CHEMISTRY (CHEM)

CHEM-112C Fundamentals of General, Organic, and Biochemistry I 3 Credits
An introduction to the study of matter and properties. The course surveys in one semester chemical topics such as: atomic theory, periodic trends, measurements and stoichiometry, chemical reactions, reduction and oxidation chemistry, chemical equilibrium, nuclear chemistry and acids and bases. This course is designed for students who need a refresher in general chemistry. It also serves as an excellent introductory course for students in the health sciences or as a general science for non-majors. Course fulfills Core education laboratory science requirement. Lecture three hours.
Co-Requisite: Concurrent: CHEM-112CL

CHEM-112CL Fundamentals of General, Organic, and Biochemistry I Lab 1 Credit
A complementary laboratory course to CHEM 112C emphasizing the study of matter and properties. This hands-on course teaches basic techniques used in the chemistry lab. Sample experiments include: separation of compounds, chemical precipitation reactions, oxidation-reduction reactions, household chemical qualitative analysis. Laboratory three hours. Lab fee.
Co-Requisite: Concurrent: CHEM-112C

CHEM-113 Fundamentals of General, Organic, and Biochemistry I 3 Credits
A continuation of the study of matter and its properties. This course explores the following areas of chemistry: Organic Chemistry and Biochemistry. Topics such as: organic functional groups, basic organic reactions, biomolecular structure, metabolism, protein synthesis, and instrumentation will be covered. This course is designed for students in the health sciences, liberal studies, or as a general science for non-majors. Lecture three hours.

CHEM-113L Fundamentals of General, Organic, and Biochemistry II Lab 1 Credit
A complementary laboratory course for CHEM 113. This course implements the following experiments: organic synthesis of aspirin or other analgesic, synthesis of esters, separation of compounds using chromatographic techniques, synthesis of organic dyes, combustion of carbohydrates, analysis of proteins and DNA. This course is designed for students in the health sciences, liberal studies, or as a general science for non-majors. Laboratory three hours. Lab fee.

CHEM-120 General Chemistry I 3 Credits
Fundamental concepts including chemical reactions, stoichiometry, atomic structure, chemical bonding, changes in state, and the periodic table. Should students not be prepared to succeed in chemistry, it is recommended that students enroll in CHEM 112C/CL. After successful completion of CHEM 112C/CL, the student can re-enter. Three hours lecture per week.
Prerequisite: CHEM-112CL or passing score on the Chemistry Placement Exam.
Co-Requisite: CHEM-120L

CHEM-120L General Chemistry I Lab 1 Credit
Students will learn introductory laboratory techniques such as observation, measurement, separations, and identification of reactions. Experiments will involve concepts including: atomic structure, chemical bonding, changes in state, periodic table, oxidation, kinetics, equilibrium, thermodynamics, and electrochemistry. One 4-hour laboratory session per week. Lab fee.
Prerequisite: CHEM-112CL
Co-Requisite: CHEM-120

CHEM-120R General Chemistry I Recitation 1 Credit
Recitation section to accompany CHEM 120. This course develops problem solving skills of students studying the fundamental concepts presented in CHEM 120 including: chemical reactions, stoichiometry, atomic structure, chemical bonding, changes in state, and the periodic table. One hour recitation session per week; credit/fail course.

CHEM-121 General Chemistry II 3 Credits
Fundamental concepts including kinetics, equilibrium, thermodynamics, and electrochemistry. Special topics will include nuclear chemistry, transition metal periodicity and coordination compounds. Three hours lecture per week.
Prerequisite: CHEM-120
Co-Requisite: CHEM-121L

CHEM-121L General Chemistry II Lab 1 Credit
Students will continue their introduction to laboratory techniques including gravimetric and volumetric analysis, neutralization, and catalysis. Experiments will involve the concepts including: atomic structure, chemical bonding, changes in state, periodic table, oxidation, kinetics, equilibrium, thermodynamics, and electrochemistry. One 4-hour laboratory session per week. Lab fee.
Prerequisite: CHEM-120L
Co-Requisite: CHEM-121

