CHEM – CHEMISTRY

CHEM 020
Chemistry 20
5 Credits Weekly (6-0-0)
The material covered in Chemistry 20 is equivalent to Alberta Education's Chemistry 20. Topics include: matter as solutions (acids, bases, and gases), quantitative relationships in chemical changes, chemical bonding in matter, and the diversity of matter.
Prerequisites: SCIE 010 or equivalent.
Co-requisites: MATH 010C or equivalent.

CHEM 030
Chemistry 30
5 Credits Weekly (6-0-0)
The material covered in Chemistry 30 is equivalent to Alberta Education's Chemistry 30. Topics include thermochemical changes, electrochemical changes, organic chemistry and chemical equilibrium.
Prerequisites: CHEM 020 or equivalent.
Co-requisites: MATH 020-1 or MATH 020-2 or equivalent.

CHEM 101
Introductory University Chemistry I
3 Credits Weekly (4-3-0)
This course serves as a foundation for all subsequent chemistry courses. Atomic properties as they relate to the periodic table are considered, along with quantum mechanics for hydrogen-like orbitals and electron configurations. The course provides an introduction to bonding theories as they apply to the stability, molecular geometry and intermolecular interactions of atomic, ionic and molecular species. Topics include chemical nomenclature, stoichiometry, classification of chemical reactivity, gases (both ideal and real) and thermochemistry. Note: Credit may be obtained in only one of CHEM 101 or CHME 103.
Prerequisites: Chemistry 30.

CHEM 102
Introductory University Chemistry II
3 Credits Weekly (4-3-0)
This course emphasizes the importance of chemical equilibrium as it applies to gases, acids and bases, solubility and precipitation reactions and complex ion formation. Also studied are kinetics (rates of reactions, differential and integrated rate laws, the Arrhenius equation), catalysts, thermodynamics (spontaneity, entropy, free energy), and electrochemistry (balancing redox reactions, calculating standard and non-standard cell potentials), with emphasis on some practical applications related to batteries, corrosion and industrial processes. A special topic, selected by the instructor, is covered if time permits. Note: Credit may only be obtained in one of CHEM 102 or CHME 105.
Prerequisites: A minimum grade of C- in CHEM 101.

CHEM 211
Applied Analytical Chemistry
3 Credits Weekly (3-4-0)
This course surveys the principles, methods, and experimental applications of classical analytical chemistry, emphasizing solution phase equilibria, titrimetry, volumetric laboratory skills, and the evaluation of experimental data. This course includes real life examples of organic and inorganic analysis and analytical chemistry literature. Students are introduced to principles, methods, and experimental applications of separation techniques, atomic and molecular spectrometry, potentiometry, and the evaluation of experimental data.
Prerequisites: A minimum grade of C- in CHEM 102 or CHME 105.

CHEM 232
Inorganic Chemistry
3 Credits Weekly (3-3-0)
This course examines the bonding models used for inorganic compounds (main group and transition metal elements). Reactivity patterns of inorganic compounds are considered to gain an understanding of the role of thermodynamics and kinetics in their preparation and reactivity. Physical methods that are used to characterize inorganic compounds are discussed. The relevance and importance of inorganic compounds in the environment, industry and biology are emphasized.
Prerequisites: A minimum grade of C- in CHEM 102.

CHEM 242
Fundamentals of Physical Chemistry
3 Credits Weekly (3-3-0)
An introduction to the methods used to devise quantitative models for macroscopic chemical systems, to design experiments to test such models, and to determine their scope of validity in actual conditions. Principles of chemical thermodynamics include the definition and application of the laws, methods, and quantities (i.e., the extent of a physicochemical process, internal energy, enthalpy, entropy and free energy functions) to perform the materials and energy balances of reactions, phase transitions, transport of matter, and coupled processes of these at equilibrium and at steady-state regimes. These principles are applied to find the optimal experimental conditions (e.g., of temperature, pressure and composition), and to predict and control the direction and extent of physicochemical processes. Principles of chemical kinetics include finding differential and integrated rate laws, reaction mechanisms of complex multistep reactions, spatial and temporal organization at the steady state, and microscopic theories of reaction rates.
Prerequisites: Minimum grades of C- in CHEM 102 and MATH 114.

