chemistry I, 4.00 Credits
Level: Lower
Applied Learning-Other, Course Fee $6.00, Gen Ed - Natural Sciences, Liberal Arts and Science
This course is designed for science majors particularly focused in the health or agricultural areas who have had high school chemistry. It can be a terminal course in chemistry for those seeking an AAS in veterinary technology. Topical coverage includes: metric units and conversions, atomic theory, periodicity, electronic bonding models (Lewis, Pauling, Gillespie VSEPR), inorganic nomenclature, inorganic reactions (metathesis, acid-base, redox), stoichiometry and the mole concept, gas laws, phase transitions (phase diagrams, cooling curves, critical phenomena, heat capacities, intermolecular interactions), equilibrium (calculations involving K, Le Chatelier's principle) and elementary kinetics (Arrhenius model).

CHEM - 1984 Chemical Principles I, 4.00 Credits
Level: Lower
Applied Learning-Other, Course Fee $8.00, Gen Ed - Natural Sciences, Liberal Arts and Science
This course is intended for physical science and engineering majors. While providing a general overview of modern chemistry, the course emphasizes the development of chemical concepts and problem-solving techniques that are essential in science. General topics include atomic structure of matter, chemical reactions, thermochemistry, electronic structure of the atom and chemical bonding.

CHEM - 2124 General Chemistry II, 4.00 Credits
Prerequisite(s): CHEM 1114 with D or better or CHEM 1984 with D or better
Level: Lower
Applied Learning-Other, Course Fee $27.00, Gen Ed - Natural Sciences, Liberal Arts and Science
This course is a continuation of General Chemistry I and is intended for science majors. It completes the presentation of topics started in General Chemistry I by surveying the topics of: Acids & Bases, Electrochemistry and Nuclear Chemistry. After these foundations are laid, the course will then explore two broad chemical themes: 1) Organic Chemistry, where the language and chemistry of selected functional groups (alkanes, alkenes, aromatics, alcohols, aldehydes, ketones, amines, and carboxylic acids), along with an exploration of chirality will be covered and 2) Biochemistry, where the chemistry and structure of carbohydrates, lipids and proteins will be surveyed.

CHEM - 2984 Chemical Principles II, 4.00 Credits
Prerequisite(s): CHEM 1984 with D or better or CHEM 1114 with D or better
Level: Lower
Applied Learning-Other, Course Fee $10.00, Gen Ed - Natural Sciences, Liberal Arts and Science
This course is a continuation of Chemical Principles I and is intended for physical science and engineering majors. Those basic concepts from the first semester are applied to more complex aspects of chemistry which include the states of matter, solutions, thermodynamics, equilibrium, electrochemistry and nuclear chemistry. In addition, the course is designed to have more out-of-class activities related to these topical areas which are completed by a team of students.

CHEM - 3514 Organic Chemistry I, 4.00 Credits
Prerequisite(s): CHEM 2124 with D or better or CHEM 2984 with D or better
Level: Lower
Applied Learning-Other, Course Fee $33.00, Gen Ed - Natural Sciences, Liberal Arts and Science
This course is the first semester of a two semester sequence in organic chemistry and is a thorough introduction to the language, mechanisms, materials and concepts fundamental to organic chemistry. Lecture topics include: VSEPR and atomic orbital models; basic valence hybrid and molecular orbital theory; the language of stereochemistry; the basic 'activated complex' model of Eyring and Polanyi; free radical reactions, notably as they occur in alkanes; alkene preparation and synthesis; SN1 and SN2 substitution reaction pathways notably as they occur in alkyl halides and alcohols; E1 and E2 elimination pathways, notably as they occur for alcohols and alkyl halides; the stereochemistry and energetics of cycloalkanes, and an introduction to retrograde, multi-step synthesis. Lab skills taught include: principles and practice of simple, fractional and steam distillation; recrystallization, solvent extraction, melting point, refractive index determination, IR and GC instrumental characterizations of compounds. Students are also required to synthesize three different compounds, including a multi-step Grignard synthesis to 2-methyl-2 hexene starting from 2-propanone and 1-bromobutane.

CHEM - 4524 Organic Chemistry II, 4.00 Credits
Prerequisite(s): CHEM 3514 with D or better
Level: Lower
Applied Learning-Other, Course Fee $62.00, Gen Ed - Natural Sciences, Liberal Arts and Science
This course is the second semester of a two semester sequence in organic chemistry starting with Organic Chemistry I. Lecture topics include: synthetic routes to and from unsaturated aliphatics, notably: alkenes, alkynes, allylic and alkadienes with emphasis on accompanying mechanistic pictures notably: radical and carbocation additions, concerted additions, radical substitutions; synthetic routes to and from substituted aromatic compounds with emphasis on the electrophilic substitution mechanism; synthetic routes to and from carbonyl compounds including: aldehydes, ketones, carboxylic acids and their derivatives with particular focus on the special role played by the beta hydrogen; a brief survey of reactions and properties of amines, ester enolates, and a survey of carbohydrate structure and chemistry. A thorough introduction to stereochemical language not covered in the first semester is also carried out. Lab topics include mastery of organic techniques not covered in the first semester, e.g. NMR and polarimetry, mass spectroscopy and, hands-on experience with the various reactions discussed in lecture, notably: ring substitution, cycloaddition, stereoaddition, carbonyl condensations, and esterification.

