# **Inorganic Chemistry**

# **Fall 2018**

# CHEM-3310, 40704, Face-to-Face Modality, 3 Credit Hours

**Instructor:** Dr. John Lee

**Email and Phone Number:** John-Lee@utc.edu and 425-4488

**Office Hours and Location:** MWF 10:00 am – 12:00 pm in Grote 401

**Course Meeting Days, Time, and Location:** MWF, 9:00-9:50 am, Grote 411

**Course Catalog Description:** Concepts and models in inorganic chemistry with emphasis on atomic structure and bonding, molecular orbital theory, material science, and descriptive inorganic chemistry including biological and environmental applications.

**Course Pre/Co-Requisites:** Prerequisites: CHEM 3020 and CHEM 3020L with a minimum grade of C; MATH 1920/MATH 1921 with a minimum grade of C or department head approval. Pre- or Co-requisite: CHEM 3210 and PHYS 1040/PHYS 1040L or PHYS 2310/PHYS 2310L with a minimum grade of C or department head approval.

**Course Student Learning Outcomes:** Upon completion of the required credit hours in this category, students will be able to:

1. Students will be able to demonstrate a qualitative understanding of atomic structure, atomic orbital shapes and orientations, effective nuclear charge, and electron configurations.

2. Students will use atomic structure knowledge to predict periodic trends such as atomic/ionic radii, ionization energy, electron affinity, and electronegativity.

3. Students will be able to draw appropriate 2-dimensonal representations of molecular substances using Lewis structures based on the octet rule, formal charge and resonance, and predict 3-dimensional shapes using VSEPR/D.

4. Students will be able to utilize theories in bonding interactions for covalent molecular substances that will include both valence bond theory (hybridization,-bonds, and -bonds) and molecular orbital theory (homo- and hetero-nuclear diatomics and main-group polyatomic molecules).

5. Students will be able to utilize close-packing in metals to demonstrate knowledge of basic structure for solid-state materials such as metallic solids, ionic compounds, and network solids.

6. Students will utilize concepts related to solid-state materials to discuss: metals, metal compounds, metallic bonding, band theory, conductivity, semiconductors, insulators, and defects.

7. Students will use concepts related to polarization to predict metallic, covalent, polar covalent and ionic bonding for a particular substance.

8. Students will use molecular orbital theory and periodic trends in the analysis of acid-base definitions for main-­group molecules that include hydrides, oxides and some d-block oxides.

9. Students will develop a basic knowledge of transition metal coordination chemistry to include: ligands, nomenclature, coordination number, stereochemistry, magnetic properties, and thermodynamic aspects.

10. Students will use molecular orbital theory and periodic trends in the analysis of electron transfer reactions in order to balance oxidation­-reduction reactions, predict reaction spontaneity, and use Lattimer and Frost diagrams in order to look at stability for a number of different oxidation states for a particular substance.

11. Students will use concepts from transition metal coordination chemistry to survey the key roles of select transition metals in biological inorganic chemistry.

**Required Course Materials:** “Principles of Inorganic Chemistry”, by Phennig.

**Supplemental/Optional Course Materials:** Inorganic Chemistry WikiBook that can be found at <https://en.wikibooks.org/wiki/Introduction_to_Inorganic_Chemistry>.

**Technology Requirements for Course:** Calculators may be used for all assignments including major exams. You must bring a calculator to the exam with you. You may not share a calculator during an exam. Always make sure that your calculator is fully charged before coming to an exam.

**Technology Skills Required for Course:** Access to UTC Learn (Blackboard, Bb) and the Internet.

**Technology Support****:** If you have problems with your UTC email account or with UTC Learn, contact IT Solutions Center at 423-425-4000 or email itsolutions@utc.edu.

**Course Assessments and Requirements:** Four closed-book in-class exams will be given during the semester. The final exam can replace your lowest in-class exam grade.

The exams will be objective in nature consisting of problems, short answer questions, and multiple choice. Material for the questions will be derived from homework problems, reading assignments, and class discussions.

**Final Exam:** The final exam is comprehensive and will be given on Wednesday, December 5 at 8:00 am in Grote 411. The final exam will consist of a standardized multiple-choice examination which will be computer-graded. The exam was developed for Foundations Inorganic Chemistry by the American Chemical Society. The final day for a course withdrawal is Monday, October 22. You cannot withdraw from the class after this date.

The exam includes an exam packet that must not be written in. If you do write in your exam packet you will be given one day to erase the marks. If you do not erase the marks either by meeting with me within 24 hours or if the marks are too deep to be properly erased this will result in a letter grade drop from your final grade.

**Homework:** Throughout the semester Homework assignments will be provided related to the material covered in lecture. These assignments are to be turned in on or before the assigned due date with no exceptions.

**Class Participation:** Throughout the semester we will do class discussions on recent advances related to the material we are covering. You are required to be in class on those days and prepared to participate in the discussion. A handout related to the paper we are discussing will be due that day to count toward your homework grade.

**Course Grading**

**Course Grading Policy:** Your final grade for lecture is non-negotiable and will be calculated as follows:

 Exams 68% (includes replacing a low score with Final Exam)

 Final Exam 22%

 Homework/ 10%

 Class Participation

 A: 90-100, B: 80-89.9, C: 70-79.9, D: 60-69.9, F: Below 59.9

The instructor might modify (up or down) the average grade of students up to 3% based on (but not limited to) class attendance and participation, general interest, attitude, etc. In case your score was not recorded correctly on UTC Learn, it is your responsibility to provide a proper document such as the graded assignment.

