

# CHEMISTRY (CHEM)

## **CHEM 101 – Chemistry & Current Events 3 credit hours**

This course offers an exploration of chemistry from the non-majors point of view with an emphasis on concepts and critical thinking. This course may not be used toward requirements for a degree in chemistry.

## **CHEM 126 – First Year Seminar 1 credit hour**

The First-Year Seminar provides students with a multidisciplinary experience in which they approach an issue or problem from the perspective of three different academic differences. The First-Year Seminar will consist of three 1-credit hour courses taken as co-requisites in a single semester. The successful completion of all three courses satisfies the General Studies LOPER 1 course requirement. Students may take the First-Year Seminar in any discipline, irrespective of their major or minor. Students admitted as readmit students or transfer students who transfer 18 or more hours of General Studies credit to UNK are exempt from taking a LOPER 1 course.

## **CHEM 145 – Introductory Chemistry 4 credit hours**

Introductory course in the fundamental laws and principles of chemistry including a study of the properties of elements and their compounds. It is recommended that MATH 102 be completed or taken concurrently with CHEM 145. Three lectures, one laboratory each week. Credit for this course may be obtained by examination.

Prerequisite: MATH 101 or completion of or concurrent enrollment in MATH 102 or Math ACT subscore of 20 or above or SAT Math subscore of 560 or above

Additional Course Fee Required

## **CHEM 148 – Introductory Chemistry for the Health Sciences 4 credit hours**

This is a one semester course that summarizes the principles and theories of modern chemistry. This course is designed for students who need an introductory chemistry class for the health sciences.

Prerequisite: MATH 101 or completion of or concurrent enrollment in MATH 102 or Math ACT subscore of 20 or above or SAT Math subscore of 560 or above.

Additional Course Fee Required

## **CHEM 150 – Introduction to Organic and Biochemistry 4 credit hours**

An introduction to fundamental concepts of chemistry with special attention to organic and biological chemistry. Applications of chemistry concepts in materials, energy use, nutrition, health, drugs, and toxic substances are emphasized. Not applicable to a major or minor in chemistry. Three lectures, one lab per week.

Additional Course Fee Required

## **CHEM 160 – General Chemistry 3 credit hours**

The first semester of a comprehensive year course in chemistry that includes the principles and theories of modern chemistry. This course is designed for students who need a sound introduction to the discipline of chemistry, and it is the prerequisite for advanced chemistry courses. A student should have high school chemistry and/or two years of high school algebra before enrolling in this course. If this is not the case, take CHEM 145 and MATH 102 to prepare for chemistry at this level. Three lectures each week. Credit for this course may be obtained by examination.

Prerequisite: MATH 102 or MATH 103 or MATH 115 or Math ACT score of 22 or above or permission of instructor.

Corequisite: CHEM 160L.

## **CHEM 160L – General Chemistry Laboratory 1 credit hour**

The first semester of a full year general chemistry lab covering both manual and instrumental techniques, obtaining and analyzing information, measurement of physical and chemical properties, understanding and predicting reactions, quantitative and qualitative measurements, and understanding and drawing diagrams of molecules in two and three dimensions. Take concurrently with CHEM 160.

Corequisite: CHEM 160.

Additional Course Fee Required

## **CHEM 161 – General Chemistry 3 credit hours**

The second semester of a comprehensive year course in chemistry. The course will focus on intermolecular forces and phase behavior, properties of solutions, chemical kinetics and thermodynamics, and equilibrium.

The study of equilibria includes acid-base chemistry, ionic solubility and complexation, and electrochemistry. Three lectures each week.

Prerequisite: Grade of C or above in CHEM 160 and CHEM 160L or advanced placement.

Corequisite: CHEM 161L.

## **CHEM 161L – General Chemistry Laboratory 1 credit hour**

The second semester of a full year general chemistry lab covering manual, instrumental, and statistical techniques. Students will conduct experiments and quantitatively analyze the data, which reinforce concepts from the corequisite lecture (CHEM 161) including: Intermolecular forces, solubility, colligative properties, chemical kinetics, equilibrium, and acid-base properties.

