Chemistry

Course Learning Outcomes are measurable statements that are used to identify the specific knowledge and skills that a student should have at the end of a course.

CHEM 1100
L1- Understanding and Use of the Scientific Method.
L2- Chemical Models Related to Structure in Our World.
L3- Ethical and Social Consequences of Chemistry.
L4- Introduction of Laboratory Methods and Skills.

CHEM 1101
L1- Introduction to the structure, electronic properties, chemical periodicity, and reactivity of the elements.
L2- Introduction to chemical nomenclature.
L3- Molecular structure, bonding, and stoichiometric methods.
L4- States of matter.
L5- Properties and chemistry of solutions.
L6- Introduction to chemical equilibrium, acids and bases, and pH.

CHEM 1102
L1- Introduction to organic nomenclature and functional groups.
L2- Introduction of some foundational concepts of organic chemistry structure and reactivity.
L3- Description and characterization of fundamental properties of biochemical molecules.

CHEM 1103
L1- Competency in basic laboratory skills.
L2- Understanding and use of the scientific method.
L3- Ability to apply and reinforce chemical concepts in a laboratory setting.

CHEM 1111
L1- Structure, Electronic Properties, Chemical Periodicity, and Reactivity of the Elements Nomenclature and Categorization of Chemical Reactions.
L2- Molecular Structure, Bonding, and Stoichiometric Methods.
L3- States of Matter.
L4- Properties and Chemistry of Solutions.
L5- Gases.
L6- Thermochemistry.

CHEM 1111L
L1- Competency in Basic Laboratory Skills.
L2- Understanding and Use of the Scientific Method.

CHEM 1112
L1- Introductory Chemical Kinetics.
L2- Chemical Equilibrium.
L3- Thermodynamics and Thermochemistry.
L4- Electrochemistry.
L5- Nuclear Chemistry.

CHEM 1112L
L1- Continued Practice of Basic Laboratory Skills.
L2- Further Experience at Applying Chemical Concepts in a Laboratory Setting.
L3- Practice Advanced Chemical Preparatory and Measurement skills.

CHEM 2211
L1- To have the basic knowledge of: atomic structure, spectra and orbitals, ionization energy, electron affinity, redox potentials, shielding and effective nuclear charge, Main Group Elements. Synthesis, structure, physical properties, variations in bonding motifs, acid-base character including hard-soft acid/base theory, and reactivities of the elements and their compounds, Covalent Molecular Substances. Diatomic Molecular orbitals, Geometries (symmetry point groups), valence bond theory (hybridization, #, #, obonds), synthetic techniques

CHEM 2213
L1- To give students experience with a range of techniques used in the synthesis and characterization of inorganic compounds and to give them experience in preparing and analyzing various classes of inorganic compounds (coordination, organometallic, and main group compounds, extended solids) and bonding/ structural motifs (fluxional behavior, metal-metal multiple bonds, ligands with multiple bonding modes, 3-center bonds, hapticity).
L2- To give students experience with the following techniques: Synthetic Methods that make use of inert atmospheres (dry box/bag, Schlenk methods), a high temperature furnace/heated tube, a vacuum line, a high-pressure autoclave, and electrochemical apparatus. Purification Methods such as column/ion exchange chromatography, sublimation, recrystallization and resolution of optically active compounds. Characterization Methods that involve measurements of magnetic susceptibility, conductivity, oxidation-reduction potentials, X-ray diffraction, IR, UV-vis, NMR (variable temperature, multinuclear, multidimensional), optical rotation, ESR, Mössbauer, and mass spectrometry.

CHEM 2232
L1- Solve stoichiometric and other analytical calculations.
L2- Demonstrate their ability to carry out quantitative volumetric calculations including acid base, complexometric, and redox titrations.
L3- Explain the instrumental and experimental operational principles of Beer's law as it pertains to ultraviolet and visible spectrophotometry.
L4- Demonstrate their ability to carry out quantitative spectrophotometric calculations.
L5- Demonstrate their ability to carry out quantitative gravimetric calculations.
L6- Demonstrate their ability to carry out quantitative potentiometric calculations.
L7- Explain the necessity for and use of error estimates and statistical methods.
L8- Perform basic statistical analysis of quantitative chemical data including mean, standard deviation, outlier assessment, and least squares.

