CHEMISTRY

Faculty: Schreiner, Chair; Borowski, Green, Mattei, Michelsen, Sampson, and Thoburn.

- Chemistry Major (https://catalog.rmc.edu/programs/chemistry/chemistry-major/)
- Chemistry Minor (https://catalog.rmc.edu/programs/chemistry/chemistry-minor/)

CHEM 111 - Chemistry for the Citizen (4 Hours)
This course, intended for non-science majors, uses familiar topics to introduce chemical concepts. The module, "Can we Find a Cure for AIDS?" discusses the problem of AIDS in our society, including why and how AIDS is spread as well as background on the disease itself, and focuses on organic chemistry principles. The module "The Art of Faking It" discusses the chemistry behind forgery, particularly art forgery. Various spectroscopic techniques will be discussed, and inorganic chemistry is introduced. The final module, "Rock Climbing, Kayaking, and Cycling: The Chemistry of Outdoor Sports," explores the world of polymer chemistry by taking an in-depth look at the materials which are used in outdoor sporting equipment.

CHEM 117 - Drugs and the Body (4 Hours)
From cocaine, marijuana, and meth to aspirin, caffeine, and alcohol, drugs (both legal and illegal) permeate today's society. In this course, intended for non-science majors, students will learn about what drugs are, where they come from and how they are made through an integrated lecture and lab. In addition, students will learn about drug testing and what happens to a drug in the human body. C21:NS,SP.

CHEM 118 - The Chemistry of Food and Diet (4 Hours)
This course intended for non-science majors introduces students to the chemical composition of food. Information about nutrients (proteins, carbohydrates, fat) and food additives will be a central topic. The physiological processes required to use nutrients from food and the biochemical basis of popular diet trends will also be addressed. In addition, students will learn methods to better evaluate nutrition-related issues and popular diets in the media. C21:NS,SP.
Curriculum: NS,SP

CHEM 125 - Chemistry and Crime:From Sherlock Holmes to Today's Courtroom (4 Hours)
In this course, the student will acquire an understanding of the methods and techniques used in crime detection. Topics as diverse as microscopy, toxicology, serology, finger-printing, and document and voice examination, as well as arson and explosives investigation, will be examined. Extensive use of case studies will be made emphasizing the role that the forensic scientist played in the detection and solution of the crime. Three hours of lecture and one three-hour laboratory session per week. C21:NS,SP.
Curriculum: NS,SP

CHEM 130 - Environmental Chemistry (4 Hours)
This course will provide students with an interdisciplinary understanding of the chemical processes that govern environmental phenomena including climate change, stratospheric ozone depletion, and air and water pollution. Students will also investigate public policy surrounding these issues. The course is intended for non-science majors. Three hours of lecture and one three-hour laboratory session per week. Offered alternate years. C21:NS,SP.
Curriculum: NS,SP

CHEM 160 - Chemistry of Winemaking (4 Hours)
Students will become familiar with the various systems of classification of wine and develop an understanding of the grape plant, its variety, and taxonomy. The course will include detailed coverage of the production of wine from vine planting and vineyard care to harvesting, fermentation, bottling, aging, and shipping. In addition, students will learn the chemical mechanisms behind the fermentation of natural substances to produce ethanol, as well as the analytical instrumentation used in the quality control, verification, and identification of wines from around the world. The travel portion of the course will include tours of wineries, visits to departments of enology and viticulture at research universities, visits to wine laboratories, and hands-on experience in winemaking. Offered January term only. C21:EL,NS,SP.
Curriculum: EL,NS,SP