Corequisite: CHEM 161.

Additional Course Fee Required

## **CHEM 169 – Chemistry Foundations and Careers 1 credit hour**

The first of three skill-building classes for chemistry majors. Includes an introduction to writing in chemistry, research opportunities in the department, careers in chemistry, and an introduction to scientific literature resources and ethical conduct in chemistry.

Prerequisite: 4 hours of Chemistry

## **CHEM 250 – Fundamentals of Organic Chemistry 4 credit hours**

A survey of the field of organic chemistry designed primarily for students who do not expect to become chemists or chemical engineers. Covers the same topics as CHEM 360 and CHEM 361, but less rigorously. Four lectures, one lab per week. Counts toward chemistry minor.

Prerequisite: Grade of C or above in CHEM 161 and CHEM 161L

Corequisite: CHEM 250L.

## **CHEM 250L – Fundamentals of Organic Chemistry Lab 1 credit hour**

This lab course is designed to reinforce organic chemistry concepts learned in the classroom through experiential learning. Initially students are introduced general chemistry principles required for organic chemistry, followed by series of labs that focus on separation techniques. Second half of the semester will introduce students to classical organic chemical reactions and train them in commonly employed methods and techniques in organic synthesis and reaction purification. They also receive a hands-on training in organic spectroscopy.

Corequisite: CHEM 250.

Additional Course Fee Required

## **CHEM 300 – Environmental Chemistry 3 credit hours**

A study of the fate of chemicals in the air, water, and soil, and their impact on human health and the natural environment. Topics will include water pollution and water treatment, greenhouse gases and ozone-layer destruction, sources and management of hazardous wastes, and environmental toxicology of specific industrial and agricultural chemicals.

Prerequisite: CHEM 250 and CHEM 250L or CHEM 360 and CHEM 360L

**CHEM 301 – Analytical Chemistry 3 credit hours**

This will provide a short, engaging elementary introduction to modern analytical chemistry for students whose primary interests lie inside or outside of chemistry. Three lectures per week.

Prerequisite: Grade of C or above in CHEM 161 and CHEM 161L

**CHEM 301L – Analytical Chemistry Lab 1 credit hour**

To be taken concurrently with Chem 301. Offers students an opportunity to obtain hands-on experience in analytical methods with a focus on data analysis. Techniques introduced include traditional wet chemistry methods such as acid-base, redox, and complexometric titrations as well as instrumental methods such as UV-vis spectroscopy, fluorescence spectroscopy, ion selective electrodes, modern chromatography, and inductively coupled plasma-optical emission spectrometry.

Corequisite: CHEM 301.

Additional Course Fee Required

**CHEM 310 – Safety in Chemistry 1 credit hour**

This course addresses chemical safety issues and best safety practices that apply in undergraduate chemistry laboratories and serve as fundamental knowledge in preparing students for proper safety cultures in academic, industrial, and high school teaching professions. This includes basic laboratory safety, hazard identification, risk assessment using the RAMP method, PPE, safety equipment, and chemical storage requirements.

Prerequisite: Grade of C or above in CHEM 161 and CHEM 161L

Corequisite: CHEM 250 or CHEM 360.

**CHEM 351 – Biochemistry I 4 credit hours**

A study of the structure and function of the fundamental biomolecules including proteins, nucleic acids, carbohydrates, lipids and vitamins. The course concludes with the chemistry and regulation of the metabolic pathways glycolysis, the citric acid cycle and oxidative phosphorylation. Four lectures per week.

Prerequisite: BIOL 106 and a Grade of C in CHEM 250 and CHEM 250L OR CHEM 360 and CHEM 360L.

**CHEM 351L – Biochemistry Lab 1 credit hour**

This lab course is designed to enhance a student's general understanding of the subject of biochemistry and develop hands-on skills that biochemists use every day to study biomolecules. It includes purification and analysis techniques for proteins and DNA. It also develops scientific writing skills in the area of experimental biochemistry.

