Sul Ross State University Syllabus

Inorganic Chemistry I (CHEM 2402-01)

(Fall 2020)_11974

Class: Inorganic Chemistry I
Room: WSB 307
Time: MWF 12:00-12:50am
Date: Aug.24 to Dec.9
(Face-to-Face: Aug.24 to Nov.27)
(After Thanksgiving Break, all classes and final exam will be online)

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

Due to the COVID-19 pandemic, you must wear a suitable mask/face covering while on campus (including lectures & laboratories). You will be asked to leave the classroom if you come to class without a suitable mask/face covering.

https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/diy-cloth-face-coverings.html

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, octet rule, isoelectronic structures, electronegativity, and VSEPR Model

3. understand symmetry operations, symmetry elements, point groups, character tables, vibrational modes in molecules, chiral molecules for poly atomic molecules.

4. explain the bonding in polyatomic molecules based on hybridization of atomic orbitals or MOT (Molecular Orbital Theory) using by 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 that 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, naming them and decide stability constants to affect for the formation of complex and thermodynamic consideration of complex formation.

9. Understand reduction and oxidation process and explain the relations between E°, ΔG°, and *K*.

10. interpret for the Frost-Ebsworth diagram and understand the relations between 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).

The following chapters will be covered:

Chapter 1: Basic concepts: atoms

Chapter 2: Basic concepts: molecules

Chapter 3: Introduction to molecular symmetry

Chapter 5: Bonding in polyatomic molecules

Chapter 6: Structures and energetics of metallic and ionic solids

Chapter 7: Coordination compounds / Acids, bases and ions in aqueous solution

Chapter 8: Reduction and oxidation

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 in the SRSU Blackboard. After download 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 into my email, 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 on-line.

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: 25%
Each Midterm Exam (16.67%): 50%
Final Exam: 25%

Midterm Exam I: Friday, October 9th, face-to-face
Midterm Exam II: Friday, November 6th, face-to-face
Final Exam: Wednesday, December 9th on-line at 1:00pm to 6:00pm, in Blackboard

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

Lecture 1 (Aug. 24): Discussion on Syllabus, importance of inorganic chemistry

Lecture 2 (Aug. 26): Chapter 1. Fundamental particles, wave mechanics

Lecture 3 (Aug. 28): Atomic orbitals, Many-electron atoms, the periodic table, Aufbau principle, ionization energy and electron affinity, nuclear reactions, and natural radioactivity.

Lecture 4 (Aug. 31): Review of Octet Rule and exception of Octet Rule for inorganic compounds

Lecture 5 (Sep. 2): Chapter 2. Bonding model (Homework 1 due)

Lecture 6 (Sep. 4): Molecule orbital theory_1

Labor Day: Holiday, No Class

Lecture 7 (Sep. 9): Molecule orbital theory_2

Lecture 8 (Sep. 11): Dipole moments, VSEPR model

Lecture 9 (Sep. 14): Molecular shape (Homework 2 due)

Lecture 10 (Sep. 16): Chapter 3. Symmetry operations and symmetry elements

Lecture 11 (Sep. 18): Point groups_1

Lecture 12 (Sep.21): Point groups_2

Lecture 13 (Sep. 23): Character table_1

Lecture 14 (Sep. 25): Character table_2

Lecture 15 (Sep. 28): Application of symmetry operation and symmetry elements

Lecture 16 (Sep. 30): Vibrational spectroscopy

Lecture 17 (Oct. 2): Chiral molecules_1

Lecture 18 (Oct. 5): Chiral molecules_2

Lecture 19 (Oct. 7): Revision of Exam I (Homework 3 due)

Lecture 20 (Oct. 9): Exam I (covering chapter 1, 2, and 3)

Lecture 21 (Oct. 12): Chapter 5. Valence Bond Theory (VBT): hybridization of atomic orbitals

Lecture 22 (Oct. 14): Molecular Orbital Theory (MOT)_1: Introduction

Lecture 23 (Oct. 16): Molecular Orbital Theory (MOT)_2: Application to triatomic molecules

Lecture 24 (Oct. 19): Molecular Orbital Theory (MOT)_3: π-bonding and three-centre two-electron interactions

Lecture 25 (Oct. 21): Chapter 6. Packing sphere, metallic radii, alloys (Homework 5 due)

Lecture 26 (Oct. 23): Bonding in metals, semiconductor

Lecture 27 (Oct. 26): Sizes of ions, ionic lattices according to structure types

Lecture 28 (Oct. 28): ionic Lattices: wurtzite (ZnS), rutile (TiO_2), layer structures (CdI_2 & $CdCl_2$), and perovskite ($CaTiO_3$)

Lecture 29 (Oct. 30): Lattice energy

Lecture 30 (Nov. 2): Defect in solid state lattices

Lecture 31 (Nov. 4): Revision of Exam II (Homework 6 Due)

Lecture 32 (Nov. 6): Exam II (covering chapter 5 & 6)

Lecture 33 (Nov. 9): Chapter 7. Properties of water, aqueous solutions, Acids and bases, Dissociation

NO CLASS: Veterans Day (Holiday, *November 11th*)

Lecture 34 (Nov. 13): Common-ion effect, coordination complexes

Lecture 35 (Nov. 16): Coordination complexes and characteristic properties

Lecture 36 (Nov. 18): Stability constants of coordination complexes

Lecture 37 (Nov. 20): Chapter 8. Reduction & oxidation (Homework 7 due)

Lecture 38 (Nov. 23): relationships between E°, ΔG°, and *K*

Thanksgiving Day Holiday (Nov. 25-27)

Lecture 39 (Nov. 30): Potential diagram (This class will be on-line)

Lecture 40 (Dec. 2): Frost-Ebsworth diagrams (This class will be on-line)

Lecture 41 (Dec. 4): Review on Final Exam (chapter 1, 2, & 3) (This class will be on-line) (Homework 8 due)

Lecture 42 (Dec. 7): Review on Final Exam (chapter 5, 6, 7, & 8) (This class will be on-line)

Lecture 43 (Dec. 9): Final Exam (*mandatory & comprehensive*): at 1:00 pm–6:00 pm, in your Blackboard