CHEM 210 - Introduction to College Chemistry (4 Hours)
This course is an introduction to college-level chemistry intended for students with limited high school exposure to chemistry who are biology, chemistry, or other sciences. Topics will include a review of the mathematics of chemistry, the history of chemistry, an introduction to the periodic table and the properties of elements, gas laws, manipulation of chemical equations, stoichiometric calculations, acid/base chemistry, and other topics. In the lab, students will be introduced to basic safety procedures in the chemistry laboratory and master the laboratory skills needed for more advanced chemistry courses. This course is not recommended for non-science majors. All students intending to enroll in chemistry must be pre-placed into the appropriate course. Contact the department chair to arrange for placement. A special fee ($50) is charged for this course. C21:NS,SP.
Prerequisite(s): Placement into course

Curriculum: NS,SP

CHEM 215 - Principles of Chemistry (4 Hours)
Principles of Chemistry is for students who plan to take additional courses in chemistry. The course is an introduction to the chemist's description and use of light and matter in the context of larger issues such as astronomy, the greenhouse effect, and fats in our diet. Specific topics include the interaction of light and matter (spectroscopy), the structure of the atom and the atomic structure of matter, chemical bonds and intermolecular forces, and chemical descriptions of color and solubility, solution phenomena, thermodynamics, chemical equilibria, and kinetics. All students intending to enroll in chemistry must be pre-placed into the appropriate course. Contact the department chair to arrange for placement. A special fee ($50) is charged for this course. C21:NS,SP.
Prerequisite(s): CHEM 210 or placement into the course

Curriculum: NS,SP

CHEM 220 - Basic Inorganic Chemistry (4 Hours)
This course presents the topics of nuclear chemistry, atomic structure, multi-electron atoms and bonding, periodicity, the chemistry of ionic compounds, generalized acid-base theories, kinetics, thermodynamics, and transition metal chemistry. All of these topics are presented in the context of both historical and contemporary applications. The laboratory includes experiments used in inorganic synthesis directly related to topics covered in lectures, including an introduction to molecular modeling, spectroscopic methods of characterization, and classical methods of analysis. A special fee ($50) is charged for this course. C21:NS,SP.
Prerequisite(s): CHEM 215 or placement into the course

Curriculum: NS,SP

CHEM 230 - Quantitative Chemical Analysis (4 Hours)
This course presents the theory and techniques necessary for quantitative analysis of chemical systems at equilibrium. Topics covered will include volumetric and gravimetric analysis, acid-base chemistry, and electrochemistry. Laboratory investigations will involve wet chemical methods and introductory instrumental techniques to analyze quantitatively the components of complex mixtures. Statistical methods will be used to interpret the analytical results.A special fee ($70) is charged for this course. C21:NS,SP.
Prerequisite(s): CHEM 215 or placement into the course

Curriculum: NS,SP

CHEM 251 - Directed Study in Chemistry (1 Hour)
These courses are designed for students wishing to work on a research project prior to their senior year. Interested students may select a project in consultation with a faculty member and work under his/her supervision. Permission of a chemistry faculty member is required. The student is required to spend at least three hours per week in the laboratory. C21:EL.
Prerequisite(s): permission of instructor

Curriculum: EL

CHEM 252 - Directed Study in Chemistry (1 Hour)
These courses are designed for students wishing to work on a research project prior to their senior year. Interested students may select a project in consultation with a faculty member and work under his/her supervision. Permission of a chemistry faculty member is required. The student is required to spend at least three hours per week in the laboratory. C21:EL.
Prerequisite(s): permission of instructor

Curriculum: EL

CHEM 261 - Organic Chemistry (4 Hours)
Fundamental facts, theories and nomenclature of organic compounds, and their reactions are discussed. Students study such topics as structural theory, stereochemistry, and reaction mechanisms, as applied to basic physical, chemical and spectroscopic properties of aliphatic, alicyclic and aromatic hydrocarbons, mono-, di-, and polyfunctional compounds, including some natural products and biomolecules. Students will use molecular modeling software to gain a better understanding of the intricacies of molecular structures and reactivity. Most of the information covered in this course is prerequisite to biochemistry, medicinal chemistry, other advanced chemistry and some biology courses. CHEM 261 is a prerequisite for CHEM 262. Three hours of lecture and three hours of lab.
Prerequisite(s): CHEM 220 or CHEM 230

