**Chemistry (Chem)**


**Courses**

**CHEM 101. Orientation to Chemistry. 1 Credit.**
This seminar course will introduce 1st year students pursuing either a BS in Chemistry or BS with major in Chemistry degree, and provide acquaintance with relevant UND learning resources. Students will have the opportunity to meet faculty and senior undergraduate and graduate students providing exposure to research in chemistry, exploring what it means to perform scientific research. Prerequisite or Corequisite: CHEM 121 or CHEM 221. F.

**CHEM 115. Introductory Chemistry. 3 Credits.**
A course designed specifically for non-science majors who wish to obtain a basic understanding of chemistry as applied in the world today. Does not serve as a prerequisite for any other chemistry course. Includes laboratory. F,S.

**CHEM 115L. Introductory Chemistry Laboratory. 1 Credit.**
Laboratory to accompany CHEM 115. Corequisite: CHEM 115. F,S.

**CHEM 116. Introduction to Organic and Biochemistry. 3 Credits.**
Does not satisfy the prerequisite for any advanced chemistry course. A second semester of general chemistry with emphasis on organic and biochemistry. Includes alkanes, alkenes, alkynes, aromatics, alcohol, phenols, ethers, aldehydes, ketones, carboxylic acids, esters, amines, amides, carbohydrates, lipids, amino acids, proteins, and nucleic acids. Required of students in the B.S. in Chemistry program. Prerequisites: CHEM 115 and CHEM 115L, or CHEM 121 and CHEM 121L; a minimum of a C in either course is required. F,S.

**CHEM 116L. Introduction to Organic and Biochemistry Laboratory. 1 Credit.**
Laboratory to accompany CHEM 116. Prerequisites: CHEM 115 and CHEM 115L, or CHEM 121 and CHEM 121L. Corequisite: CHEM 116. F,S.

**CHEM 121. General Chemistry I. 3 Credits.**
Open to all students; no high school credit in chemistry required. Elementary principles and theories of chemistry; matter, measurement, atoms, ions, molecules, reactions, chemical calculations, thermochemistry, bonding, molecular geometry, periodicity, gases. Prerequisite or Corequisite: MATH 103 or higher. F,S,SS.

**CHEM 121L. General Chemistry I Laboratory. 1 Credit.**
Laboratory to accompany CHEM 121. Prerequisite or Corequisite: CHEM 121. F,SS.

**CHEM 122. General Chemistry II. 3 Credits.**
Elementary principles and theories of chemistry; Intermolecular forces, liquids, solids, kinetics, equilibria, acids and bases. Solution of chemistry, precipitation, thermodynamics, electrochemistry. Prerequisite: CHEM 121 with a grade of C or better and CHEM 121L. F,S,SS.

**CHEM 122L. General Chemistry II Laboratory. 1 Credit.**
Laboratory to accompany CHEM 122. Prerequisite: CHEM 121 and CHEM 121L. Corequisite: CHEM 122. F,S,SS.

**CHEM 221. Fundamentals of Chemistry - Concepts. 3 Credits.**
Atomic and molecular structure, stoichiometry, states of matter, thermodynamics, periodicity and descriptive inorganic chemistry. Prerequisite: High school chemistry. Corequisite: CHEM 221L. Prerequisite or Corequisite: MATH 165. F.

**CHEM 221L. Fundamentals of Chemistry Laboratory. 1 Credit.**
Laboratory to accompany CHEM 221. Prerequisites: High school chemistry and MATH 103 or appropriate Math Placement score. Corequisite: CHEM 221. F.

**CHEM 254. Inorganic Chemistry I. 3 Credits.**
Required for chemistry majors. Chemistry of the elements with emphasis on occurrence, preparation, physical properties, chemical reactivity, uses, nomenclature, structure, and periodic behavior. Includes chemical kinetics and thermodynamics. Prerequisite: CHEM 122 or CHEM 221. Corequisite: CHEM 254L. S.