CHEM-121R General Chemistry II Recitation 1 Credit
This course develops problem solving skills of students studying the fundamental concepts presented in CHEM 121 including: Fundamental concepts including kinetics, equilibrium, thermodynamics, and electrochemistry. Special topics will include nuclear chemistry, transition metal periodicity and coordination compounds. One hour recitation session per week; credit/fail course.
**CHEM-210 Integrated Chemistry  4 Credits**
This course is designed to give beginning students who have not had prior exposure to chemistry a basic overview in general, organi, and biochemistry. The following topics will be surveyed: mater and engergy, atomic theory, stoichiometry, nomenclature, the periodic table, atomicn structure, gas liquid and solid states, solutions, nuclear chemistry, functional groups, alkanes, alkenes, alcohols, ethers, aldehydes, ketones, amines, carboxylic acids, lipids, carbohydrates, amino acids, proteins, nucleic acids, metabolism and respiration, photosynthesis, transcription, translation, kinetics, and DNA replication. Upon completion of this integrated chemistry course, the student will have an understanding of basic principles paramount to the study of chemistry, a proficiency with stoichiometry (as it relates to the nusing discipline), writing and interpreting chemical formulas, DNA replication, transcription and translation. In addition, the student should develop an appreciation for the importance of chemistry in other disciplines. (Meets Chemistry requirement for RN to BSN students; meets Science/Lab requirement for Professional Studies students). Also meets Lab CORE Science Requirement for the traditional undergraduate student when taken with CHEM-201CL.  
Prerequisite: BIOL-205 or BIOL-210

**CHEM-210L Integrated Chemistry Laboratory  1 Credit**
A complementary laboratory chourse to CHEM-201C emphasizing teh study of matter and properties. This hands-on course teaches basic techniques used in chemistry lab. Sample experiments include: separation of componds, chemical precipitation reactions, oxidation-reduction reactions, household chemical qualitative analysis. Further, the organic synthesis of aspirin or other analgesics, synthesis of esters, separation of compounds using chromatographic techniques, synthesis of organic dyes, combustion of carbohydrates, analysis of proteins and DNA are performed. This course is designed for students in the health sciences, liberal studiems or as a general science for non-majors. This course fulfills the LAB CORE science requirement. Laboratory three hours. Lab fee.

**CHEM-212 Teaching Chemistry I  2 Credits**
This course will cover the design of chemistry laboratory experiments to demonstrate and foster the understanding of important chemical principles. Students will both design experiments and analyze experiments from a standard experimental text to determine which principles the experiment is designed to demonstrate. Particular attention will be paid to issues of safety both in the execution of an experiment and in the determination of its suitability for student involvement. In addition to three hours of lab per week, three mandatory visitations to a 6th-12th grade chemistry class per semester (at a public school) will be required. The students will provide oral and written reports on their experiences in the field visitations. Two semester sequence. Lab fee.

**CHEM-214 Teaching Chemistry II  2 Credits**
This course will cover the design of chemistry laboratory experiments to demonstrate and foster the understanding of important chemical principles. Students will both design experiments and analyze experiments from a standard experimental text to determine which principles the experiment is designed to demonstrate. Particular attention will be paid to issues of safety both in the execution of an experiment and in the determination of its suitability for student involvement. In addition to three hours of lab per week, three mandatory visitations to a 6th-12th grade chemistry class per semester (at a public school) will be required. The students will provide oral and written reports on their experiences in the field visitations. Two semester sequence. Lab fee.

**CHEM-250 Teaching Chemistry II  2 Credits**
This course will cover the design of chemistry laboratory experiments to demonstrate and foster the understanding of important chemical principles. Students will both design experiments and analyze experiments from a standard experimental text to determine which principles the experiment is designed to demonstrate. Particular attention will be paid to issues of safety both in the execution of an experiment and in the determination of its suitability for student involvement. In addition to three hours of lab per week, three mandatory visitations to a 6th-12th grade chemistry class per semester (at a public school) will be required. The students will provide oral and written reports on their experiences in the field visitations. Two semester sequence. Lab fee.

**CHEM-252 Analytical Chemistry  3 Credits**
The theory of and techniques for calculations pertaining to classical gravimetric and volumetric methods, theory and techniques of separation, and an introduction to instrumental methods. Three hours lecture per week. Offered in alternate years.  
Prerequisite: CHEM-120  
Co-Requisite: CHEM-252L

**CHEM-252L Analytical Chem Techniques  1 Credit**
Laboratory experiments in classical gravimetric and volumetric methods, techniques of separation, and an introduction to instrumental methods. One four-hour laboratory session per week. Lab fee. Offered in alternate years.  
Prerequisite: CHEM-120L  
Co-Requisite: CHEM-252

