Chemistry 401 : Modern Inorganic Chemistry (3 credits) Fall 2016

Monday, Wednesday, Friday 9:10-10:00 am in Fulmer 225

Syllabus

Instructor: Professor Qiang (Jack) Zhang
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I receive lots of emails every day. I will do my best to reply to all email messages in 24 hours from the time I receive them. Please understand that it is particularly difficult to reply to all emails the evening before exams as the number of emails can be quite high at that time. Please try not to wait until the last minute to ask questions.

Office Hours: Monday 10-11 am, Friday 10:00-11:00 am, or by appointment
Website: The course website and gradebook will be maintained in Blackboard (http:/learn.wsu.edu)
Prerequisite: Chemistry 332 (Physical Chemistry) (With a C or better, or concurrent enrollment)
Required Text: Shriver, et al Inorganic Chemistry, 6th Ed. (ISBN : 978-1429299060) (available at the Bookie)

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 : 978-0321811059)
Chemistry-A Molecular Approach, Tro (ISBN:978-1269932608) (General Chemistry text book)

Student Learning Outcomes

Chem 401 is designed for senior undergraduate student to advance their foundation and comprehension of chemistry 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 fundamental understandings in quantum mechanics, symmetry and crystallography, and the trend of the periodic table of elements. The objective is to introduce the concepts of symmetry and symmetry operation, molecular bonding, oxidation-reduction reaction, electron transfer process, molecular structure, and acid-base chemistry, then to use the knowledge to understand the chemistry of the periodic table of elements, with a main focus on the transition metals. The course will also include cutting-edge research progress in some specific areas.

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:
Identify the atomic orbital and calculate the nodes.	*Atomic Structure, electronic configurations. (Lecture 1)*	*Quizzes, class exercises, homework, exams*
Predict the ideal geometry of a molecule	*Molecular structure, VSEPR (Lectures 2-4)*	*Quizzes, class exercises, homework, exams*
Derive a molecular orbital diagram for a molecule and fill these orbitals with electrons	*Molecular Orbital Theory and Group Theory (Lectures 3-8)*	*Quizzes, class exercises, homework, and exams*
Assign point groups to molecules.	*Group Theory (Lectures 3-8)*	*Quizzes, class exercises, homework, and exams*
Demonstrate the descriptive chemistry of the elements.	*Periodic trends, Coordination Chemistry and Organometallics (Lectures 1, 20-23, 29-32)*	*Quizzes, class exercises, homework, exams*
Distinguish Brønsted acid & base and Lewis acid & base.	*Acids and bases (Lectures 14-16)*	*Quizzes, class exercises, homework, exams*
Count electrons of coordination compounds.	*Coordination Chemistry (Lectures 20-23)* *Organometallics and Catalysis (Lectures 29-32, 35-36)*	*Quizzes, class exercises, homework, exams*
Demonstrate a basic knowledge of redox chemistry.	*Oxidation and Reduction (Lectures 17-19)*	*Quizzes, class exercises, homework, exams,*
Demonstrate a basic knowledge of porous materials, and nanomaterials.	*Materials Chemistry and nanomaterials (Lectures 33-34)*	*Quizzes, class exercises, homework, exams,*
Demonstrate the catalytic process and mechanism.	*Materials Chemistry and Catalysis (Lectures 34-36)*	*Quizzes, class exercises, homework, exams,*

Grading Scheme:

Homework (7)	**200 pts**	(biweekly) two low scores will be dropped.
Quizzes (12)	**200 pts**	(weekly) two low scores will be dropped.
Midterm Exams	**300 pts**	(Sep. 14th, Oct. 14th and Nov. 9th, in class) lowest score will be dropped.
Final Exam	**300 pts**	(Thursday, December 15th 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

Additional exam rule: turn off and stow all electronic devices, except your calculator, during exams.

Bonus Points: **30 pts.** Literature review. Literatures will be provided for students to select. The review should include the summary of the paper and the point group of the molecule or material discussed in the paper. The literature will be available in the middle of the semester and the review is due on Wednesday, Nov. 30th (Before 5:00 PM) after the Thanksgiving break. No page limitations.

Assignments

Homework: Homework will be assigned biweekly on Monday and be due the next Monday before 5:00 PM. Late homework will not be accepted. There will be seven homework sets, with five counting towards the final grade (two low scores will be dropped).

Quizzes: Quizzes will take place the last 10 -15 minutes of class on Fridays. There will be twelve quizzes, with ten counting towards the final grade (two low scores will be dropped).

In class assignments: In class assignments will take place as needed, they will not be graded. The purpose of in class assignments is to help students to comprehend specific concept or phenomena learned in the lecture.

Exams: Three 50-minute exams will be given in-class throughout the semester, not including the Final Exam. 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. There will be 150 points in each midterm exam. The lowest score will be dropped.