**CHEM 254L. Inorganic Chemistry I Laboratory. 1 Credit.**
Qualitative and quantitative inorganic chemistry, including precipitation, acid-base reactions, and redox reactions in aqueous solutions. The preparation and isolation of main-group element and transition metal compounds. The characterization of these compounds with standard chemical and instrumental methods. Determinations of the rates of chemical reactions and of bond parameters. Prerequisite: CHEM 122 or CHEM 221. Corequisite: CHEM 254. S.

**CHEM 333. Analytical Chemistry. 3 Credits.**
For all science majors interested in using analytical chemistry techniques in a modern science laboratory. Principles of quantitative and qualitative chemical analysis as applied to environmental, clinical and forensic science are covered. Prerequisite: CHEM 122 or CHEM 221. Corequisite: CHEM 333L. F.

**CHEM 333L. Analytical Chemistry Laboratory. 1 Credit.**
Laboratory to accompany CHEM 333. Principles of quantitative and qualitative chemical analysis as applied to environmental, clinical and forensic science are covered. Prerequisite: CHEM 122 or CHEM 254. Corequisite: CHEM 333. F.

**CHEM 340. Survey of Organic Chemistry. 4 Credits.**
For all students interested in a one-semester survey of organic chemistry. Structure and bonding, nomenclature; hydrocarbons: alkanes, alkenes, alkyne, aromatics; substituted hydrocarbons: alky halides, stereochemistry, alcohols, phenols, ethers, amines; carboxylic acids, aldehydes, ketones; carboxylic acids, esters, amides. Prerequisites: CHEM 122 with a grade of C or better and CHEM 122L; or CHEM 254 and CHEM 254L. Prerequisite or Corequisite: CHEM 340L or CHEM 341L. S.

**CHEM 340L. Survey of Organic Chemistry Laboratory. 1 Credit.**
Laboratory to accompany CHEM 340. Prerequisite: CHEM 122L or CHEM 254L. Corequisite: CHEM 340. S.

**CHEM 341. Organic Chemistry I. 3 Credits.**
Designed for science and pre-professional students. Structure and bonding, acid-base reactions, nomenclature, stereochemistry, functional groups, alkanes, alkenes, alkynes, alkyl halides and alcohols. Application of spectrometric methods (NMR, IR and MS) for identification of organic compounds. Prerequisites: CHEM 122 with a grade of C or better and CHEM 122L; or CHEM 254 and CHEM 254L. Corequisite: CHEM 341L. F,S.

**CHEM 341L. Organic Chemistry I Laboratory. 1 Credit.**
Laboratory to accompany CHEM 341. Required for chemistry majors. Prerequisite: CHEM 122L or CHEM 254L. Prerequisite or Corequisite: CHEM 341. F,S.

**CHEM 342. Organic Chemistry II. 3 Credits.**
Designed for science and pre-professional students. Structure and reactivity, organometallic compounds, aldehydes, ketones, carboxylic acids and their derivatives, aromatic compounds, amines, multi-step synthesis. Prerequisite: CHEM 341 or CHEM 341C with a grade of C or better and CHEM 341L. Prerequisite or Corequisite: CHEM 342L. F,S.

**CHEM 342L. Organic Chemistry II Laboratory. 1 Credit.**
Required for all chemistry majors. Laboratory to accompany CHEM 342. Prerequisite: CHEM 341. Prerequisite or Corequisite: CHEM 342. F,S.

**CHEM 361. Problem Solving in Organic Chemistry I. 1 Credit.**
Reaction mechanisms and multi-step syntheses based on the reactions of alkenes, alkynes, alky halides and alcohols. Prerequisites: CHEM 122, with a grade of C or better and CHEM 122L; or CHEM 254 and CHEM 254L. Prerequisites or Corequisites: CHEM 341 and CHEM 341L. F.

