

Chemistry 401 : Modern Inorganic Chemistry (3 credits) Fall 2014

Monday, Wednesday, Friday 10:10-11 am in Fulmer 225

Syllabus

Instructor: Professor Zachariah Heiden

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Office Hours: Tuesday 10-11 am, Wednesday 4-5 pm, or by appointment

Website: The course website and gradebook will be maintained in ANGEL (<http://lms.wsu.edu/>)

Prerequisite: Chemistry 332 (Physical Chemistry)

Required Text: Peter Atkins, et al Inorganic Chemistry, 6th Ed. (ISBN : 978-1429299060)

Recommended Resources:

Chemistry of the Elements, Greenwood and Earnshaw (ISBN : 978-0750633659)

Advanced Inorganic Chemistry, Cotton and Wilkinson (ISBN : 978-0471199571)

Inorganic Chemistry, Miessler and Tarr (ISBN : 9780321811059)

Student Learning Outcomes

Chemistry 401 is designed to advance students toward the WSU Learning Goals, especially Scientific Literacy, Critical and Creative Thinking, Quantitative Reasoning, Communication, and Information Literacy. This course will provide upper level undergraduates with a foundation in the theoretical principles and the descriptive chemistry of the elements of the periodic table. The objective is to introduce the concepts of symmetry, bonding, oxidation-reduction, molecular structure, and acid-base chemistry, then to use this framework to understand the chemistry of the elements, with a focus on the transition metals.

By the end of the course it is expected that every student will:

- 1) Be able to predict the ideal geometry of a molecule and determine the point group symmetry to understand and deduce the spectroscopic properties of the molecule.
- 2) Be able to derive a molecular orbital diagram for a molecule and to use the diagram to aid in the prediction of the chemical behavior.
- 3) Have the basic knowledge of the descriptive chemistry of the element families to be able to read, understand, and communicate about the current chemical literature.
- 4) Be able to propose a plausible reaction mechanism for a chemical transformation from experimental rates laws.
- 5) Use Scifinder Scholar and Web of Science to search the chemical literature.

Assessment

Student Learning Outcomes At the end of this course, students should be able to:	Course Topics/Dates The following topic(s)/dates(s) will address this outcome:	Evaluation of Outcome: This outcome will be evaluated primarily by:
<i>Be able to predict the ideal geometry of a molecule and determine the point group symmetry to understand and deduce the spectroscopic properties of the molecule.</i>	<i>Symmetry and Group Theory (Lectures 6-8) Coordination Chemistry (Lectures 22-24)</i>	<i>Quizzes, class exercises, problem sets, exams, presentations</i>
<i>Be able to derive a molecular orbital diagram for a molecule and to use the diagram to aid in the prediction of the chemical behavior.</i>	<i>Molecular Orbital Theory (Lectures 3-6) Ligand Field Theory (Lecture 27)</i>	<i>Quizzes, class exercises, problem sets, and exams</i>
<i>Have the basic knowledge of the descriptive chemistry of the element families to be able to read, understand, and communicate about the current chemical literature.</i>	<i>Coordination Chemistry and Organometallics (Lectures 13, 22-25, 31-39, 40-41)</i>	<i>Quizzes, class exercises, problem sets, exams, presentations</i>
<i>Be able to propose a plausible reaction mechanism for a chemical transformation from experimental rates laws.</i>	<i>Ligand Substitution in Coordination Chemistry (Lectures 28, 30-31) Organometallics and Catalysis (Lectures 35-39)</i>	<i>Quizzes, class exercises, problem sets, exams, presentations</i>
<i>Use Scifinder Scholar and Web of Science to search the chemical literature.</i>	<i>Scifinder Scholar and Web of Science Training Session on September 24, 2014 in Owen 319D with Eileen Brady (Lecture 13)</i>	<i>Class exercise on September 24, problem sets, presentations</i>

Grading Scheme:	Problem Sets (6)	200 pts	(bi-weekly)
	Quizzes (12)	200 pts	(weekly)
	Literature Presentation	50 pts	
	Midterm Exams	300 pts	(October 1 st and November 5 th in class)
	Final Exam	250 pts	(Wednesday, December 17 th 8:00-10:00 am)

Grade Ranges: 1000-900 pts A, 899-800 pts B, 799-700 pts C, 699-600 pts D, 599-0 pts F

Assignments

Problem sets: The problem sets will be assigned bi-weekly on Monday and be due the following Monday at the start of class. Late problem sets will not be accepted. There will be six problem sets, with five counting towards the final grade (the lowest score will be dropped).