Corequisite: CHEM 351.

Additional Course Fee Required

**CHEM 352 – Biochemistry II 2 credit hours**

This course is a continuation of CHEM 351 and begins with discussion of additional topics in metabolism such as carbohydrate biosynthesis in plants and bacteria as well as hormonal regulation of metabolism. Our discussion then turns to the biochemistry of biological information pathways. Two lectures per week.

Prerequisite: Grade of C or above in CHEM 351.

Corequisite: CHEM 352L.

**CHEM 352L – Advanced Biochemistry Lab 2 credit hours**

This lab course is designed to provide a student with a more advanced biochemistry lab experience that both introduces basic biochemistry lab techniques and delves into more advanced lab techniques. It includes purification and analysis techniques for proteins and DNA. It also develops scientific writing skills in the area of experimental biochemistry. Credit cannot be earned in both CHEM 351L and 352L.

Corequisite: CHEM 352.

Additional Course Fee Required

**CHEM 360 – Organic Chemistry 4 credit hours**

Taken primarily by chemistry majors and pre-professional students.

The foundation for understanding organic reactions is established with considerable emphasis being placed upon bonding, stereochemistry, kinetics, and reaction mechanisms. The chemistry of the alkanes, alkenes, and aromatic compounds is considered with a primary objective of understanding how these reactions occur. Four lectures per week.

Prerequisite: Grade of C or above in CHEM 161 and CHEM 161L or equivalent.

Corequisite: CHEM 360L.

**CHEM 360L – Organic Chemistry Laboratory 1 credit hour**

CHEM 360L enhances the lecture portion of Organic Chemistry (CHEM 360). Activities in the lab focus on technique-building experiments and conducting reactions covered in the class. By the end of the semester students should have an appreciation of what an organic reaction is, how they appear, how to think critically about data, and a good understanding of basic laboratory methods in organic chemistry.

Take concurrently with CHEM 360.

Corequisite: CHEM 360.

Additional Course Fee Required

**CHEM 361 – Organic Chemistry 4 credit hours**

This course is a continuation of CHEM360. Students will expand their knowledge of the functional groups introduced in first semester and learn the associated chemical reactions. Students will become proficient in proposing multi-step reaction mechanisms and organic syntheses. Four lectures per week. Offered Spring only.

Prerequisite: Grade of C or above in CHEM 360 and CHEM 360L.

Corequisite: CHEM 361L.

**CHEM 361L – Organic Chemistry Laboratory 1 credit hour**

CHEM 361L is the second semester laboratory associated with Organic Chemistry II lecture (CHEM 361). This course is designed to allow students to apply the reactions, principles and rules learned from CHEM 361 lecture to prepare organic molecules as needed. Additionally, this course provides an opportunity for students to learn spectroscopic methods (IR, NMR and MS) used in identifying structures of organic molecules including the sample preparation. Take concurrently with CHEM 361.

Corequisite: CHEM 361.

Additional Course Fee Required

**CHEM 399 – Chemistry Apprenticeship 1-4 credit hours**

The chemistry apprenticeship program is meant to provide meaningful experiences such as teaching and preparation of demonstrations. The apprentice will work mainly with one member of the department whose permission must be obtained before registration.

Total Credits Allowed: 4.00

**CHEM 430 – Inorganic Chemistry 3 credit hours**

A study of the underlying principles behind the structural and spectroscopic properties of inorganic compounds. Lecture topics include symmetry, molecular orbital theory, solid-state structures, transition metal chemistry, and organometallics. The laboratory will focus on preparation and characterization methods for inorganic compounds. Three lectures per week.