Exam 1: In class, Wednesday, September 14th, 2016

Exam 2: In class, Friday, October 14th, 2016

Exam 3: In class, Wednesday, November 9th, 2016

Final Exam: Thursday, December 15th, 2016 8:00-10:00 AM

Tentative Course Schedule:

Date	Lecture Number/Topic	Textbook Sections	Assignments
8/22/16 (M)	1) Electron Configurations, Periodic Trends	Chapter 1, Sections 1.1-1.7	
8/24/16 (W)	2) Molecular Structures, Valence Bond Theory	Chapter 2, Sections 2.1-2.6	
8/26/16 (F)	3) Molecular Orbital Theory	Chapter 2, Sections 2.7-2.9	Quiz #1
8/29/16 (M)	4) Molecular Orbital Theory	Chapter 2, Sections 2.10-2.12	Homework #1 Due (Lectures 1-3)
8/31/16 (W)	5) Structure and bond properties	Chapter 2, Sections 2.13-2.16	
9/2/16 (F)	6) Symmetry， Character Tables	Chapter 6, 6.1-6.2	Quiz #2
9/7/16 (W)	7) Applications of symmetry	Chapter 6, Section 6.3-6.5	
9/9/16 (F)	8) Symmetry of MOs, representations	Chapter 6, Sections 6.6-6.10	Quiz #3
9/12/16 (M)	9) Exam 1 Review	Chapters 1, 2, 6	Homework #2 Due (Lectures 4-8)
9/14/16 (W)	**Exam 1 (Chapters 1, 2, 6)**		
9/16/16 (F)	10) lattice and unit cells	Chapter 3, Sections 3.1-3.2	Quiz #4
9/19/16 (M)	11) Packing of Spheres	Chapter 3, Sections 3.2, 3.3	
9/21/16 (W)	12) Structures of Solids, Alloys	Chapter 3, Sections 3.4-3.10,	
9/23/16 (F)	13) Semiconductors and electronic structures of solids	Chapters 3, Sections 3.11-3.20	Quiz #5
9/26/16 (M)	14) Brønsted Acids	Chapter 4, Sections 4.1-4.5	Homework #3 Due (Lectures 10-13)
9/28/16 (W)	15) Lewis Acids & Bases	Chapter 4, Sections 4.6-4.10	
9/30/16 (F)	16) Hard/Soft Acid Base Theory	Chapter 4, Sections 4.9, 4.10	Quiz #6
10/3/16 (M)	17) Redox reactions	Chapter 5, Sections 5.1-5.5	
10/5/16 (W)	18) Redox stability	Chapter 5, Sections 5.6-5.11	
10/7/16 (F)	19) Latimer, Pourbaix, & Frost Diagrams	Chapter 5, Sections 5.12-5.15	Quiz #7
10/10/16 (M)	Exam #2 Review	Chapters 3, 4, 5	Homework #4 Due (Lectures 14-19)
10/14/16 (F)	**Exam #2 (Chapters 3, 4, 5)**		
10/17/16 (M)	20) Introduction to Coordination Chemistry	Chapter 7, Sections 7.1-7.5	
10/19/16 (W)	21) Electron counting rules	Chapter 7, Section 7.2	

10/21/16 (F)	22) Electron counting rules	Chapter 7, Section 7.2	Quiz #8
10/24/16 (M)	23) Coordination Number and Isomers	Chapter 7, Sections 7.3-7.10	Homework #5 Due (Lectures 20-22)
10/26/16 (W)	24) Crystal Field theory and ligand field theory	Chapters 20, Sections 20.1-20.2	
10/28/16 (F)	25) Crystal Field theory and ligand field theory	Chapter 20, Section 20.1-20.2	Quiz #9
10/31/16 (M)	26) Electronic spectra and Magnetism	Chapter 20, Section 20.3-20.9	
11/2/16 (W)	27) Ligand substitution reactions	Chapters 21, Sections 21.1-21.4	
11/4/16 (F)	28) Rate laws and photochemical reactions	Chapters 21, Sections 21.5, 21.6, 21.8, 21.13-21.15	Quiz #10
11/7/16 (M)	Exam #3 Review	Chapters 7, 20, 21	Homework #6 Due (Lectures 23-28)
11/9/16 (W)	**Exam #3 Chapters 7, 20, 21**		
11/14/16 (M)	29) Ligands in Organometallics	Chapter 22, Sections 22.1-22.4	
11/16/16 (W)	30) Ligands in Organometallics	Chapter 22, Sections 22.4-22.7, 22.14	
11/18/16 (F)	31) Reactions of Metal Carbonyls & Organometallic Complexes	Chapter 22, Sections 22.15-22.22	Quiz #11
11/28/16 (M)	32) Catalysis Nomenclature, Catalytic Cycles	Chapter 22, Sections 22.22-22.26	Homework #7 Due (Lectures 29-31)
11/30/16 (W)	33) Framework structures and hydrogen storage materials	Chapter 24, Section 24.11-24.14	Literature Review Due
12/2/16 (F)	34) Photocatalysis and Nanomaterials	Chapter 24, Section 24.17,24.22, 24.26,	Quiz #12
12/5/16 (M)	35) Homogeneous catalysis	Chapter 25, Sections 25.3-25.9	
12/7/16 (W)	36) Heterogeneous Catalysis	Chapter 25, Sections 25.10-25.17	
12/9/16 (F)	Final Exam review		
12/15/16 (Th)	**Final Exam (8:00-10:00 am)**		

Homework due dates are highlighted in Yellow.

Quiz assignments are highlighted in Green.

Literature review due date is highlighted in Red.

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 http://www.catalog.wsu.edu/catalog/content/acadcalspecializedaccreditation.pdf.