CHEM 261
Organic Chemistry I
3 Credits Weekly (3-3-0)
This course covers the molecular structure and reactivity of organic compounds based on their functional groups. The course provides an introduction to nomenclature, three dimensional structure and physical properties of organic compounds as well as reaction mechanisms and infrared spectroscopy. Although most organic functional groups are discussed, the focus is on the chemistry of alkanes, alkenes, alkynes and alkyl halides. Mechanisms of nucleophilic substitution and elimination reactions of alkyl halides are discussed.
Prerequisites: Minimum grade of C- in either CHEM 102 or CHME 105.

CHEM 263
Organic Chemistry II
3 Credits Weekly (3-3-0)
The nomenclature, structure, physical properties, synthesis and selected reactions of the basic functional groups in organic chemistry are discussed. Functional groups covered include alkenes, alkynes, aromatic compounds, alcohols, phenols, ethers, aldehydes, ketones, amines, carboxylic acids and carboxylic acid derivatives. An emphasis will be placed on understanding the fundamental mechanistic processes behind these chemical transformations. The application of spectroscopic methods for structure determination in simple organic molecules is discussed.
Prerequisites: Minimum grade of C- in CHEM 261.

CHEM 311
Advanced Chemical Analysis
3 Credits Weekly (3-4-0)
This course discusses instrumentation and analytical applications of spectroscopic, chromatographic, and electroanalytical methods. The theory governing each analytical technique and its advantages and disadvantages are discussed. Emphasis is placed on choosing the appropriate method for a particular analysis.
Prerequisites: A minimum grade of C- in one of CHEM 211, CHEM 270, or CHEM 372.

CHEM 320
Introduction to Geochemistry
3 Credits Weekly (3-3-0)
This course provides an introduction to the interdisciplinary science of geochemistry. The first part of the course examines our home planet from a geochemical perspective and includes formation of the Earth and our solar system, the origin of the elements and their distribution within the Earth, and evolution of the crust, mantle and core. An introduction to the essential geochemical tools of thermodynamics and kinetics, isotope geochemistry and trace element geochemistry is also provided. The second part of the course examines the geochemistry of igneous, sedimentary and metamorphic rocks and covers topics as diverse as the melting and crystallization of rocks to the contamination of our water supplies and the stability of carbonates in our oceans. Note: Credit can only be obtained in one of CHEM 320 or EASC 320.
Prerequisites: Minimum grades of C- in a 200-level CHEM *(*p. 1*) course and a 200-level* EASC *(*https://calendar.macewan.ca/course-descriptions/easc*/) course.*

CHEM 322
Introduction to Biogeochemistry
3 Credits Weekly (3-3-0)
Biogeochemistry is the study of the chemical, physical, geological, and biological processes and reactions that govern planet Earth. This course provides an introduction to the discipline, focusing on the exchange of energy and elements between the biosphere and the geosphere. The fundamental components of the Earth's system are examined, including the atmosphere, hydrosphere, biosphere, and geosphere, alongside their evolutionary histories and linkages. Topics include the principle biogeochemical cycles, such as the carbon, sulfur, and nitrogen cycles, and their histories. These cycles are assessed in the context of recent environmental and climate change driven by anthropogenic activities. This course incorporates a multitude of disciplines, spanning geology, chemistry, biology, and environmental science. Note: Credit cannot be obtained in both CHEM 322 and EASC 322.
Prerequisites: Minimum grades of C- in a 200-level CHEM *(*p. 1*) course and a 200-level* EASC *(*https://calendar.macewan.ca/course-descriptions/easc*/) course.*

CHEM 333
Organometallic Chemistry
3 Credits Weekly (3-3-0)
This course surveys the basic principles of the organometallic chemistry as they apply to metals of the d-block elements and main group metals. Topics include a survey of ligands and coordination chemistry/geometry of transition metals and main group metals. The properties and reactions of organometallic complexes, and applications of organotransition metal compounds in catalysis, organic synthesis, bioinorganic chemistry and medicinal chemistry are reviewed.
Prerequisites: Minimum grades of C- in CHEM 232 and CHEM 263.