**CHEM 362. Problem Solving in Organic Chemistry II. 1 Credit.**
Reaction mechanisms and multi-step syntheses involving organometallic compounds, aldehydes, ketones, carboxylic acids and their derivatives, aromatic compounds and amines. Prerequisites: CHEM 341 with a grade of C or better, CHEM 341L, and CHEM 361. Corequisites: CHEM 342 and CHEM 342L. S.
CHEM 392. Special Problems in Chemistry. 1-3 Credits.
An opportunity for students to be involved in research, teaching, and outreach activities under close faculty guidance. Prerequisite: Consent of Instructor. Repeatable to 6 credits. S/U grading. F,S.

CHEM 397. Cooperative Education. 1-2 Credits.
May be repeated for a maximum of 6 credits. Prerequisites: One year of freshman chemistry with laboratory and either one of the following course sequences: (CHEM 341, CHEM 342) or (CHEM 341, BMB 301). Repeatable to 6 credits. S/U grading. F,S,SS.

CHEM 431. Selected Topics in Chemistry. 1-5 Credits.
Repeatable with different topics. Repeatable. On demand.

CHEM 441. Instrumental Analysis I - Spectroscopy. 2 Credits.
Topics ranging from the fundamentals of spectroscopic analysis to contemporary techniques (including atomic absorption spectroscopy, atomic emission spectroscopy, atomic fluorescence spectroscopy, UV-vis molecular spectroscopy, fluorescence molecular spectroscopy, and infrared spectroscopy) are explored in the classroom and in laboratory exercises. Prerequisites: CHEM 333 and CHEM 333L. S, even years.

CHEM 442. Instrumental Analysis II - Electrochemistry. 2 Credits.
Topics ranging from the fundamentals of electrochemistry (including thermodynamics, kinetics, and mass transfer) to contemporary techniques of electroanalysis (such as potentiometry, coulometry, amperometry, and voltammetry) are explored in classroom and laboratory exercises. Prerequisites: CHEM 333 and CHEM 333L. odd years.

CHEM 443. Instrumental Analysis III - Chromatography/Mass Spectrometry. 2 Credits.
Topics involving the fundamentals of gas and liquid chromatography (GC and LC) and mass spectrometry (MS) as well as their practical considerations in the method development (including sample preparation and MS interpretation) are covered. The modern chromatographic techniques (GC, GC/MS, and high resolution MS) are explored in classroom and laboratory exercises. Prerequisites: CHEM 333 and CHEM 333L. F, odd years.

CHEM 454. Inorganic Chemistry II. 3 Credits.
Chemistry of inorganic compounds in terms of modern theories and concepts. Prerequisites: CHEM 254 and CHEM 342. Corequisite: CHEM 454L. F.

CHEM 454L. Inorganic Chemistry II Laboratory. 1 Credit.
A course in laboratory techniques as applied to inorganic systems, including modern methods for synthesizing inorganic compounds and their analyses by spectroscopic and diffraction techniques. Prerequisites: CHEM 254 and CHEM 254L. Corequisite: CHEM 454. F.

CHEM 455. Spectroscopy and Structure. 3 Credits.
Applications of spectroscopic techniques to the determination of molecular structure. Prerequisite: CHEM 342 or CHEM 466. F.

CHEM 462. Physical Chemistry Laboratory. 3 Credits.
Required for B.S. in Chemistry and B.S. with Major in Chemistry Physical Science Emphasis majors. The solution of chemical problems in the laboratory using modern physical and analytical methods. Prerequisites: CHEM 466. Prerequisite or Corequisite: CHEM 471. S.

CHEM 463. Advanced Synthesis Laboratory. 3 Credits.
Advanced synthetic, separatory and characterization methods currently used in modern laboratory practice will be emphasized. Prerequisites: CHEM 462 or CHEM 467, and CHEM 455. S.

CHEM 466. Fundamentals of Physical and Biophysical Chemistry. 3 Credits.
Required for students pursuing either a B.S. in Chemistry or a B.S. with a Major in Chemistry degree. Survey of topics in physical and biophysical chemistry with an emphasis for the life sciences. Topics include chemical thermodynamics, kinetics, introductory quantum mechanics, and spectroscopy. Prerequisites: CHEM 340 or CHEM 342, MATH 146 or MATH 165, and PHYS 212 or PHYS 252. F.