CHEM 262 - Organic Chemistry II (4 Hours)
Fundamental facts, theories and nomenclature of organic compounds, and their reactions are discussed. Students study such topics as structural theory, stereochemistry, and reaction mechanisms, as applied to basic physical, chemical and spectroscopic properties of aliphatic, alicyclic and aromatic hydrocarbons, mono-, di-, and polyfunctional compounds, including some natural products and biomolecules. Students will use molecular modeling software to gain a better understanding of the intricacies of molecular structures and reactivity. Most of the information covered in this course is prerequisite to biochemistry, medicinal chemistry, other advanced chemistry and some biology courses. A special fee ($70) is charged for this course. Three hours of lecture and three hours of lab.
Prerequisite(s): CHEM 220, CHEM 230, and CHEM 261

CHEM 305 - Chemistry in Earth Systems (3 Hours)
This course investigates environmental chemistry topics from an Earth systems science perspective, with an emphasis on the atmosphere and the hydrosphere. The first half of the course focuses on Earth system science: introducing box modelling, reservoirs, and element cycling (C, N, and S in particular). The second half of the course will survey topics that build on the first half, such as climate change, stratospheric ozone depletion, and types of pollution. While there is no laboratory component, the course will be activity-based, including environmental data analysis and modeling. This course serves as an upper-level elective for chemistry majors and an area of expertise course for EVST majors with either a chemistry or geology focus. Chemistry majors and EVST majors with a chemistry area of expertise should register for CHEM 305. EVST majors with a geology area of expertise should register for GEOL 305.
Prerequisite(s): CHEM 220 or CHEM 230 and CHEM 261

Cross-list: GEOL 305

CHEM 311 - Introduction to Physical Chemistry (4 Hours)
Application of the laws of physics to chemical phenomena will be examined. An attempt is made to provide a theoretical foundation for the study of the other disciplines of chemistry. Topics considered include chemical thermodynamics, including its application to thermochemistry, phase equilibria, and colligative properties; the kinetic theory of gases; chemical kinetics, including the treatment of rate data and the theory of rate processes; and an introduction to spectroscopy. Three hours of lecture and one three-hour laboratory session per week.
Prerequisite(s): CHEM 220, MATH 132 and PHYS 151

CHEM 312 - Advanced Physical Chemistry (3 Hours)
Application of the laws of physics to chemical phenomena will be examined. An attempt is made to provide a theoretical foundation for the study of the other disciplines of chemistry. Topics covered include statistical thermodynamics as applied to chemical systems; molecular symmetry and quantum theory as applied to the spectroscopy and structure of atoms and molecules; and advanced topics of interest.
Prerequisite(s): CHEM 311 and PHYS 152

CHEM 322 - Instrumental Methods of Analysis (4 Hours)
In this course the student will acquire an understanding of the fundamental principles upon which modern measuring devices are based and the type of information an instrument can contribute to a chemical analysis. Among the methods studied will be UV/VIS, fluorescence, IR, NMR, AA, chromatography, and mass spectrometry.
Prerequisite(s): CHEM 220 or CHEM 230 and MATH 132

CHEM 335 - Forensic Chemistry (3 Hours)
This course consists of an overview of forensic chemistry and its application to criminal and civil cases. Topics covered will include the history of forensic science, statistical data analysis, instrumentation, drugs and pharmacology, chemical analysis of physical evidence, the chemistry of polymers, and analysis of plastic products.
Prerequisite(s): CHEM 220, CHEM 230, and CHEM 262

CHEM 345 - Junior Seminar (1 Hour)
This course will present chemistry and the work of chemists in a variety of ways. Students will learn about original research by reading the scientific literature and by attending presentations by seminar speakers. The course will focus on experimental design and analysis of results, both published and unpublished. Students are required to synthesize knowledge from the different areas of chemistry. Students will be evaluated based on written assignments and class discussion. Active participation and asking of questions at the seminar are integral to the course.
Prerequisite(s): CHEM 262 and junior standing