CHEM 342
Materials Chemistry
3 Credits Weekly (3-3-0)
An introduction to molecular structure, molecular packing, and the emergence of physical properties that may bring about the performance and applications of materials. It covers materials classed as metal alloys, crystals, glasses, ceramics, plastics and composites. Contents include the models of interatomic and intermolecular bonding at play in the structural assembling of materials at the macroscopic, microscopic, nanoscopic and atomistic scales of size. It also includes the study of electrical, surface and catalytic properties explained from the combined relationship of structural assemblage and bonding. Students use up-to-date software, to build, render and visualize the structure and bonding of materials.
Prerequisites: Minimum grades of C- in MATH 114 and one of CHEM 232, CHEM 242, or CHEM 261; or a C- in both CHEM 102 and PHYS 224.

CHEM 353
Forensic Chemistry
3 Credits Weekly (3-3-0)
This course examines the theory and practice of forensic chemistry. The course focuses on chemical analytical techniques used for the detection, identification, and comparison of forensic evidence such as illicit drugs, poisons, gunshot residues, fire accelerants, and explosives. The theory of a variety of analytical techniques along with their scope and limitations is embedded in this discussion. The practical application of these techniques is considered with reference to appropriate examples and forensic case studies. This is further reinforced in the laboratory, where students will gain hands-on experience in the use of a range of analytical techniques for the investigation of simulated crime scenarios. The structure and function of forensic chemistry laboratory services and the key issues of cross-contamination and laboratory quality control and quality assurance will be examined.
Prerequisites: A minimum grade of C- in CHEM 261 and either CHEM 211 or CHEM 252.

CHEM 362
Advanced Organic Chemistry
3 Credits Weekly (3-3-0)
This course is designed to build upon the concepts introduced in Chemistry 261 and Chemistry 263, offering a more advanced and sophisticated insight into the physical properties and chemical reactions of organic compounds. A focal point will be the chemistry of carbonyl compounds. Mechanistic understanding of reaction pathways and multistep synthesis of more complex compounds will be emphasized.
Prerequisites: Minimum grade of C- in CHEM 263.

CHEM 364
Introduction to Medicinal Chemistry
3 Credits Weekly (3-0-0)
This course will explore the history of molecules as medicine, the complexity of targeting disease in the human body, and the roles of academic research, government agencies, and pharmaceutical companies in the development of new drugs. Students will be introduced to the pharmaceutical drug discovery process and the pivotal role played by chemistry. The principles and processes involved in modern drug design and development are presented and, throughout, are emphasized by reference to compounds in current clinical usage. Recent advances in the use of computational and combinatorial chemistry in drug design are discussed. Students can expect to gain a better understanding of how organic chemistry fits into this process, how drug design has evolved over time, and what areas hold the most potential for modern society.
Prerequisites: A minimum grade of C- in CHEM 263 or BICM 200.

CHEM 372
Environmental Chemistry
3 Credits Weekly (3-3-0)
The chemistry of natural environmental process and the impact of anthropogenic activity on those processes will be examined. Topics include atmospheric chemistry, including photochemical reactions, ozone depletion and urban air pollution; aquatic chemistry, including complex equilibria, buffering, and oxidation and reduction; and an introduction to sources and fate of organic and inorganic pollutants. In the laboratory, students will gain hands on experience in common methods of environmental testing and remediation. Note: Credit cannot be received for both CHEM 270 and CHEM 372.
Prerequisites: Minimum grades of C- in CHEM 102 and CHEM 261.

CHEM 380
Process and Flow Chemistry
3 Credits Weekly (3-3-0)
This course provides an introduction and training in the different types of chemical and physical methods, and equipment that may be employed in process and flow chemistry. The use and installation of process analytical technology/chemistry is also explored. On-line and in-line monitoring of chemical processes is strongly emphasized, both in the lecture and the laboratory environment.
Prerequisites: A minimum grade of C– in CHEM 211 or CHEM 263.

