

# Sul Ross State University Syllabus

## Inorganic Chemistry I (CHEM 2402-001) CRN: 11591

(Fall 2023)

Class: Inorganic Chemistry I  
Room: WSB 307  
Time: T/TR 2:00 pm-3:15 pm  
Date: Aug.28 to Dec.13

Instructor: Dr. Hong Young Chang  
Office: WSB 219  
Office Phone: (432) 837-8113  
Email: hxc19tv@sulross.edu

### OBJECTIVES

#### *Student Learning Outcomes (SLO):*

A student graduating with a *chemistry major* is expected to demonstrate that (s)he is able to do the following:

1. Organic Chemistry—Students will be able to draw organic molecular structures and explain organic reactions, stereochemistry, structural analysis and reactions in biological systems.
2. Inorganic Chemistry—The student will be able to demonstrate understanding of coordination chemistry, valence theory, elementary actions and advanced molecular theory.
3. Analytical Chemistry—The student will be able to demonstrate an understanding of theory of analytical chemistry and conduct analytical analysis, including data analysis and calibration, equilibrium chemistry, gravimetric analysis, titrimetric analysis, spectroscopic analysis, and electrochemical analysis.
4. Physical Chemistry—The student will be able to demonstrate an understanding of the application and theory of physical chemistry, including topics such as atomic structure, electrochemistry, surface chemistry, solid-state chemistry, and thermodynamics.
5. Research—The student will collect and analyze published chemical literature and undertake a chemistry research project.

#### *BSc in Chemistry Marketable Skills*

At the end of this course, a student should have a good understanding of:

1. Students will become good at punctuality and time management.
2. Students will analyze &/or synthesize molecules and perform spectroscopic characterization and interpret their results scientifically.

3. Students will become proficient at writing scientific papers and identifying appropriate references for their papers.
4. Students will become proficient at orally presenting scientific topics including the use of visual aids.

***Inorganic Chemistry I Learning Objectives:***

At the end of this course, a student should have a good understanding and will be able to:

1. Explain the atomic structure based on quantum mechanics; ground state of electron configuration, Aufbau principle, ionization, affinity, and periodic properties of the atoms.
2. Understand and explain chemical bonding with Lewis structures, VBT (Valence Bond Theory), molecular shape, the octet rule, isoelectronic structures, electronegativity, and VSEPR Model
3. Understand symmetry operations, symmetry elements, point groups, character tables, vibrational modes in molecules, and chiral molecules for polyatomic molecules.
4. Explain the bonding in polyatomic molecules based on hybridization of atomic orbitals or MOT (Molecular Orbital Theory) using character tables.
5. Explain the crystal structures of metal and ionic compounds by packing of spheres and understand the structures for the alloys and intermetallic compounds
6. Explain what kind of parameters affect the crystal structure of a compound and perform calculations of the lattice enthalpy of ionic compounds.
7. Explain the different definitions of acids/bases and predict the reactions between acids and bases.
8. Explain the definition of coordination compounds, name them, and decide on stability constants to affect the formation of complex and thermodynamic consideration of complex formation.

## **Text Book:**

***“Inorganic Chemistry: 4<sup>th</sup> Edition”*** by Catherine E. Housecroft and Alan G. Sharpe, Pearson Education Limited, Essex, England, **2012**. (Older editions such as the 2<sup>nd</sup> or 3<sup>rd</sup> editions are ok to use).

### ***The following chapters will be covered:***

**Chapter 1:** Basic concepts for atomic structures

**Chapter 2:** Basic concepts about nuclear properties: nuclear binding energy, radioactivity, etc.

**Chapter 3:** Introduction to molecular symmetry: Symmetry operators, symmetry elements, character tables, introductions of vibrational modes based on symmetry elements

**Chapter 5:** Bonding in polyatomic molecules: Hybridization of atomic orbitals, Molecular Orbital Theory (MOT), delocalized bonding, application of MOT by Group Theory

**Chapter 6:** Structures and energetics of metallic and ionic solids: Packing of spheres, Metallic radii, Size of ions, Ionic lattices, lattice energies, Defect in solid state lattices

**Chapter 7:** Acids, bases, and ions in aqueous solution: Coordination of compounds as acids, bases, and ions in aqueous solution

**Chapter 19:** *d*-Block Metal Chemistry: General Considerations and Coordination Complexes

***Calculator:*** A scientific calculator is required for this course.

***Cell phones*** **ARE NOT** permitted for use in exams and should be turned off during class time.

**Homework & Assignments:** There will be Questions assigned for each chapter as homework. ***The homework will be uploaded to the SRSU Blackboard. After downloading and printing the homework sheet, you need to solve Questions as homework.*** After solving the Questions, please, send the scanned file to me at my email, [hxc19tv@sulross.edu](mailto:hxc19tv@sulross.edu)

**NO LATE HOMEWORK WILL BE ACCEPTED.**

**Examinations:** There will be *two midterm* examinations and *a final* examination. The final is mandatory and comprehensive.