CHEM 351 - Directed Study in Chemistry (1 Hour)
These courses are designed for students wishing to work on a research project prior to their senior year. Interested students may select a project in consultation with a faculty member and work under his/her supervision. Permission of a chemistry faculty member is required. The student is required to spend at least three hours per week in the laboratory. C21:EL.
Prerequisite(s): permission of instructor

Curriculum: EL

CHEM 352 - Directed Study in Chemistry (1 Hour)
These courses are designed for students wishing to work on a research project prior to their senior year. Interested students may select a project in consultation with a faculty member and work under his/her supervision. Permission of a chemistry faculty member is required. The student is required to spend at least three hours per week in the laboratory. C21:EL.
Prerequisite(s): permission of instructor

Curriculum: EL

CHEM 381 - Special Topics in Chemistry (3 Hours)
These courses focus on areas of chemistry not specifically covered in the general curriculum and are designed to meet the needs of advanced students. Prerequisites vary according to offering.

CHEM 382 - Special Topics in Chemistry (3 Hours)
These courses focus on areas of chemistry not specifically covered in the general curriculum and are designed to meet the needs of advanced students. Prerequisites vary according to offering.

CHEM 390 - Introduction to Nanochemistry (3 Hours)
This course will introduce students to the rapidly growing research area of nanomaterials and their connections to chemistry. Students will study nanoscience from a largely synthetic viewpoint delving into content involving materials synthesis, crystal structures, and characterization of nanomaterials. Their knowledge base will then be expanded to contemporary research by reviewing the literature along with presenting and discussing scientific ideas. Contemporary topics of study can include, but are not limited to inorganic nanoparticles, organic-inorganic nanocomposites, carbon nanotubes, graphene, and quantum dots. The goal of this course is to familiarize students with nanomaterials, to further develop their skills of critical reading and thinking, and to encourage creative ideas that fuel innovative research. C21:OC.
Prerequisite(s): CHEM 220 and CHEM 261

Curriculum: OC

CHEM 400 - Chemical Internship (3 Hours)
This course is designed to introduce chemistry majors who express an interest in pursuing a career in chemistry to industrial and institutional research and development. Each student will spend 130 hours in an industrial or institutional scientific laboratory. Actual work performed will be determined by on-site supervisors. A special fee ($200) is charged for this course. Offered as needed. Enrollment is limited. Application required; see Internship Program. C21:EL.
Prerequisite(s): departmental approval

Curriculum: EL

CHEM 401 - Advanced Experimental Chemistry (3 Hours)
A student who wishes to work on a research project for eight hours per day, five days per week, for four weeks during the January term will have the opportunity to do so in this course. Daily logs, weekly reports, and a final report must be written to the satisfaction of a faculty supervisor. Offered as needed. C21:EL.
Prerequisite(s): departmental approval

Curriculum: EL

CHEM 402 - Medicinal Chemistry (3 Hours)
This course is offered for those students who want to pursue a career in some area of the health-related sciences. It should be of interest to both chemistry and biology majors. Studies are made of the chemical structures of drugs and their direct influence on pharmacological activity. Many classifications of drugs are covered, and emphasis is placed on structures, mechanisms of action, and structure-activity relationships. Students are expected to obtain an understanding of the structural features of drugs which cause them to produce various types of biological responses. This basic understanding will support further studies in such fields as medicine, dentistry, biochemistry, or pharmaceutical chemistry. Introductory biology is helpful, but not required. Offered alternate years.
Prerequisite(s): CHEM 262

