Chemistry 401: Modern Inorganic Chemistry (3 credits) Fall 2017

Monday, Wednesday, Friday 9:10-10:00 am in Troy G5

Syllabus

Instructor: Professor Qiang 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 ANGEL (http://lms.wsu.edu/)
Prerequisite: Chemistry 345 (Organic Chemistry I)
Highly Recommended: Chemistry 220 (Quantitative Chemical Analysis)
Required Text: Shriver, 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 : 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 and/or graduate students 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 transition metals. The course will also include cutting-edge research progress in some specific areas.

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

1) Be able to identify the atomic orbital and calculate the nodes.
2) Be able to predict the ideal geometry of a molecule.
3) Be able to derive a molecular orbital diagram for a molecule and fill these orbitals with electrons.
4) Be able to assign point groups to molecules.
5) Have the basic knowledge of the descriptive chemistry of the elements.

6) Be able to tell the difference between Brønsted acid & base and Lewis acid & base.
7) Be able to count electrons of coordination compounds.
8) Have the basic knowledge about redox chemistry.
9) Have basic knowledge about porous materials and nanomaterials.
10) Have the basic knowledge about catalysis.

Assessment

Student Learning Outcomes **At the end of this course, students should be able to:**	**Course Topics** **The following topic(s) will address this outcome:**	**Evaluation of Outcome:** **This outcome will be evaluated primarily by:**
Be able to identify the atomic orbital and calculate the nodes.	*Atomic Structure, electronic configurations. (Lecture 1)*	*Quizzes, class exercises, homework, exams*
Be able to predict the ideal geometry of a molecule	*Molecular structure, VSEPR (Lectures 2-4)*	*Quizzes, class exercises, homework, exams*
Be able to 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*
Be able to assign point groups to molecules.	*Group Theory (Lectures 3-8)*	*Quizzes, class exercises, homework, and exams*
Have the basic knowledge of the descriptive chemistry of the elements.	*Periodic trends, Coordination Chemistry and Organometallics (Lectures 1, 21-24, 30-33)*	*Quizzes, class exercises, homework, exams*
Be able to tell the difference between Brønsted acid & base and Lewis acid & base.	*Acids and bases (Lectures 14-17)*	*Quizzes, class exercises, homework, exams*
Be able to count electrons of coordination compounds.	*Coordination Chemistry (Lectures 21-24)* *Organometallics and Catalysis (Lectures 30-33, 36-37)*	*Quizzes, class exercises, homework, exams*
Have the basic knowledge of redox chemistry.	*Oxidation and Reduction (Lectures 18-20)*	*Quizzes, class exercises, homework, exams,*
Have basic knowledge of porous materials, and nanomaterials.	*Materials Chemistry and nanomaterials (Lectures 34-35)*	*Quizzes, class exercises, homework, exams,*
Have the basic knowledge about catalysis.	*Materials Chemistry and Catalysis (Lectures 35-37)*	*Quizzes, class exercises, homework, exams,*

Grading Scheme:	**Homework (7)**	**200 pts**	(biweekly) two lower scores will be dropped.
	Quizzes (11)	**200 pts**	(weekly) lowest scores will be dropped.
	Midterm Exams	**300 pts**	(Sep. 15th, Oct. 13th and Nov. 8th, in class) lowest score will be dropped.
	Final Exam	**300 pts**	(Monday, December 11th 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

Bonus Points: **20 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 after the Thanksgiving break (Monday, Nov. 27th, 2017). No page limitations.

Assignments

Homework: Homework will be assigned biweekly on Monday and be due the next Monday at the start of class. Late homework will not be accepted. There will be 7 homework sets, with 5 counting towards the final grade (two lower scores will be dropped).

Quizzes: The quizzes will take place the last 10 minutes of class on Fridays. There will be 12 quizzes, with ten counting towards the final grade (two lower scores will be dropped).

In class assignments: In class assignments will take place as needed, it will not be graded. The purpose of in class assignments is to help students to comprehend specific concept or phenomenon 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 15th, 2017

Exam 2: In class, Friday, October 13th, 2017

Exam 3: In class, Wednesday, November 8th, 2017

Final Exam: Monday, December 11th, 2017 8:00-10:00 AM

Additional exam rule: turn off and stow all electronic devices during exams (phones, ipods, etc.).