CHEM 391
Applied Spectroscopy
3 Credits Weekly (3-2-0)
This course focuses on the practical aspects of preparing samples for analysis, collecting and analyzing data, and characterizing organic, inorganic and/or biological compounds. Methods are explored from a theoretical and practical perspective and include infrared spectroscopy, mass spectrometry, and nuclear magnetic resonance. Note: Credit cannot be obtained for both CHEM 291 and CHEM 391.
Prerequisites: A minimum grade of C- in CHEM 263.

CHEM 398
Independent Study
3 Credits Total (0-0-72)
This course permits an intermediate-level student to work with a faculty member to explore a specific topic in depth through research or through directed reading in primary and secondary sources. The student plans, executes and reports the results of their research or study project under the direction of a faculty supervisor. To be granted enrollment in the course, the student must have made prior arrangements with a faculty member willing to supervise his or her project. This course can be taken twice for credit.
Prerequisites: Any 200-level chemistry course and permission of the department, Faculty mentors may require additional prerequisites according to the project needs.

CHEM 410
Industrial Chemistry
3 Credits Weekly (3-0-0)
An introduction to the principles and practice of industrial chemistry with a special emphasis on modern and emerging chemical technology processes. Selected industrial processes will be discussed, such as the production of primary petrochemicals and their associated secondary products, including polymers, pharmaceuticals, dyes, perfumes, and pesticides. Students will be introduced to the production of such products based on emerging principles of sustainable industrial chemistry. The focus will be on chemical plant design processes, chemo/biocatalysis, biowaste valorization, and pollution control. Principles of green and environmental chemistry and how they impact the United Nations Sustainable Development Goals (UN SDGs) will be emphasized. Students will also learn professional ethics as they relate to chemistry practice. This course includes presentations by guest industrial chemists and tours of chemical plants and industrial laboratories.
Prerequisites: A minimum grade of C- in any 300-level CHEM *(*p. 1*) course.*

CHEM 441
Molecular Modelling
3 Credits Weekly (3-3-0)
This introduction to molecular modelling focuses on the application of computational chemistry methods used to compute structural models, molecular and bulk properties of matter, and the mechanisms by which molecules interact, break bonds and make new bonds. Students use up-to-date software to build, render and visualize molecular structures; to compute molecular properties and spectra of substances; to design reaction mechanisms of uncatalyzed and catalyzed reactions, and to compute their associated energy profiles. Students devise structural and computational models for acid-base, redox, enzyme and surface reactions relevant to life, environment and technology.
Prerequisites: A minimum grade of C- in CHEM 342.

CHEM 442
Soft Matter Chemistry
3 Credits Weekly (3-3-0)
An introduction to the spontaneous formation, preparation, properties, stability, and applications of soft matter. It focuses on the complex and easily deformable structures that emerge in between atomic and macroscopic length scales in solutions of polymers and surfactants, colloids, liquid crystals, granular and soft biological matter. It examines the physical mechanisms of structural assembling and self-organization of molecules to form thin films, micelles, lipid bilayers, vesicles and liposomes under the action of intermolecular and surface forces. Topics include surfaces, charged interfaces, effects of surface tension and curvature on capillarity and wetting, optical, electrokinetic, flow and rheological properties. Emphasis is placed on the applications of soft matter phenomena in petroleum, pharmaceutical, cosmetics and food technologies and products.
Prerequisites: A minimum grade of C- in CHEM 342.

CHEM 464
Advanced Synthetic Medicinal Chemistry
3 Credits Weekly (3-1.5-0)
This advanced medicinal chemistry course examines the application of organic chemistry in the design and synthesis of small-molecule drugs. Students will utilize the principles of the drug discovery process to identify targets for pharmaceutical development and gain an in-depth understanding on how to chemically modify a drug through each stage of the development process. Emphasis will be placed on examining the structure-activity relationship between molecules and their targets, drug delivery, drug modes of action, and the fate of drugs once inside the body.
Prerequisites: A minimum grade of B- in either CHEM 364 or CHEM 362.

CHEM 466
Modern Catalysis
3 Credits Weekly (3-0-0)
This course in modern catalysis provides a comprehensive review of current research and practice in the field. It provides an opportunity for students to read, discuss, and critically evaluate current research in catalysis. The topics covered include, catalytic design, catalysis and energy, chemical transformations, biocatalysts and environmental catalysts.
Prerequisites: A minimum grade of C- in CHEM 333 or CHEM 362.

