

Chemistry 501 : Advanced Inorganic Chemistry (3 credits) Spring 2018

Monday, Wednesday, Friday 10:10-11 am in Spark 333

Syllabus

Instructors: Prof. Qiang Zhang Troy 220 509-335-1269 q.zhang@wsu.edu
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Office Hours: (QZ) Monday 11 am-12 pm, Wednesday 11 am-12 pm, or by appointment, (KN) by appointment

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

Prerequisite: Chemistry 332 (Physical Chemistry) or equivalent

Required Text: Housecroft and Sharpe Inorganic Chemistry, 4th Ed. (ISBN : 978-0273742753)

Recommended Resources: These texts listed below may provide useful explanations, but are not required for the course. Many of the topics discussed can be found in standard inorganic texts and specific references will be provided by the individual instructors. Selections from a variety of “classical” (many-out-of-print) inorganic chemistry resources will be provided as necessary.

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)

Inorganic Chemistry, Shriver and Atkins (ISBN : 978-1429299060)

Organotransition Metal Chemistry From Bonding to Catalysis, Hartwig (ISBN: 978-1891389535)

Chemical Applications of Group Theory, F. Albert Cotton (ISBN: 0-471-51094-7)

Radiochemistry and Nuclear Chemistry, 3rd Edition, Choppin, Liljenzin, Rydberg (ISBN: 0-7506-7463-6)

Lanthanide and Actinide Chemistry, S. Cotton (ISBN-10: 0-470-01006-1)

Student Learning Outcomes

Chemistry 501 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 graduate students 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 nuclear chemistry/origins of the elements, symmetry, bonding, structure, oxidation-reduction, and acid-base chemistry, then to use this framework to understand the chemistry of the elements, with a focus on the d- and f- block metals. The level of the course assumes an entering graduate student with a B.S. in Chemistry with some experience with the topic of inorganic chemistry.

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 based on group theory 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 count electrons of coordination compounds and clusters.
- 5) Be able to propose a plausible reaction mechanism for a chemical transformation from experimental rates laws and patterns of chemical reactivity.
- 6) Have gained a basic understanding of the factors that govern the stability/instability of atomic nuclei, including concepts of radioactive decay and nuclear reactions like fusion and fission.

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 Coordination Chemistry</i>	<i>Class exercises, Homework, exams</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 Group Theory Ligand Field Theory</i>	<i>Class exercises, Homework, 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>Lanthanides and Actinides, Nuclear Chemistry, Coordination Chemistry, Organometallics.</i>	<i>Class exercises, Homework, exams</i>
<i>Be able to count electrons of coordination compounds and clusters.</i>	<i>Coordination Chemistry, d-block metal complexes and cluster chemistry</i>	<i>Class exercises, Homework, exams</i>
<i>Be able to propose a plausible reaction mechanism for a chemical transformation from experimental rates laws and patterns of chemical reactivity.</i>	<i>Ligand Substitution in Coordination Chemistry Organometallics and Catalysis</i>	<i>Class exercises, Homework, exams</i>

Grading Scheme: **Homework (7)** **100 pts** (bi-weekly)

Midterm Exams **200 pts** (February 12th and March 30th in class)
Final Exam **200 pts** (Thursday, May 4th 8:00-10:00 am)

Grade Ranges: 500-450 pts A, 449-400 pts B, 399-350 pts C, 349-300 pts D, 299-0 pts F

Assignments

Homework: The homework will be assigned bi-weekly on Friday and be due the following Friday before 5:00 PM. Late homework will not be accepted. There will be seven homework sets, with five counting towards the final grade (the lowest two scores will be dropped).

Homework Due Dates: Homework #1 – January 19th, Homework #2 – February 2nd, Homework #3 – February 16th, Homework #4 – March 2nd, Homework #5 – March 23rd, Homework #6 – April 13th, Homework #7 – April 27th.

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.

Midterm Exams: Two 50-minutes 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 devices 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 100 points in each midterm exam.

