Sul Ross State University Syllabus

Inorganic Chemistry I (CHEM 2402-001)

(Fall 2022) _11391

Class: Inorganic Chemistry I
Room: WSB 307
Time: T/TR 2:00 pm-3:15 pm
Date: Aug.22 to Dec.7

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

OBJECTIVES

Student Learning Objectives (SLO):

A student graduating with the ***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.

Core Objectives (CO):

1. **Critical Thinking Skills** – Students will gain/improve their critical thinking ability by solving real life chemistry problems through inquiry, analysis, and evaluation of available information. Students will be tested on their critical thinking ability in exams and through lab experiments.

2. **Communication Skills** – Students will have the opportunity of improving communication skills through oral discussion and writing reports (i.e. observation, explanation, and conclusion, etc.) on the experiments done in the lab sessions.

3. **Empirical and Quantitative Skills** – Students will use the mathematical skills needed to manipulate and analyze numerical data obtained through experimentation in order to form conclusions.

4. **Teamwork** – Students will use team spirit and consider different points of view to work effectively while conducting experiments as a team working toward a shared purpose or goal.

5. **Career Goals –** Students will be trained in a broad set of skills in many disciplines that are ideal for pursuing jobs in industry or academics in graduate schools.

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 for the formation of complex and thermodynamic consideration of complex formation.

9. Understand the reduction and oxidation process and explain the relations between $E°$, $\Delta G°$, and K.

10. Interpret the Frost-Ebsworth diagram and understand the relations between the potential diagram and the Frost-Ebsworth diagram.

11. Explain the nucleus stability attributable to the nuclear binding energy of neutrons and protons, nuclear reactions, and natural radioactivity.

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

SRSU Library Services: The Sul Ross Library 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. Off-campus access requires your LoboID and password. Check out materials using your photo ID. Librarians are a tremendous resource for your coursework and can be reached in person, by email (srsulibrary@sulross.edu), or phone (432-837-8123).

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 and symmetry elements

Chapter 4: Bonding in polyatomic molecules: Hybridization of atomic orbitals, Molecular Orbital Theory, and Delocalized bonding

Chapter 5: 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 6: Acids, bases and ions in aqueous solution: Coordination of compounds as acids, bases and ions in aqueous solution

Chapter 7: Reduction and oxidation: Standard reduction potentials and potential diagrams

Chapter 19 & 20: *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 the problem-sets assigned for each chapter. ***The homework will be uploaded to the SRSU Blackboard. After downloading and printing the homework sheet, you need to solve the problem sets of the homework.*** After solving the problem sets, please, send the scanned file to me at my email, hxc19tv@sulross.edu

NO LATE HOMEWORK WILL BE ACCEPTED.

Examinations: There will be ***three 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 three 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: 25%
Each Midterm Exam (16.67%): 50%
Final Exam: 25%

Midterm Exam I: Tuesday, September 27th, face-to-face
Midterm Exam II: Tuesday, October 27th, face-to-face
Midterm Exam III: Thursday, November 17th, face-to-face
Final Exam: Monday, December 5th at 12:30 pm to 2:30 pm, in WSB 307

Students with Special Needs: *Sul Ross State University (SRSU) is committed to equal access in compliance with 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 for accessibility service. Please contact Ms. Rebecca Greathouse Wren, M.Ed., LPC-S, Director/Counselor, Accessibility Services Coordinator, Ferguson Hall (Suite 112) at 432.837.8203; mailing address is P.O. Box C-122, Sul Ross State University, Alpine, Texas 79832. E-mail: rebecca.wren@sulross.edu Students should then contact the instructor as soon as possible to initiate the recommended accommodations.*

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. 23	Lecture 1	Ch 1	Discussion on the syllabus, the importance of inorganic chemistry Fundamental particles, wave mechanics	
Aug. 25	Lecture 2		An overview 1 of atomic structures: atomic number, mass number, isotopes, wave mechanics, atomic orbitals, many-electron atoms, the periodic table,	
Aug. 30	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. 1	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. 6	Lecture 5	Ch 2	Nuclear binding energies, Radioactivity, Artificial isotopes Nuclear fission	**Ch1 HW due**
Sep. 8	Lecture 6	Ch 3	Symmetry operations and symmetry elements	
Sep. 13	Lecture 7		Point Groups: Determining the point group of a molecules or molecular ion	
Sep. 15	Lecture 8		Character tables: an introduction and application on molecular orbitals	**Ch2 HW due**
Sep. 20	Lecture 9		Application of molecular symmetry Revision of Chapter 3	
Sep. 22	Lecture 10	Review & Test	Exam 1 Revision	
Sep. 27	Lecture 11		**Exam 1 day (it covers Ch 1, 2, & 3)**	**Ch3 HW due**

Sep. 29	Lecture 12	Ch 4	Valence bond theory: Hybridization of atomic orbitals Hybridization of *sp*, sp^2, sp^3 Multiple bonding in polyatomic molecules	
Oct. 4	Lecture 13		MOT (Molecular Orbital Theory) application on the polyatomic molecules BH_3, NH_3, and CH_4	
Oct. 6	Lecture 14	Ch 5	Revision of Chapter 4 Packing of spheres, Cubic and hexagonal close-packing, Unit cell, Interstitial holes	**Ch4 HW due**
Oct. 11	Lecture 15		Metallic radii, Alloys and intermetallic compounds, Bonding in metals and semiconductors	
Oct. 13	Lecture 16		Size of ions, ionic lattices, lattice energy from electrostatic model, Born-Haber Cycles	
Oct. 18	Lecture 17		Defects in solid state lattices: an introduction	
Oct. 20	Lecture 18	Ch 6	Revision of Chapter 5 Definition of Bronsted acids and bases, Lewis acid-base, Solubilities of ionic salts, Common-ion effect Coordination complexes, Hard and soft metal centres and ligands	**Ch5 HW due**
Oct. 25	Lecture 19	Review & Test	Revision of Chapter 6 Exam 2 Revision	
Oct. 27	Lecture 20		**Exam 2 day (it covers Ch 4, 5, & 6)**	**Ch6 HW due**
Nov. 1	Lecture 21	Ch 7	Oxidation and Reduction, Oxidation numbers, Standard reduction potentials Relationships between E^o, ΔG^o, and *K* Half-cell and galvanic cells	
Nov. 3	Lecture 22		Potential diagrams, Frost-Ebsworth diagrams, Interpretation of Frost-Ebsworth diagrams	
Nov. 8	Lecture 23	Ch 19 & 20	Revision of Chapter 7 Ground state electronic configurations (d-block metals), Characteristic properties; a general perspective, color, paramagnets, complex formation, Variable oxidation states, Coordination numbers	**Ch7 HW due**

Nov. 10	Lecture 24		Spectrochemical series, Bonding in d-block metal complexes by VBT Crystal field stabilization energy Electronic spectra Bonding in d-block metal complexes by MOT	
Nov. 15	Lecture 25	Review & Test	Exam 3 Revision	
Nov. 17	Lecture 26		**Exam 3 Day (it covers Ch7, 19, & 20)**	**Ch19&20 HW due**
Nov. 22	Lecture 27	Review	Final Exam Revision_1	
Nov. 24			**Thanksgiving Day, Holiday**	
Nov. 29	Lecture 28	Review	Final Exam Revision_2	
Dec. 1	Lecture 29		**Dead day for 16 weeks term**	
Dec. 5 Monday	Lecture 30	Test	**Final Exam Day, Monday, 12:30PM to 2:30PM, WSB307**	