CHEM 472
Environmental Fate of Organic Contaminants
3 Credits Weekly (3-2-0)
This course presents an advanced study of anthropogenic pollutants in the environment. Fate and transport processes of legacy and emerging anthropogenic pollutants, including important physio-chemical processes, such as partitioning, hydrolysis, photolysis and biotransformation, are discussed on both a local and global scale. In the laboratory, students gain hands-on experience with the techniques used to determine the environmental fates of pollutants via investigations of their physio-chemical properties.
Prerequisites: Minimum grades of C- in CHEM 261 and in either CHEM *(*p. 1*)/EASC 322 or CHEM 372.*

CHEM 474
Environmental Analytical Chemistry
3 Credits Weekly (3-3-0)
Students will learn the theory and develop practical skills in the quantitative and qualitative analysis of chemicals in the environment. Proper procedures for environmental sampling design will be discussed, followed by a detailed treatment of environmental sampling, extraction, and cleanup techniques. The theory and application of modern analytical techniques will be discussed in the context of environmental monitoring. In the laboratory, students will design and carry out field-based measurements and apply lecture material in a practical setting.
Prerequisites: Minimum grades of B- in CHEM 211 and CHEM 372.

CHEM 484
Sustainable and Green Chemistry
3 Credits Weekly (3-0-0)
This course introduces Green Chemistry and examines industrial sources of contaminants and the modification of industrial processes to minimize environmental impact. In addition, the course reviews industrial waste management, control, and treatment. Students will gain an understanding of modern green chemistry which considers both the application and use of the 12 principles of green chemistry and life cycle analysis. In this regard, both the advantages and limitations of the various green chemistry approaches will be examined.
Prerequisites: A minimum grade of C- in CHEM 372.

CHEM 495
Special Topics
3 Credits Weekly (0-0-3)
This course involves reading, discussing and critically evaluating current research on specialized topics in chemistry. Topics covered vary with the interests of students and faculty. Students should consult with faculty members in the Department of Physical Sciences for details regarding current offerings. Note: This course is intended for students in the final year of their degree. This course may be taken up to two times for credit.
Prerequisites: A minimum grade of B- in a 300-level CHEM *(*p. 1*) course and permission of the department.*

CHEM 496
Course-Based Research in Chemistry
3 Credits Weekly (0-6-0)
This is a laboratory-based course focusing on techniques utilized in a research or industrial laboratory setting. Students will gain an understanding of the theory and application of modern experimental methods and build practical skills through project-based applications. The specific topics covered will vary with the interests of the faculty member teaching the course, and students should consult with the Department of Physical Sciences for details regarding current offerings. Note: This course may be taken up to two times, provided the topic of the course is different.
Prerequisites: A minimum grade of C- in a 300-level chemistry course relevant to the specific topic and consent of the department.

CHEM 497
Chemistry Internship Practicum
3 Credits Total (45-0-90)
This course provides students with practical experience in a chemistry related work environment. Students engage in work integrated learning through employment or internship at a chemistry-related industry. Students learn in practice the professional aspects (work and ethics) of a chemist. At the end of the placement, students provide a presentation to demonstrate the learning accomplished. The contact hours are a minimum of 90 hours but can involve more depending on the placement. This course may be taken two times for credit. All placements require departmental approval.
Prerequisites: A minimum grade of C- in 6 credits of any 300-level CHEM *(*p. 1*) courses and consent of the Department.*

CHEM 498
Advanced Independent Study
3 Credits Total (0-0-72)
This course permits a senior-level student to work with a faculty member to explore a specific topic in depth through research or through directed reading in primary and secondary sources. The student plans, executes and reports the results of their research or study project under the direction of a faculty supervisor. To be granted enrollment in the course, the student must have made prior arrangements with a faculty member willing to supervise his or her project. This course can be taken twice for credit.
Prerequisites: A minimum grade of B- in a 300-level CHEM *(*p. 1*) course, a minimum grade of C- in SCIE 201, and permission of the department; faculty mentors may require additional prerequisites according to the project needs.*