CHEM - 4900 Directed Study, 1.00 TO 6.00 Credits
Level: Lower
Liberal Arts and Science
A student may contract for one to six credit hours of independent study through an arrangement with an instructor who agrees to direct such a study. The student will submit a plan acceptable to the instructor and to the department chairperson. The instructor and student will confer regularly regarding the progress of the study.

CHEM - 5013 Applied Chemical Principles, 3.00 Credits
Prerequisite(s): MATH 1033 with C or better or MATH 1054 with D or better or MATH 1063 with D or better or MATH 1084 with D or better
Level: Upper
Applied Learning-Practicum, Course Fee $3.00, Liberal Arts and Science, Upper Level
This course is designed to provide engineering students with a foundation in the important concepts and principles of chemistry needed to communicate effectively with colleagues, develop manufacturing methods, and solve industrial problems related to Chemistry. Emphasis will be placed on those areas considered most relevant in an engineering context, and practical applications in engineering and technology will be examined. Topics include: atomic theory, bonding, stoichiometry, acid-base chemistry, oxidation-reduction, gases, and chemical equilibrium.

CHEM - 5414 Analytical Principles, 4.00 Credits
Prerequisite(s): CHEM 2124 with C or better or CHEM 2984 with C or better
Level: Upper
Applied Learning-Practicum, Course Fee $62.00, Upper Level
This course is an in-depth examination of the chemistry and mathematical underpinnings connected to classical chemical calculations and wet chemical methods that form the foundation of modern quantitative chemistry. Using only a balance, buret and various classical volumetric devices, students will develop skills and understanding of gravimetric, titrimetric, complexometric, argentometric and redox methodologies. The course contains a thorough coverage of the manifold concentration systems and conversions as well as complete treatment of the details of equilibrium equations connected to precipitation, acid-base reactions, buffers, complexation and redox. Non-ideal corrections, notably Debye-Huckel theory, will also be covered.

CHEM - 5900 Directed Study, 1.00 TO 6.00 Credits
Level: Upper
Upper Level
A student may contract for one to six credit hours of independent study through an arrangement with an instructor who agrees to direct such a study. The student will submit a plan acceptable to the instructor and to the department chairperson. The instructor and student will confer regularly regarding the progress of the study.

CHEM - 6614 Instrumental Analysis, 4.00 Credits

Prerequisite(s): CHEM 4524 with D or better
Level: Upper
Applied Learning-Practicum, Course Fee $55.00, Upper Level
A strongly lab-focused course devoted to providing students a thorough exposure to the most common instrumental methods found in modern chemistry and material science labs including: UV-VIS spectroscopy, Atomic Absorption Spectroscopy (AAS), Infrared Spectroscopy (IR), Gas Chromatography (GC), Mass Spectroscopy (MS), High Performance Liquid Chromatography (HPLC), optical and electron microscopy, calorimetric methods including Differential Scanning Calorimetry (DSC) and X-ray Diffraction (XRD). Additionally, fundamentals of glass, glass blowing and basic electronics including passive component behavior as well as some exposure to the fundamentals of semi-conductor devices (transistors, op amps) will be explored.

CHEM - 6854 Physical Chemistry, 4.00 Credits

Prerequisite(s): CHEM 2984 with C or better and PHYS 1064 with C or better and MATH 6114 with C or better
Level: Upper
Applied Learning-Practicum, Course Fee $57.00, Upper Level
This course provides students who plan future studies in forensic science technology, chemical sciences or chemical engineering a firm grounding in the quantum mechanical description of molecules, as well as a critical set of insights into thermochemical reasoning. The quantum mechanical focus will be on key model systems, notably the 1- and 2D particle-in-a box, the rigid rotor, the harmonic oscillator and hydrogen atom. Selected approximation methods applicable to multi-electron atomic systems and applications of infrared and visible spectroscopy will be explored, and students will be given experience in using current quantum calculation software to estimate optimal structures, predict IR spectra and estimate activated complex geometries. It is expected that students taking this course will have already taken a course of ordinary differential equations, but some of the course will also include mathematical excursions developing necessary mathematical tools, notably eigenvalue problems, series solutions of differentials and various matrix algebraic methods. The thermodynamic focus will be on efficiently developing the 4 laws of thermodynamics into useful forms whereby chemical equilibria and phase change of chemical systems can be predicted and described. A strong emphasis will be laid on using the practical chemical results of thermodynamic reasoning (K and Q predictions, Clausius-Clapeyron, Gibbs-Helmholtz and Nernst equation, phase rules and Gibbs-Duhem equations) rather than deriving the abstracted expressions of the several thermodynamic laws.

CHEM - 7784 Biochemistry, 4.00 Credits

Prerequisite(s): CHEM 4524 with C or better and BIOL 2204 with C or better
Level: Upper
Applied Learning-Practicum, Course Fee $109.00, Upper Level
This course is a comprehensive course intended for science majors. Topics covered include the basic structure and reactions of biological compounds (carbohydrates, lipids, proteins, enzymes, and nucleic acids), the digestion and absorption of nutrients, bioenergetic principles, and catabolic and anabolic metabolism of major biochemicals in the human body. The laboratory exercises include classic techniques in isolation, purification and assay of proteins, enzymes (and kinetics), carbohydrates, lipids, and nucleic acids as well as polypeptide and polynucleotide sequencing and synthesis.