CHEM 2234
L1- Students should learn the experimental methods and the requisite theoretical concepts associated with: Preparing standards Using a pH Electrode for an acid-base titration Potentiometric titrations EDTA titrations Redox titration Spectrophotometric determinations Gravimetric analysis Operate at a level of good laboratory practice including safety and cleanliness Implement a professional-level lab notebook Construct professional-level lab reports.

CHEM 3301
L1- To introduce the fundamental concepts of the structural characterization of organic molecules.
L2- To introduce the foundational concepts of Organic Chemistry structure and reactivity.

CHEM 3302
L1- To introduce the concepts of organic synthesis.
L2- To introduce the foundational concepts of Biochemistry.

CHEM 3303

L1- To apply instrumental analysis techniques towards the characterization of organic compounds.
L2- To supplement the basic understanding of the concepts of organic structure, reactivity, and structure/property relationships addressed in the lecture.
L3- To demonstrate the ability to follow experimental procedures and run experiments properly.
L4- To have the basic knowledge of commonly used synthetic techniques.
L5- To demonstrate the ability to follow experimental procedures and run experiments properly.
L6- To apply instrumental analysis techniques towards the characterization of organic compounds.

CHEM 3304
L1- To have the basic knowledge of commonly used synthetic techniques.
L2- To supplement the basic understanding of the concepts of organic reaction mechanisms, relative rates, and advanced structure/property relationships addressed in the lecture.
L3- To apply instrumental analysis techniques towards the characterization of Synthetic products.
L4- To demonstrate the ability to design and perform reaction procedures with some direction.
L5- To apply instrumental analysis techniques towards the characterization of organic compounds.

CHEM 3311
L1- Students are to integrate and reinforce chemistry knowledge.
L2- Students are to begin a research project as a means for integrating undergraduate learning experiences, allowing students to participate directly in the process of science, and to perform chemical experiments to help address a research question or achieve a research goal.

CHEM 3312
L1- Students are to integrate and reinforce chemistry knowledge.
L2- Students are to begin a research project as a means for integrating undergraduate learning experiences, allowing students to participate directly in the process of science, and to perform chemical experiments to help address a research question or achieve a research goal.

CHEM 3331
L1- Identify and explain sources of noise in instrumental analysis.
L2- Demonstrate their ability to carry out calculations involving signal to noise enchantments.
L3- Solve fundamental calibration problems based on classic calibration, internal standard, and standard addition method.
L4- Demonstrate their ability to carry out quantitative analysis calculations using Beer's law and Beer's law like relationships.
L5- Identify and calculate figure of merits characterizing an instrumental analysis.
L6- Identify and explain the fundamental components of spectral methods of analysis including: sources, dispersion devices, sample types, placement holder, and/or introduction, and detectors for atomic and molecular methods including flame AA and AE, ICP AES, UV-vis, FT-IR, fluorescence, and Raman.
L7- Demonstrate their ability to carry out calculations involving monochromator specifications, effective bandwidths, resolution, and optimization of spectral analysis performance.
L8- Identify and explain the fundamental components of chromatographic methods of analysis including: sample types and sample introduction, column properties and operation, and detectors for GC, HPLC, and IC.
L9- Calculate and explain the fundamental chromatographic components of migration rates, band broadening and column efficiency, and optimization of column performance

CHEM 3334
L1- Students will perform accurate and precise quantitative measurements; use and understand modern instruments; interpret experimental results and draw reasonable conclusions; analyze data statistically and assess reliability of results; anticipate, recognize, and respond properly to hazards of chemical manipulations.