CHEM 404 - Advanced Organic Chemistry (3 Hours)
This course is intended to give students of chemistry, biochemistry, and biology a broader foundation in organic chemistry. It will cover a variety of topics not covered in the traditional one-year Organic Chemistry course. For students pursuing an advanced degree in Chemistry, this course can serve as a bridge between the work you have done in Organic Chemistry I / II and graduate level course work. Topics will include: Chemistry of Alkynes, Organic Molecular Orbital Theory, Chemistry of Dienes, Chemistry of Amines, Transition Metal Catalysis of Organic Reactions Carbohydrate Chemistry, Chemistry of Aromatic Heterocycles, and Pericyclic Reactions.
Prerequisite(s): CHEM 262

CHEM 405 - Advanced Inorganic Chemistry (3 Hours)
This course offers chemistry majors an in-depth study of the fundamental principles of inorganic chemistry. Topics such as bonding, molecular geometry, and the chemical reactions of ionic, covalent, and metallic substances will be discussed. Concepts of acid-base chemistry (Bronsted-Lowry, Lewis, Drago, and Lux-Flood systems) will be examined. The student will study the synthesis, structure, properties, and periodic trends of the main-group elements as well as the coordination chemistry and descriptive chemistry, bonding, spectroscopy, thermodynamics, kinetics, and structure of the compounds of the transition elements. Applications to organometallic chemistry and bioinorganic chemistry will be introduced. Offered alternate years.
Prerequisite(s): CHEM 220 and CHEM 311 or permission of the instructor

CHEM 406 - Introduction to Organometallic Chemistry (3 Hours)
A study of the basic principles of the organometallic chemistry of d-block elements. Topics include a survey of the properties and reactions of organometallic complexes and applications of organotransition metal compounds in catalysis, organic synthesis, bioinorganic chemistry, and medicinal chemistry. Lectures will be supplemented by discussions of current literature in the field. C21:OC
Prerequisite(s): CHEM 220 and CHEM 261

CHEM 407 - Biochemistry I (4 Hours)
An in-depth study of the chemistry of living systems. A major theme of the course will be the relationship between molecular structure, function, and regulation. Topics to be covered will include: structures of amino acids, proteins, lipids, carbohydrates, and nucleic acids; protein folding; enzymes, enzyme kinetics, and regulation; protein-ligand interactions. The laboratory portion of the course will focus on techniques in protein chemistry such as expression, purification, identification, manipulation, and enzyme kinetics. Introductory biology is recommended, but not required. C21:CC.
Prerequisite(s): CHEM 230 and CHEM 262

CHEM 408 - Biochemistry II (3 Hours)
A continuation of the in-depth study of the chemistry of living systems. A major theme of the course will be the relationship between molecular structure, function, and regulation. Topics to be covered will include: degradative and synthetic metabolic pathways of various classes of molecules; synthesis of nucleic acids and proteins; expression of genetic information.
Prerequisite(s): CHEM 407

CHEM 445 - Senior Seminar (1 Hour)
This course is intended as a continuation of CHEM 345 and will present chemistry and the work of chemists in a variety of ways. Students will learn about original research by reading the scientific literature and by attending presentations by seminar speakers. The course will focus on experimental design and analysis of results, both published and unpublished. Students are required to synthesize knowledge from the different areas of chemistry. Students will be evaluated based on written assignments and class discussion. Active participation and asking of questions at the seminar are integral to the course.
Prerequisite(s): CHEM 345 and senior standing

CHEM 455 - Directed Field Study (3 Hours)
A Field Study is an experiential learning course combining elements of workplace experience, observation, and research. Students are expected to work closely with a faculty field study supervisor to develop learning objectives and a plan of study appropriate to the discipline. Assignments may include a reflective journal, activity reports, and one or more directed research papers appropriate to the discipline. Workplace experience requirements should be similar to those of internships. Students should not receive compensation from workplace experience if they are receiving three-hour course credit.