**CHEM-304 Organic Chemistry I  3 Credits**
This course is designed to introduce students to organic chemistry. The following topics will be covered: bonding and atomic theory, nomenclature, stereochemistry, functional groups, substitution reactions, elimination reactions, and both electrophilic addition and aromatic substitution reactions. Students will develop a mastery of organic functional groups and nomenclature, an understanding of basic organic reaction mechanisms, a familiarity with common organic reactions, and an appreciation for the importance of organic chemistry in other disciplines. The student will be prepared to continue their education in organic chemistry in the sequential course (CHEM 305). Three hours of lecture per week.  
Prerequisite: CHEM-121  
Co-Requisite: CHEM-304L

**CHEM-304L Organic Chemistry Techniques I  1 Credit**
This is the complementary laboratory course for CHEM 304. This course is designed to develop basic skills and techniques for practical application of the general principles of organic chemistry. The development of a safe approach to lab experimentation will be stressed. Four-hour laboratory session per week. Lab fee.  
Prerequisite: CHEM-121L  
Co-Requisite: CHEM-304

**CHEM-304R Organic Chemistry I Recitation  1 Credit**
This course includes a survey of chemical literature and methods of its use with emphasis on locating specific chemical information in primary and secondary literature. Significant time will be devoted to problem solving in Organic Chemistry 1 topics in a cooperative group setting. One hour of lecture and one hour of online work per week; credit/fail course.
**CHEM-305 Organic Chemistry II  3 Credits**
This course is designed as a continuation of the study of organic chemistry. Students will be introduced to various topics in organic chemistry including: organic oxidations and reductions, carbonyl chemistry, amines, carboxylic acids and their derivatives, organic mechanisms and various biological molecules and building blocks. Three hours of lecture per week.

**CHEM-305L Organic Chemistry Techniques 1 Credit**
This is the complementary laboratory course for CHEM 305. This course is designed to develop basic skills and techniques for practical application of the general principles of organic chemistry including identification of unknowns and multi-step synthesis. The development of a safe approach to lab experimentation will be stressed. Four-hour laboratory session per week. Lab fee.

**CHEM-305R Organic Chemistry II Recitation 1 Credit**
This course introduces basic spectrophotometric techniques of organic chemistry and biochemistry: IR, 1D and 2D NMR spectrometry, and MS with some discussion of UV/visible spectrophotometry. Multi-spectral identification of organic compounds is emphasized. Significant time will be devoted to problem solving in Organic Chemistry II topics in a cooperative group setting. One hour of lecture and one hour of online work per week; credit/fail course.

**CHEM-309 Literature and Spectroscopy 2 Credits**
This course is designed for transfer students who have previously taken Organic Chemistry 1 and 2 at other institutions. This course introduces basic spectroscopic techniques of organic chemistry and biochemistry: IR, 1D and 2D NMR spectrometry, and MS with some discussion of UV/visible spectrophotometry. Collection and multi-spectral identification of organic compounds is emphasized. Additionally this course includes a survey of chemical literature and methods of its use with emphasis on locating specific chemical information in primary and secondary literature. One hour of lecture and two hours of lab per week. Lab Fee.

**CHEM-325 History & Philosophy of Science 3 Credits**
Study of selected topics in the history and philosophy of science and the application of these principles in analyzing contemporary scientific trends. Especially recommended for liberal studies majors and those planning to teach physical or biological sciences in secondary schools. Three hours of lecture per week.

**CHEM-430 Biochemistry 3 Credits**
This course covers topics at the interface of chemistry and biology with a focus on problems where chemistry has made a particularly strong contribution to the understanding of biological system mechanisms. The chemical reactions important to biology - and the enzymes that catalyze these reactions - are discussed in an integrated format. Topics include: the chemistry and biosynthesis of carbohydrates, proteins and nucleic acids; protein folding; enzyme catalysis; bioenergetics; key reactions of synthesis and catabolism; and chemical aspects of signal transduction. An appreciation for the increasing importance of biochemistry in the chemical sciences will be cultivated. Three hours of lecture per week. Offered in alternate years.

Prerequisite: CHEM-305 and CHEM-305L
Co-Requisite: CHEM-430L

**CHEM-430L Experimental Tech/Biochemistry 1 Credit**
This is the complementary laboratory course for CHEM 430. This course is designed to enhance the basic skills and techniques learned in the previous foundational experimental chemistry courses. This course focuses on modern biochemical techniques including the operation of chromatographic and spectroscopic instruments used in the practical application biological chemistry. The development of a safe approach to lab experimentation will be stressed. Four-hour laboratory session per week. Lab fee. Offered in alternate years.