CHEM 3341
L1- Kinetic Theory of Gas and Ideal and Non-ideal Gas Laws.
L2- Thermodynamics.
L3- Phase and Solution Equilibria.
L4- Chemical Equilibria and Electrochemistry.
L5- Chemical Kinetics.

CHEM 3342
L1- Chemical Kinetics.
L2- Quantum Theory.
L3- Atomic and molecular structure.
L4- Spectroscopy.
L5- Statistical Thermodynamics.

CHEM 3351
L1- Quantum Theory.
L2- Atomic and molecular structure.
L3- Spectroscopy.
L4- Statistical Thermodynamics.

CHEM 3352
L1- Kinetic Theory of Gas and Ideal and Non-ideal Gas Laws.
L2- Thermodynamics.
L3- Phase and Solution Equilibria.
L4- Chemical Equilibria and Electrochemistry.
L5- Chemical Kinetics.

CHEM 3391
L1- To provide instruction and experience in organizing and presenting oral presentations on recent chemical research topics and/or individual research projects.
L2- To introduce the tools related to literature search and preparing effective seminar presentation.

CHEM 4400
L1- To know basic teaching skills specific to teaching chemistry.
L2- Knowledge of the chemical literature.
L3- Basic knowledge necessary to set up a high school chemistry laboratory.

CHEM 4407
L1- To have a basic knowledge of: molecular orbital theory (homo and hetero-nuclear diatomics, multi-centered MO, electron-)
L2- To have a basic knowledge of: Organometallic Chemistry. Metal carbonyls, hydrocarbon and carbocyclic ligands, 18-electron rule (saturation and unsaturation), synthesis and properties, patterns of reactivity (substitution, oxidative-addition and reductive-elimination, insertion and de-insertion, nucleophilic attack on ligands, isomerization, stereochemicalnonrigidity).

CHEM 4437
L1- Perform classroom and field experiments to examine chemical characteristics of natural surface waters.
L2- Perform classroom and field experiments to examine chemical characteristics of gas phase analytes.

CHEM 4438
L1- Practice Basic Biochemistry Laboratory Skills.
L2- Practice Biochemical Preparatory and Measurement Skills in a Safe Manner.

L3- Applying Advanced Biochemical Concepts in a Laboratory Setting.

L4- Biochemistry laboratory techniques.

CHEM 4445
L1- Introduction to Basic Aspects of Biochemical Systems.
L2- Recognition of Fundamental Chemical and Physical Properties of Biomolecules.
L3- Enzymes, their Function and Kinetics .
L4- Biochemical Equilibria and Thermodynamics.
L5- Metabolism

CHEM 4447
L1- Lipid, Amino Acid and Nucleotide Metabolism/Biosynthesis.
L2- Cell Signaling.
L3- Replication, Transcription and Translation.
L4- Nucleic Acid biochemistry.

CHEM 4481
L1- Students are to conduct undergraduate research with a faculty advisor, allowing the student to draw on faculty expertise and encouraging a student-faculty mentor relationship. The research project should be envisioned as a component of a publication in a peer-reviewed journal. It should be well-defined, stand a reasonable chance of completion in the available time, apply and develop an understanding of in-depth concepts, use a variety of instrumentation, promote awareness of advanced safety practices, and be grounded in the primary chemical literature.

CHEM 4482
L1- Students are to conduct undergraduate research with a faculty advisor, allowing the student to draw on faculty expertise and encouraging a student-faculty mentor relationship. The research project should be envisioned as a component of a publication in a peer-reviewed journal. It should be well-defined, stand a reasonable chance of completion in the available time, apply and develop an understanding of in-depth concepts, use a variety of instrumentation, promote awareness of advanced safety practices, and be grounded in the primary chemical literature.

CHEM 4491
L1- To provide instruction and experience in organizing and presenting oral presentations on recent chemical research topics and/or individual research projects.
L2- To introduce the tools related to literature search and preparing effective seminar presentation