Quizzes: The quizzes will take place the last 15 minutes of class on Fridays. There will be twelve quizzes, with ten counting towards the final grade (the two lowest scores will be dropped) encompassing material up to the day of the quiz.

Literature Presentation: The last two-three class periods will be student presentations lasting 7-10 minutes on a current research paper of the students' choice occurring within the last two years in inorganic chemistry. This presentation will be done in groups of two and the choice of paper will be due on November 3rd.

Exams: There will be two midterm exams and a comprehensive final given during class time. All exams will be short answer. You will be responsible for bringing a calculator and a pencil to all exams. No notes or books or other electronic devices are allowed, including cell phones or any device with headphones. No make-up exams will be given. If you are unable to take a scheduled exam for documented academic reasons beyond your control, you will be allowed to schedule the exam at an earlier time.

Tentative Course Schedule:

Date	Lecture Number/Topic	Textbook Sections	Assignments
8/25/14	1) Electron Configurations, Periodic Trends	Chapter 1, Sections 1.1-1.7	
8/27/14	2) Lewis Dot Structures, Valence Bond Theory	Chapter 1 & 2, Sections 1.7 & 2.1-2.6	
8/29/14	3) Molecular Orbital Theory	Chapter 2, Sections 2.7-2.8, 2.10	Quiz #1
9/3/14	4) Molecular Orbital Theory	Chapter 2, Sections 2.9-2.10	
9/5/14	5) Molecular Orbital Theory	Chapter 2, Sections 2.9, 2.11	Quiz #2
9/8/14	6) Molecular Orbital Theory, Symmetry	Chapters 2 & 6, Sections 2.11 & 6.1	Problem Set #1 Due
9/10/14	7) Point Groups	Chapter 6, Section 6.1	
9/12/14	8) Character Tables, Molecular Vibrations	Chapter 6, Sections 6.2-6.9	Quiz #3
9/15/14	9) Crystal Lattices	Chapter 3, Sections 3.1-3.3	
9/17/14	10) Packing of Spheres	Chapter 3, Sections 3.2, 3.3	
9/19/14	11) Structures of Molecular Solids, Alloys, Defects	Chapter 3, Sections 3.9, 3.10, 3.16, 3.18, 3.19	Quiz #4
9/22/14	12) Band Structure, Semiconductors	Chapters 3 & 4, Sections 3.19, 3.20, 4.1	Problem Set #2 Due
9/24/14	13) Scifinder and Web of Science Training Session (Owen 319D)		
9/26/14	14) Brønsted Acids, Metal Oxides	Chapter 4, Sections 4.1-4.5, 4.14	Quiz #5
9/29/14	15) Exam 1 Review	Chapters (1, 2, 3, & 6)	
10/1/14	Midterm Exam 1 (Chapters 1, 2, 3, & 6)		