Prerequisite: CHEM-305 and CHEM-305L
Co-Requisite: CHEM-430

**CHEM-435 Adv Biochemistry 3 Credits**
Advanced Biochemistry provides an in depth view of biosynthesis, the biochemistry of muscle action, hormones and their function, active transport, organ interrelationship in metabolism, oncology, the structure of genetic material and replication and expression of DNA. Other topics of interest may be covered. Three hours of lecture per week. Offered in alternate years. Two hours of lecture plus an additional ~6 hours of online assignments per week.

**CHEM-440 Instrumental Analysis 2 Credits**
An introduction to modern instrumental chemical analysis. The course will span theory of operation, instrument design and methodology, and applications of instrumental techniques. Electrochemical methods including potentiometry, voltammetry, and coulometry; spectroscopic methods including infrared, UV-Vis, and NMR; chromatographic methods including gas, liquid and thin layer; and thermal methods of analysis and kinetic methods of analysis will be covered.

Prerequisite: CHEM-252

**CHEM-440L Instrumental Analysis Lab 2 Credits**
Prerequisite: CHEM-252L
Co-Requisite: CHEM-440

**CHEM-450 UG Research Or Internship Program 1-4 Credits**
Prerequisite: Open to juniors and seniors. This course may be taken for a maximum of 4 units in one semester. A maximum of 6 combined units credit for CHEM-450 or CHEM-485 apply to graduation. This course is designed with the purpose of providing students the opportunity to conduct research off-campus at universities or STEM companies in the community. This course promotes early entry into the workplace for the student through part-time employment. This course requires actual work experience be sought in a biotech or STEM-focused business firm providing an opportunity to integrate classroom teaching in practical application under the direct supervision of the assigned instructor. Students are responsible for completing a project report and presenting their research results in CHEM-499C.

Prerequisite: CHEM-121

**CHEM-455 Chemistry Teaching Internship 1-3 Credits**
Regular hours each week for classes and/or meetings are established at the beginning of the semester. The intern assists an instructor in planning and conducting a course, recitation and/or laboratory sessions. This course may be taken for 1-3 units per semester. May be repeated for a maximum of six units.
CHEM-456 Physical Chemistry: Thermodynamics 2 Credits
Laws, principles and concepts of chemistry concerning the properties of gases, the laws of thermodynamics, the theory and equations of phase changes in both pure and mixed substances, chemical equilibrium, equilibrium electrochemistry. Two hours lecture per week. Offered in alternate years.
Prerequisite: CHEM-121, MATH-181; MATH-281 preferred.

CHEM-456L Physical Chem Technique Lab 1-2 Credits

CHEM-457 Phys Chem: Kinetics 2 Credits
Laws, principles and concepts of chemistry concerning molecular motion and diffusion, both classical and molecular chemical kinetics, and introductory statistical mechanics. Two hours lecture per week. Offered in alternate years.

CHEM-458 Phys Chem: Quantum Mechanics 2 Credits
Laws, principles, and concepts of chemistry concerning: quantum mechanics; quantum properties of atoms and molecules; symmetry of molecules; rotational, vibrational, electronic, and magnetic (nuclear) spectroscopy and introductory statistical mechanics. Two hours lecture per week. Offered in alternate years.

CHEM-470 Special Topic: 1-4 Credits
Study in a special topic in chemistry. May be repeated for credit. May have a lab fee. Topics may include advanced inorganic chemistry, rates and mechanisms in organic chemistry, synthetic methods in organic chemistry, or other advanced topics.

CHEM-480 Individual Studies: 1-4 Credits

CHEM-485 Undergraduate Research 1-4 Credits
Problems in advanced laboratory research with emphasis on research techniques. Research is carried out under the supervision of the instructor with weekly conferences to discuss results and direction. Emphasis will be placed on project management, safety, instrumentation, solution preparation, and research documentation skills. A written proposal and report emphasizing the literature background of the problem and the experimental results are required. The results of the research project will also be presented in an oral format in CHEM 499C. This course is a variable credit course. At least two units are required for all chemistry and biochemistry majors. A minimum of 50 of laboratory work is required per unit. May be repeated. Lab fee.

CHEM-499C Chemistry Capstone Seminar 2 Credits
This course includes a senior thesis covering an approved research topic, analysis and evaluation of current research in chemistry, and the integration of faith and the chemical sciences. An oral presentation of the senior thesis in a classroom setting is required. In-class presentations by faculty and guests are part of the course. Laboratory research in an on-campus research program or an approved off-campus research program may be required for the senior thesis. This course fulfills the Core Curriculum Capstone requirement for Chemistry majors.