Prerequisite: Grade of C or above in CHEM 250 or Grade of C or above in CHEM 360

**CHEM 430A – Inorganic Reactions & Mechanisms 1 credit hour**

A study of the underlying principles behind inorganic chemistry reactions and their mechanisms. Topics include oxidation-reduction chemistry, transition metal coordination chemistry, organometallics, bioinorganic chemistry and selected main-group reaction systems. Credit may not be obtained in both CHEM 430 and CHEM 430A.

Prerequisite: Grade of C or above in CHEM 250 or Grade of C or above in CHEM 360

**CHEM 430B – Inorganic Structures & Properties 2 credit hours**

A study of the underlying principles behind the structural and spectroscopic properties of inorganic compounds. Lecture topics include symmetry, molecular orbital theory, solid-state structures, and transition metal complex structures, spectroscopy, and magnetic properties. Credit may not be obtain in both CHEM 430 and CHEM 430B.

Prerequisite: Grade of C or above in CHEM 250 or Grade of C or above in CHEM 360

**CHEM 435 – Special Topics in Chemistry 1-3 credit hours**

Topics are studied which are not covered in other courses offered by the department. The format will vary depending upon the nature of the topic and the instructor but will typically be a seminar/discussion format with lab work included as appropriate.

Department Consent Required

Total Credits Allowed: 3.00

**CHEM 440 – Materials Chemistry 3 credit hours**

A study of solid-state compounds and the relationships between overall physical properties and atomic-or molecular-level structure.

Topics may include crystalline and amorphous solid structures, metals, semiconductors, polymers, nanomaterials, and characterization techniques.

Prerequisite: CHEM 430 and CHEM 480 or permission of instructor.

**CHEM 451 – Advanced Biochemistry 3 credit hours**

This course covers the basic principles of intermediary metabolism and the application of biochemical principles of living systems. Three lectures per week.

Prerequisite: CHEM 352 and CHEM 352L.

**CHEM 461 – Qualitative Organic Analysis 3 credit hours**

A study of classical and spectroscopic techniques used in the identifications of organic compounds including the application of NMR, FTIR, UV/Vis, and mass spectroscopy. Three lectures per week.

Prerequisite: Grade of C or above in CHEM 361 and CHEM 361L.

**CHEM 469 – Advanced Seminar in Chemistry 1 credit hour**

The third of three skill-building classes in chemistry including a critical examination and discussion of recent accomplishments of chemical investigations, career preparation with respect to resumes, interviewing techniques, and professional exam preparation. One hour per week. Fall only.

Prerequisite: CHEM 310 and Grade of C or above in CHEM 250 or CHEM 360.

**CHEM 470 – Advanced Organic Chemistry 3 credit hours**

This course will cover advanced theoretical aspects of organic chemistry. Areas of emphasis will be bonding, spectroscopy, synthesis, and mechanism. Three lectures per week.

Prerequisite: Grade of C or better in CHEM 361 and CHEM 361L.

**CHEM 475 – Instrumental Analysis 3 credit hours**

The study of modern methods of analysis using chemical instrumentation. Three lectures per week.

Prerequisite: Grade of C or above in CHEM 301 and CHEM 301L.

**CHEM 475A – Instrumental Analysis: Chromatography, NMR, & Mass Spectrometry 1 credit hour**

An in-depth study of modern instrumental methods with an emphasis on the underlying principles behind chemical separations, nuclear magnetic resonance spectroscopy and mass spectrometry. Credit may not be obtained in both CHEM 475 and CHEM 475A.

Prerequisite: Grade of C or above in CHEM 301 or department permission

**CHEM 475B – Instrumental Analysis: Spectroscopic Techniques 1 credit hour**

An in-depth study of modern instrumental methods with an emphasis on atomic and molecular spectroscopy and their various applications. Credit may not be obtained in both CHEM 475 and CHEM 475B.

Prerequisite: Grade of C or above in CHEM 301 or department permission

**CHEM 475C – Instrumental Analysis: Electroanalytical Techniques 1 credit hour**

An in-depth study of modern instrumental methods with an emphasis on electroanalytical techniques including electrophoresis, bioanalytical sensors, and microfluidics with applications related to point-of-care diagnostic tests, sequencing, and other genome analysis systems. Credit may not be obtained in both CHEM 475 and CHEM 475C.