CHEM 457 - Internship in Chemistry (Paid) (3 Hours)
With prior approval, students may earn Experiential Cross Area Requirement (CAR) credit and transcript notation for one credit hour for a paid internship. To qualify for experiential credit a student must have completed 48 semester hours of work prior to the beginning of the internship and be in good academic standing (not on academic probation) at the time of application and at the start of the internship. Registration and application procedures are similar to those for academic internship courses. Satisfactory completion of a paid internship requires a minimum of 130 hours (160 recommended) working at the host site, a reflective daily journal, a final written report, and a satisfactory evaluation from the site supervisor. C21:EL
Curriculum: EL

CHEM 490 - Learning from Chem Literature (1 Hour)
Students will draw upon the knowledge and skills acquired in previous courses to examine relevant literature in the five major sub-areas of chemistry by synthesizing chemical principles from these sub-areas. C21:CS.
Prerequisite(s): CHEM 220, CHEM 230, CHEM 261, CHEM 311, CHEM 407 and senior status

Curriculum: CS

CHEM 491 - Independent Study (3 Hours)

CHEM 496 - Senior Project (3 Hours)
The purpose of this sequence is to allow qualified students to carry out original experimental work. Considerable self-discipline, diligence, and ingenuity on the part of the student are necessary. Students may spend the entire period working on a research project of their own choice, upon approval and under the guidance of the departmental faculty, or on projects designed by and of interest to individual faculty members. In either case, students may be required to use techniques and apparatus which may not have been available to them in other courses. They will be expected to plan and carry out their work on their own initiative to the satisfaction of the faculty member directly involved and of the department. A written thesis and an oral presentation are required. The equivalent of nine hours of laboratory work per week, in addition to time required for library research and thesis preparation, is expected of each student who enrolls in this sequence. The ultimate goal of this training is to impart to each student self-reliance and confidence concerning laboratory research. All qualified students who intend to pursue graduate work in chemistry are urged to enroll in this sequence. Student earns a total of six hours for the full senior project experience (496, 497, and 498). C21:CS,EL.
Prerequisite(s): CHEM 262 or permission

Curriculum: CS,EL

CHEM 497 - Senior Project (3 Hours)
The purpose of this sequence is to allow qualified students to carry out original experimental work. Considerable self-discipline, diligence, and ingenuity on the part of the student are necessary. Students may spend the entire period working on a research project of their own choice, upon approval and under the guidance of the departmental faculty, or on projects designed by and of interest to individual faculty members. In either case, students may be required to use techniques and apparatus which may not have been available to them in other courses. They will be expected to plan and carry out their work on their own initiative to the satisfaction of the faculty member directly involved and of the department. A written thesis and an oral presentation are required. The equivalent of nine hours of laboratory work per week, in addition to time required for library research and thesis preparation, is expected of each student who enrolls in this sequence. The ultimate goal of this training is to impart to each student self-reliance and confidence concerning laboratory research. All qualified students who intend to pursue graduate work in chemistry are urged to enroll in this sequence. Student earns a total of six hours for the full senior project experience (496, 497, and 498). C21:CS,EL.
Prerequisite(s): CHEM 262

Curriculum: CS,EL

CHEM 498 - Senior Project (3 Hours)
The purpose of this sequence is to allow qualified students to carry out original experimental work. Considerable self-discipline, diligence, and ingenuity on the part of the student are necessary. Students may spend the entire period working on a research project of their own choice, upon approval and under the guidance of the departmental faculty, or on projects designed by and of interest to individual faculty members. In either case, students may be required to use techniques and apparatus which may not have been available to them in other courses. They will be expected to plan and carry out their work on their own initiative to the satisfaction of the faculty member directly involved and of the department. A written thesis and an oral presentation are required. The equivalent of nine hours of laboratory work per week, in addition to time required for library research and thesis preparation, is expected of each student who enrolls in this sequence. The ultimate goal of this training is to impart to each student self-reliance and confidence concerning laboratory research. All qualified students who intend to pursue graduate work in chemistry are urged to enroll in this sequence. Student earns a total of six hours for the full senior project experience (496, 497, and 498). Prerequisite: CHEM496. C21:CS,EL.
Prerequisite(s): instructor approval

Curriculum: CS,EL