Tentative Course Schedule:

Date	Lecture Number/Topic	Textbook Sections	Assignments
8/21/17 (M)	1) Electron Configurations, Periodic Trends	Chapter 1, Sections 1.1-1.7	Homework #1
8/23/17 (W)	2) Molecular Structures, Valence Bond Theory	Chapter 2, Sections 2.1-2.6	
8/25/17 (F)	3) Molecular Orbital Theory	Chapter 2, Sections 2.7-2.9	Quiz #1
8/28/17 (M)	4) Molecular Orbital Theory	Chapter 2, Sections 2.10-2.12	Homework #1 Due
8/30/17 (W)	5) Structure and bond properties	Chapter 2, Sections 2.13-2.16	
9/01/17 (F)	6) Symmetry, Character Tables	Chapter 6, 6.1-6.2	Quiz #2
9/04/17 (M)	Labor Day		
9/06/17 (W)	7) Applications of symmetry	Chapter 6, Section 6.3-6.5	Quiz #3 (Take home)
9/08/17 (F)	No Class	Dr. Zhang will be Out of Town	
9/11/17 (M)	8) Symmetry of MOs, representations	Chapter 6, Sections 6.6-6.10	Homework #2
9/13/17 (W)	9) Exam 1 Review	Chapters 1, 2, 6	
9/15/17 (F)	Exam 1 (Chapters 1, 2, 6)		
9/18/17 (M)	10) lattice and unit cells	Chapter 3, Sections 3.1-3.2	Homework #2 Due
9/20/17 (W)	10) Packing of Spheres	Chapter 3, Sections 3.2, 3.3	
9/22/17 (F)	11) Structures of Solids, Alloys	Chapter 3, Sections 3.4-3.10,	Quiz #4
9/25/17 (M)	12) Semiconductors and electronic structures of solids	Chapters 3, Sections 3.11-3.20	Homework #3
9/27/17 (W)	14) Brønsted Acids	Chapter 4, Sections 4.1-4.5	
9/29/17 (F)	16) Lewis Acids & Bases	Chapter 4, Sections 4.6-4.10	Quiz #5
10/02/17 (M)	17) Hard/Soft Acid Base Theory	Chapter 4, Sections 4.9, 4.10	Homework #3 Due
10/04/17 (W)	18) Redox reactions	Chapter 5, Sections 5.1-5.5	
10/06/17 (F)	19) Redox stability	Chapter 5, Sections 5.6-5.11	Quiz #6
10/09/16 (M)	20) Latimer, Pourbaix, & Frost Diagrams	Chapter 5, Sections 5.12-5.15	Homework #4
10/11/17 (W)	Exam #2 Review	Chapters 3, 4, 5	
10/13/17 (F)	Exam #2 (Chapters 3, 4, 5)		
10/16/17 (M)	21) Introduction to Coordination Chemistry	Chapter 7, Sections 7.1-7.5	Homework #4 Due
10/18/17 (W)	22) Electron counting rules	Chapter 7, Section 7.2	
10/20/17 (F)	23) Electron counting rules	Chapter 7, Section 7.2	Quiz #7
10/23/17 (M)	24) Coordination Number and Isomers	Chapter 7, Sections 7.3-7.10	Homework #5
10/25/17 (W)	25) Crystal Field theory and ligand field theory	Chapters 20, Sections 20.1-20.2	

10/27/17 (F)	26) Crystal Field theory and ligand field theory	Chapter 20, Section 20.1-20.2	Quiz #8
10/30/17 (M)	27) Electronic spectra and Magnetism	Chapter 20, Section 20.3-20.9	Homework #5 Due
11/01/17 (W)	28) Ligand substitution reactions	Chapters 21, Sections 21.1-21.4	
11/03/17 (F)	29) Rate laws and photochemical reactions	Chapters 21, Sections 21.5, 21.6, 21.8, 21.13-21.15	Quiz #9
11/06/17 (M)	Exam #3 Review	Chapters 7, 20, 21	Homework #6
11/08/17 (W)	Exam #3 Chapters 7, 20, 21		
11/10/17 (F)	Veterans Day		
11/13/17 (M)	30) Ligands in Organometallics	Chapter 22, Sections 22.1-22.4	Homework #6 Due
11/15/17 (W)	31) Ligands in Organometallics	Chapter 22, Sections 22.4-22.7,	
11/17/17 (F)	32) Reactions of Metal Carbonyls & Organometallic Complexes	Chapter 22, Sections 22.15-22.22	Quiz #10
11/20/17 (M)	Thanksgiving Break!		
11/22/17(W)			
11/24/17 (F)			
11/27/17 (M)	33) Catalysis Nomenclature, Catalytic Cycles	Chapter 22, Sections 22.22-22.26	Homework #7
11/29/17 (W)	34) Framework structures and hydrogen storage materials	Chapter 24, Section 24.11-24.14	
12/01/17 (F)	35) Photocatalysis and Nanomaterials	Chapter 24, Section 24.17,24.22, 24.26,	Quiz #11
12/04/17 (M)	36) Homogeneous catalysis	Chapter 25, Sections 25.3-25.9	Homework #7 Due
12/06/17 (W)	37) Heterogeneous Catalysis	Chapter 25, Sections 25.10-25.17	
12/08/17 (F)	Final Exam review		
12/11/17 (M)	**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 http://www.catalog.wsu.edu/catalog/content/acadcalspecializedaccreditation.pdf.