**The final exam will be taken face-to-face.**

**NO MAKE-UP EXAMS WILL BE GIVEN.**

**NOTE: Homework and two midterm exams MUST be completed in pen!**

**Attendance Request: Being absent from more than 9 lectures will result in failing the course.**

**Percentage Breakdown of Marks:**

Homework & Assignments: 20%

Each Midterm Exam (30%): 60%

Final Exam: 20%

**Midterm Exam I:** Tuesday, October 3<sup>rd</sup>, face-to-face

**Midterm Exam II:** Thursday, November 16<sup>th</sup>, face-to-face

**Final Exam:** Monday, December 11<sup>th</sup>, 12:30 pm to 2:30 pm, in WSB 307

**SRSU Disability Services: ADA (Americans with Disabilities Act):**

Sul Ross State University (SRSU) is committed to equal access in compliance with the Americans with Disabilities Act of 1973. It is SRSU policy to provide reasonable accommodations to students with documented disabilities. It is the student's responsibility to initiate a request each semester for each class. Students seeking accessibility/accommodations services must contact Mrs. Mary Schwartze Grisham, LPC, SRSU's Accessibility Services Director at 432-837-8203 or email [mschwartz@sulross.edu](mailto:mschwartz@sulross.edu). Our office is located on the first floor of Ferguson Hall, room 112, and our mailing address is P.O. Box C122, Sul Ross State University, Alpine, Texas, 79832.

**Scholastic Dishonesty:** *Students who violate the University rules on scholastic dishonesty are subject to penalties, including the possibility of an F in the course and/or dismissal from the University. All assignments (including homework) need to be individually completed and not copied from another student's work.*

# Course Calendar

\*This course calendar could be changed. Before one week, your professor will let you know the changes.

Date	Lecture #	Chapter #	Topics	Due work
Aug. 29	Lecture 1	Ch 1	Discussion on the syllabus, the importance of inorganic chemistry Fundamental particles, wave mechanics	
Aug. 31	Lecture 2		An overview 1 of atomic structures: atomic number, mass number, isotopes, wave mechanics, atomic orbitals, many-electron atoms, the periodic table,	
Sep. 5	Lecture 3		An overview 2 of atomic/molecular structures: Aufbau principle, ionization energies, the introduction of bonding models with Lewis structures, Covalent bonds, the Octet rule	
Sep. 7	Lecture 4		Electronegativity values, Dipole moments, Orbital interactions, Overview of VSEPR model and Valence Bond Theory (VBT) Determination of molecular shape/3D structures from the VSEPR model, Geometric Isomerism	
Sep. 12	Lecture 5	Ch 2	Nuclear binding energies, Radioactivity, Artificial isotopes Nuclear fission, Revision Ch 2	Ch 1 HW due
Sep. 14	Lecture 6	Ch 3	Symmetry operations and symmetry elements	
Sep. 19	Lecture 7		Point Groups: Determining the point group of a molecules or molecular ion	Ch 2 HW due
Sep. 21	Lecture 8		Character tables: an introduction and application on molecular orbitals	
Sep. 26	Lecture 9		Application of molecular symmetry Revision on Ch 3	
Sep. 28	Lecture 10	Review & Test	Exam 1 Revision	Ch 3 HW due
Oct. 3	Lecture 11		<b>Exam 1 (it covers Ch 1, 2, &amp; 3)</b>	

Oct. 5	Lecture 12	Ch 5	Valence bond theory (VBT): Hybridization of atomic orbitals Hybridization of $sp$ , $sp^2$ , $sp^3$ Multiple bonding in polyatomic molecules	
Oct. 10	Lecture 13		VBT: multiple bonding in polyatomic molecules ( $C_2H_4$ , HCN, $BF_3$ ) Molecular Orbital Theory (MOT): The ligand group orbital approach	
Oct. 12	Lecture 14		MOT (Molecular Orbital Theory) application on the polyatomic molecules $BH_3$ , $NH_3$ , and $CH_4$ Comparison of the MOT and VBT	
Oct. 17	Lecture 15		MOT (Molecular Orbital Theory) application on $\pi$ -bonding in $CO_2$ , $[NO_3]^-$ , $SF_6$	
Oct. 19	Lecture 16		MOT (Molecular Orbital Theory) application on "Three-Centre two-electron interactions" Revision on Ch 5	
Oct. 24	Lecture 17		Packing of spheres, Cubic and hexagonal close-packing, Unit cell, Interstitial holes	<b>Ch 5 HW due</b>
Oct. 26	Lecture 18	Ch 6	Alloy and intermetallic compounds, electrical conductivity and resistivity, intrinsic and extrinsic semiconductors	
Oct. 31	Lecture 19		Introduction of basic crystallography	
Nov. 2	Lecture 20		size of ions, ionic lattices (rock salt, CsCl, antiferite, Zinc blende, wurtzite, rutile, $CdI_2$ , and Perovskite type)	
Nov. 7	Lecture 21		Lattice energy from the electrostatic model and Born-Haber Cycles	
Nov. 9	Lecture 22		Defects in solid-state lattices (Schottky, Frenkel defects) non-stoichiometric compounds, Revision on Chapter 6	
Nov. 14	Lecture 23	Review & Test	Exam 2 Revision	<b>Ch 6 HW due</b>
Nov. 16	Lecture 24		<b>Exam 2 (it covers Ch 5 &amp; 6)</b>	
Nov. 21	Lecture 25	Ch 7	Definition of Bronsted acids and bases, Lewis's acid-base, Solubilities of ionic salts, Common effect Coordination complexes, Hard and soft metal centers and ligands, Revision on Ch 7	