CHEM 466R. Fundamentals of Physical & Biophysical Chemistry Recitation. 1 Credit.
CHEM 466R provides a biophysical perspective on material covered in CHEM 466. In addition, CHEM 466R introduces and uses Mathematica to solve some numerically challenging problems assigned in CHEM 466. Corequisite: CHEM 466. F.

CHEM 467. Survey of Physical Chemistry Laboratory. 2 Credits.
Required for B.S. with a Major in Chemistry. Biochemistry Emphasis, majors. The solution of chemical problems in the laboratory using physical and biophysical methods. Prerequisite: CHEM 466. S.

CHEM 471. Quantum Mechanics & Spectroscopy. 3 Credits.
Theory and nature of bonding and structure, spectroscopy, and optics. Prerequisites: CHEM 466, MATH 265, and PHYS 252. S.

CHEM 471R. Quantum Mechanics & Spectroscopy Recitation. 1 Credit.
CHEM 471R is the Recitation/Discussion section of CHEM 471 to help students in developing essential skills in connecting Calculus, Physics and Chemistry. Prerequisites: CHEM 466, MATH 265, and PHYS 252. Corequisite: CHEM 471. S.

CHEM 475. Materials Chemistry. 3 Credits.
Thermodynamics and kinetics, material chemistry, preparation methods and case studies in materials science. Prerequisites: CHEM 466 or PHYS 252, MATH 165. F.

CHEM 488. Undergraduate Seminar. 1 Credit.
Required for B.S. in Chemistry. Introduction to current research in chemistry and to professional chemistry seminar preparation. Corequisite: CHEM 492 or CHEM 463. S.

CHEM 489. Senior Honors Thesis. 1-8 Credits.
Supervised independent study culminating in a thesis. Repeatable to 9 credits. Repeatable to 9 credits.

CHEM 492. Senior Research. 1-3 Credits.
An opportunity for advanced students to work on research problems under close faculty guidance. Prerequisite: CHEM 342. Prerequisite or Corequisite: CHEM 462 or CHEM 467. Repeatable to 6 credits. F,S,SS.

CHEM 495. Chemistry Capstone. 3 Credits.
Designed for all senior students majoring in Chemistry. Discussion of current research topics in chemistry. Practice critical thinking skills and the knowledge gained in various chemistry courses to interpret and evaluate chemistry research data. Process information from different sources to provide an original interpretation of a given chemical phenomenon. Prepare a professional research paper and poster or oral presentation. Prerequisite or Corequisite: CHEM 462 or CHEM 467. S.

CHEM 497. Cooperative Education. 1-2 Credits.
Repeatable with different topics. Repeatable. On demand.

CHEM 498. Undergraduate Seminar. 1 Credit.
Repeatable to 9 credits. Repeatable to 9 credits.

CHEM 499. Senior Honors Thesis. 1-8 Credits.
Supervised independent study culminating in a thesis. Repeatable to 9 credits. Repeatable to 9 credits.

CHEM 501. Advanced Synthesis Laboratory. 3 Credits.
Advanced synthetic, separatory and characterization methods currently used in modern laboratory practice will be emphasized. Prerequisites: CHEM 462 or CHEM 467, and CHEM 455. S.

CHEM 506. Special Problems in Chemistry. 1-3 Credits.
An opportunity for students to be involved in research, teaching, and outreach activities under close faculty guidance. Prerequisite: Consent of Instructor. Repeatable to 6 credits. S/U grading. F,S.

CHEM 571. Cooperative Education. 1-2 Credits.
May be repeated for a maximum of 6 credits. Prerequisites: One year of freshman chemistry with laboratory and either one of the following course sequences: (CHEM 341, CHEM 342) or (CHEM 341, BMB 301). Repeatable to 6 credits. S/U grading. F,S,SS.