**Instructor Grading and Feedback Response Time:** Assignments will be graded and handed back within one week of completing or turning in the assignment.

**Course and Institutional Policies**

**Late/Missing Work Policy:** Homework assignments are due on or before the assigned due date and cannot be turned in late. For in-class literature discussions no homework will be accepted if absent the day of the class discussion. If an exam is missed due to either University-related travel, an interview, or illness it is the student’s responsibility to 1) provide appropriate documentation and 2) schedule a time with the instructor to make up the in-class exam.

**Student Conduct Policy:** UTC’s Academic Integrity Policy is stated in the [Student Handbook](https://www.utc.edu/dean-students/student-handbook.php).

**Honor Code Pledge:** I pledge that I will neither give nor receive unauthorized aid on any test or assignment.  I understand that plagiarism constitutes a serious instance of unauthorized aid.  I further pledge that I exert every effort to ensure that the Honor Code is upheld by others and that I will actively support the establishment and continuance of a campus-wide climate of honor and integrity.

**Course Attendance Policy:** There is no formal attendance policy. However, you are expected to arrive on time at 8:55 am, and you are responsible for everything that is covered in lecture.

**Course Participation/Contribution:** Throughout the semester we will have class activities and discussions. Participation is required and these activities could be graded at the instructor’s discretion to count toward the Homework/Class Participation part of your final grade.

**Course Learning Evaluation:** Course evaluations are an important part of our efforts to continuously improve the learning experience at UTC. Toward the end of the semester, you will receive a link to evaluations and are expected to complete them. We value your feedback and appreciate you taking time to complete the anonymous evaluations.

**Course Calendar/Schedule:** Listed below are the Sections of your lecture textbook that will be covered on a particular class meeting. Slight variations in the schedule may arise. The dates of the course exams are also listed.

DATE Topic Reading Assignment

8-20 Introduction Chapter 1 for Review of Matter

8-22 Early Quantum Theory and Bohr Model pp 41-55

8-24 Bohr Model to Quantum Mechanics pp 55-74

8-27 The Hydrogen Atom pp 81-90, 93-96

8-29 Polyelectronic Atoms and Electron Configs. pp 91-93, 96-98 & 105-107

8-31 Periodic Table and Trends pp 109-113, 118-122 & 133-136

9-03 **Labor Day (University) – No Class**

9-05 Periodic Trends and Properties & Review pp 122-125,130-132

9-07 **Exam I**

9-10 Lewis Structures, Formal Charge, Resonance pp 140-144

9-12 Lewis Structures, Formal Charge, Resonance pp 146-148

9-14 Molecular Geometry and VSEPR pp 155-176

9-17 VB Theory and Hybridization pp 259-266

9-19 VB Theory and Hybridization pp 267-276

9-21 MO Theory: Intro and Homonuclear Diatomics pp 276-288

9-24 MO Theory: Heteronuclear Diatomics pp 289-292

9-26 MO Theory: Polyatomics pp 292-301

9-28 MO Theory: Polyatomics pp 317-325

10-01 Structure/Bond Properties and Clusters pp 144-146, 325-334

10-03 **Exam II**

10-05 Basics of the Solid-State pp 340-345, 350-355, 404-406

10-08 Structure of Ionic Solids pp 391-398

10-10 Diffraction Methods pp 345-350

10-12 Lattice Enthalpy and the Born-Haber Cycle pp 398-404

 **Midterm Grades Due**

10-15 **Fall Break (University) – No Class**

10-17 Bonding in Ionic Solids pp 149-153, 115-117, 404-417

10-19 Band Theory of Solids pp 360-374

 Read on your own: pp 355-359

10-22 Conductivity in Solids pp 374-384

10-24 Silicates, Zeolites and Defects pp 417-425

10-26 Crystalline Solid Classification pp 431-449

10-29 **Exam III**

10-31 Nuclear Chemistry pp 15-21, 30-38

11-02 **SERMACS – No Class**

11-05 Bronsted-Lowry Acids & Bases pp 453-459, 125-126

11-07 Lewis Acids & Bases and HSAB pp 459-473

11-09 Oxidation-Reduction Reactions pp 473-475

11-12 Lattimer and Frost Diagrams pp 126-129

Read on your own: pp 475-479

11-14 Introduction to Coordination Chemistry pp 483-492

11-16 Coordination Geometries and Isomerism pp 492-501

11-19 Magnetic Properties and Intro to CFT pp 501-506

11-21 **Thanksgiving (University) – No Class**

11-23 **Thanksgiving (University) – No Class**

11-26 Bioinorganic Overview No Reading Assignment

11-28 Literature Discussion Assigned Article

11-30 **Exam IV**

12-03 Final Review & Last Day of Classes

12-05 Final Exam 8:00 am – 10:00 am in Grote 411

 **FINAL EXAM: Wednesday, December 5th 8:00 am – 10:00 am in Grote 411**

**Miscellaneous Items:**

Cell phones and etiquette: Please turn cell phones OFF before coming to class. They are disruptive to your fellow students and the instructor.

Study helps: Students are encouraged to consult with the instructor during office hours and at other times. There is no substitute for working and understanding the assigned problems! If you do encounter academic difficulties, try to address them early in the course. End-of-chapter problems, that will *not* be graded, will be posted with the exam study guide to help with exam preparation.