Nov. 28	Lecture 26	Ch 19	Bonding in d-block metal complexes by MOT Electronic spectra, Spectrochemical series, Ground state electronic configurations (d-block metals)	<b>Ch 7 HW due</b>
Nov. 30	Lecture 27		Characteristic properties; a general perspective color, paramagnetism, complex formation, variable e oxidation states, coordination numbers, Revision on Ch 19	
Dec. 5	Lecture 28	Review & Test	Final Exam Revision	
Dec. 11	Lecture 30		<b>Final Exam, Monday, 12:30 PM to 2:30 PM, WSB307</b>	

### Libraries:

The Bryan Wildenthal Memorial Library in Alpine offers FREE resources and services to the entire SRSU community. Access and borrow books, articles, and more by visiting the library's website, [library.sulross.edu/](http://library.sulross.edu/). Off-campus access requires logging in with your Lobold and password. Librarians are a tremendous resource for your coursework and can be reached in person, by email ([srsulibrary@sulross.edu](mailto:srsulibrary@sulross.edu)), or by phone (432-837-8123).

No matter where you are based, public libraries and many academic and special libraries welcome the general public into their spaces for study. SRSU TexShare Cardholders can access additional services and resources at various libraries across Texas. Learn more about the TexShare program by visiting [library.sulross.edu/find-and-borrow/texshare/](http://library.sulross.edu/find-and-borrow/texshare/) or ask a librarian by emailing [srsulibrary@sulross.edu](mailto:srsulibrary@sulross.edu).

New for Fall 2023: Mike Fernandez, SRSU Librarian, is based in Eagle Pass (Building D-129) to offer specialized library services to students, faculty, and staff. Utilize free services such as Interlibrary Loan (ILL) and Scant to get materials delivered to you at home or via email.

### Academic Integrity:

Students in this class are expected to demonstrate scholarly behavior and academic honesty in the use of intellectual property. Students should submit work that is their own and avoid the temptation to engage in behaviors that violate academic integrity, such as turning in work as original that was used in whole or part for another course and/or professor; turning in another

person's work as one's own; copying from professional works or internet sites without citation; collaborating on a course assignment, examination, or quiz when collaboration is forbidden. Students should also avoid using open AI sources *unless permission is expressly given* for an assignment or course. Violations of academic integrity can result in failing assignments, failing a class, and/or more serious university consequences. These behaviors also erode the value of college degrees and higher education overall.

### **Counseling:**

Sul Ross has partnered with TimelyCare where all SR students will have access to nine free counseling sessions. You can learn more about this 24/7/356 support by visiting [Timelycare/SRSU](#). The SR Counseling and Accessibility Services office will continue to offer in-person counseling in Ferguson Hall room 112 (Alpine campus), and telehealth Zoom sessions for remote students and RGC students.

### **Classroom Climate of Respect:**

Importantly, this class will foster free expression, critical investigation, and the open discussion of ideas. This means that all of us must help create and sustain an atmosphere of tolerance, civility, and respect for the viewpoints of others. Similarly, we must all learn how to probe, oppose, and disagree without resorting to tactics of intimidation, harassment, or personal attack. No one is entitled to harass, belittle, or discriminate against another on the basis of race, religion, ethnicity, age, gender, national origin, or sexual preference. Still, we will not be silenced by the difficulty of fruitfully discussing politically sensitive issues.

### **Distance Education:**

Students should correspond using Sul Ross email accounts and submit online assignments through Blackboard, which requires a secure login. Students enrolled in distance education courses at Sul Ross are expected to adhere to all policies pertaining to academic honesty and appropriate student conduct, as described in the student handbook. Students in web-based courses

must maintain appropriate equipment and software, according to the needs and requirements of the course, as outlined on the SRSU website. Directions for filing a student complaint are located in the student handbook.