Prerequisite: Grade of C or above in CHEM 301 or department permission

**CHEM 480 – Physical Chemistry 3 credit hours**

The first semester of a two semester sequence covering the physical basis of chemistry including topics of quantum mechanics, spectroscopy, elementary thermodynamics, phase transitions, solutions, and kinetics. Three lectures per week.

Prerequisite: PHYS 205 or PHYS 275 and grade of C or above in CHEM 301 and MATH 115.

**CHEM 480A – Chemical Thermodynamics 2 credit hours**

An in-depth study of chemical thermodynamics which is one component of a comprehensive study of physical chemistry. Credit may not be earned in both Chem 480A and Chem 480.

Prerequisite: PHYS 205 or PHYS 275 and grade of C or above in CHEM 301 and MATH 115 or department consent.

**CHEM 480B – Chemical Kinetics 1 credit hour**

An in-depth study of chemical kinetics which is one component of a comprehensive study of physical chemistry. Credit may not be earned in both Chem 480B and Chem 480.

Prerequisite: PHYS 205 or PHYS 275 and grade of C or above in MATH 115 or department consent

**CHEM 481 – Physical Chemistry II 3 credit hours**

The second semester of a two semester sequence covering the physical basis of chemistry including topics of quantum mechanics, spectroscopy, elementary thermodynamics, phase transitions, solutions, and kinetics. Three lectures per week.

Prerequisite: Grade of C or above in CHEM 480.

**CHEM 481A – Quantum Mechanics 2 credit hours**

An in-depth study of quantum mechanics in chemistry which is one component of a comprehensive study of physical chemistry. Credit may not be earned in both Chem 481A and Chem 481.

Prerequisite: PHYS 205 or PHYS 275 and grade of C or above in MATH 115 or department consent

**CHEM 481B – Spectroscopy 1 credit hour**

An in-depth study of spectroscopy in chemistry focusing on rotational and vibrational theory and methods – which is one component of a comprehensive study of physical chemistry. Credit may not be earned in both Chem 481B and Chem 481.

Prerequisite: PHYS 205 or PHYS 275 and grade of C or above in CHEM 301 and MATH 115 or department consent

**CHEM 482 – Survey of Physical Chemistry 3 credit hours**

A single semester survey of physical chemistry. Topics include thermodynamics, kinetics, atomic and molecular structure, and spectroscopy. Three lectures per week. Offered Fall of even years only.

Prerequisite: PHYS 205 or PHYS 275 and grade of C or above in CHEM 301 and MATH 115.

**CHEM 489 – Internship in Chemistry 1-3 credit hours**

This course will be taken in the last two years of the chemistry major and will emphasize professional development of the individual student.

Department Consent Required

Total Credits Allowed: 3.00

**CHEM 490L – Advanced Chemistry Laboratory 3 credit hours**

An interdisciplinary chemistry lab covering techniques from inorganic, physical, instrumental, advanced organic, and materials chemistry focusing on larger projects including synthesis of many types of materials, measurement of physical properties, and understanding and application of modern instrumentation and spectroscopic methods. Two four-hour laboratory sessions and one one-hour discussion meeting per week.

Department Consent Required

Additional Course Fee Required

**CHEM 491L – Advanced Chemistry Laboratory II 2 credit hours**

The second semester of a full year interdisciplinary chemistry lab covering techniques from inorganic, physical, instrumental, advanced organic, and materials chemistry focusing on larger projects including synthesis of many types of materials, measurement of physical properties, and understanding and application of modern instrumentation and spectroscopic methods.

Prerequisite: CHEM 490L

Additional Course Fee Required

**CHEM 499L – Research in Chemistry 1-3 credit hours**

Independent investigations of chemistry problems. Three hours of laboratory work each week for each hour credit.

Department Consent Required

Total Credits Allowed: 6.00