Date	Lecture Number/Topic	Textbook Sections	Assignments
10/3/14	16) Super Acids & Bases, Lewis Acids & Bases	Chapter 4, Sections 4.6-4.14	
10/6/14	17) Hard/Soft Acid Base Theory	Chapter 4, Sections 4.9, 4.10	
10/8/14	18) Non-aqueous Solvents	Chapter 4, Sections 4.1-4.14	
10/10/14	19) Balancing Redox Reactions, Nernst Equation	Chapter 5, Sections 5.1-5.7	Quiz #6
10/13/14	20) Latimer, Pourbaix, & Frost Diagrams	Chapter 5, Sections 5.12-5.14	Problem Set #3 Due
10/15/14	21) Ligands in Coordination Chemistry	Chapter 7, Sections 7.1	
10/17/14	22) Coordination Chemistry Nomenclature, d-electron Count	Chapter 7, Section 7.2	Quiz #7
10/20/14	23) Coordination Number and Isomers	Chapter 7, Sections 7.3-7.10	
10/22/14	24) Coordination Number and Isomers	Chapter 7, Sections 7.6-7.10	
10/24/14	25) Ligand Chirality, Crystal Field Theory	Chapters 7 & 20, Sections 7.6-7.10, 20.1	Quiz #8
10/27/14	26) Crystal Field Theory, Magnetism	Chapter 20, Section 20.1	Problem Set #4 Due
10/29/14	27) Ligand Field Theory	Chapter 20, Section 20.2	
10/31/14	28) Charge Transfer Bands, Selection Rules, Ligand Substitution Reactions	Chapters 20 & 21, Sections 20.2, 20.5, 20.6, 21.1-21.2	Quiz #9
11/3/14	29) Exam 2 Review	Chapters 4, 5, & 7	Paper Choice Due
11/5/14	Midterm Exam #2 (Chapters 4, 5, & 7)		
11/7/14	30) Ligand Substitution Reaction Mechanisms	Chapter 21, Sections 21.2-21.9	
11/10/14	31) Isomerization & Redox Reactions	Chapter 21, Sections 21.9-21.15	
11/12/14	32) Electron Counting	Chapter 22, Sections 22.1-22.4	
11/14/14	33) Ligands in Organometallics	Chapter 22, Sections 22.4-22.7, 22.14	Quiz #10
11/17/14	34) Ligands in Organometallics	Chapter 22, Sections 22.15-22.22	Problem Set #5 Due
11/19/14	35) Reactions of Metal Carbonyls & Organometallic Complexes	Chapter 22, Sections 22.22-22.26	
11/21/14	36) Catalysis Nomenclature, Catalytic Cycles	Chapter 25, Sections 25.1-25.2	Quiz #11
12/1/14	37) Catalytic Cycles	Chapter 25, Sections 25.2-25.7	
12/3/14	38) Heterogeneous Catalysis	Chapter 25, Sections 25.10-25.15	
12/5/14	39) Polymerization Catalysis	Chapter 25, Section 25.17	Quiz #12
12/8/14	40) Class Presentations		Problem Set #6 Due
12/10/14	41) Class Presentations		
12/12/14	42) Class Presentations, Final Exam Review		
12/17/14	Final Exam (8:00-10:00 am)		

Students with Disabilities: Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please either visit or call the Access Center (Washington Building 217; Phone: 509-335-3417) to schedule an appointment with an Access Advisor. All accommodations MUST be approved through the Access Center. For more information contact a Disability Specialist (Meredyth Goodwin m.goodwin@wsu.edu).

Academic Integrity: I encourage you to work with classmates on assignments. However, each student must turn in original work. No copying will be accepted. Students who violate WSU's Standards of Conduct for Students will receive an F as a final grade in this course, will not have the option to withdraw from the course, and will be reported to the Office Student Standards and Accountability. Cheating is defined in the Standards for Student Conduct WAC 504-26-010 (3). It is strongly suggested that you read and understand these definitions.

Safety and Emergency Notification: Washington State University is committed to enhancing the safety of the students, faculty, staff, and visitors. It is highly recommended that you review the Campus Safety Plan (<http://safetyplan.wsu.edu/>) and visit the Office of Emergency Management web site (<http://oem.wsu.edu/>) for a comprehensive listing of university policies, procedures, statistics, and information related to campus safety, emergency management, and the health and welfare of the campus community.

Assigning Incompletes: University policy (Acad. Reg. #90) states that Incompletes may only be awarded if: "the student is unable to complete their work on time due to circumstances beyond their control".

Important Dates and Deadlines: Students are encouraged to refer to the academic calendar often to be aware of critical deadlines throughout the semester. The academic calendar can be found at www.registrar.wsu.edu/Registrar/Apps/AcadCal.ASPX.