Final Exam: Friday, May 4th, 2018, 8:00-10:00 AM **(Cumulative)**

Tentative Course Schedule:

Date	Lecture Number/Topic	Textbook Sections	Assignments	Instructor
1/08/18 (M)	1) Basic concepts, atoms and molecules	Chapter 1 & 2		QZ
1/10/18 (W)	2) Bonding Theories	Chapter 2 & 5		QZ
1/12/18 (F)	3) Bonding Theories	Chapter 5	Homework #1	QZ
1/15/18 (M)	Martin Luther King Day (No class)			
1/17/18 (W)	4) Introduction to Group Theory	Chapter 3		QZ
1/19/18 (F)	5) Symmetry and Point Groups	Chapter 3	Homework #1 Due	
1/22/18 (M)	6) Character Tables	Chapter 3		
1/24/18 (W)	7) Application of Group Theory	Chapter 3&4		QZ
1/26/18 (F)	8) Application of Group Theory	Chapter 3&4	Homework #2	QZ
1/29/18 (M)	9) Nuclear Chemistry	Choppin et al.		KN
1/31/18 (W)	10) Nuclear Chemistry	Choppin et al.		KN
2/02/18 (F)	11) Nuclear Chemistry	Choppin et al.	Homework #2 Due	KN

2/05/18 (M)	12) Nuclear Chemistry	Choppin et al.		KN
2/07/18 (W)	13) Nuclear Chemistry	Choppin et al.		KN
2/09/18 (F)	14) The Manhattan Project (PBS video)	in classexercise	Homework #3	KN
2/12/18 (M)	Midterm Exam #1			
2/14/18 (W)	15) Lanthanides and Actinides	Chapter 27		KN
2/16/18 (F)	16) Lanthanides and Actinides	Chapter 27	Homework #3 Due	KN
2/19/18 (M)	President's Day (No class)			
2/21/18 (W)	17) Lanthanides and Actinides	Chapter 27		KN
2/23/18 (F)	18) Lanthanides and Actinides	Chapter 27	Homework #4	KN
2/26/18 (M)	19) Lanthanides and Actinides	Chapter 27		KN
2/28/18 (W)	20) Lanthanides and Actinides	Chapter 27		KN
3/02/18 (F)	21) Inorganic Spectroscopy	Chapter 4	Homework #4 Due	QZ
3/05/18 (M)	22) Solid State Structures	Chapter 6 & 28		QZ
3/07/18 (W)	23) Solid State Structures	Chapter 6 & 28		QZ
3/09/18 (F)	24) Acid/Base	Chapter 7	Homework #5	QZ
3/12/18 (M)	Spring Break (No class)			
3/14/18 (W)	Spring Break (No class)			
3/16/18 (F)	Spring Break (No class)			
3/19/18 (M)	25) Acid/Base/Redox	Chapter 7&8		QZ
3/21/18 (W)	26) Redox	Chapter 8		QZ
3/23/18 (F)	27) Hydrogen	Chapter 10	Homework #5 Due	QZ
3/26/18 (M)	28) Group 14 Elements	Chapter 14		QZ
3/28/18 (W)	29) d-block Metal Chemistry: General Considerations	Chapter 19		QZ
3/30/18 (F)	Midterm Exam #2			
4/02/18 (M)	30) <i>d</i> -block Metal Chemistry: General Considerations	Chapter 19		QZ
4/04/18 (W)	31) <i>d</i> -block Metal Chemistry: General Considerations	Chapter 19		QZ
4/06/18 (F)	32) <i>d</i> -block Metal Chemistry: Coordination complexes	Chapter 20	Homework #6	QZ
4/09/18 (M)	33) <i>d</i> -block Metal Chemistry: Coordination complexes	Chapter 20		QZ
4/11/18 (W)	34) <i>d</i> -block Metal Chemistry: Coordination complexes	Chapter 20		QZ
4/13/18 (F)	35) Electron counting rules	Chapter 24	Homework #6 Due	QZ
4/16/18 (M)	36) Cluster Chemistry	Chapter 24		QZ
4/18/18 (W)	37) Organometallic compounds of <i>d</i> -block elements	Chapter 24		QZ

4/20/18 (F)	38) Organometallic compounds of <i>d</i> -block elements	Chapter 24	Homework #7	QZ
4/23/18 (M)	39) Organometallic compounds of <i>d</i> -block elements	Chapter 24		QZ
4/25/18 (W)	40) Catalysis and reactions	Chapter 25 & 26		QZ
4/27/18 (F)	41) Catalysis and reactions	Chapter 25 & 26	Homework #7 Due	QZ
5/04/18 (F)	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 on your home campus:

Pullman or WSU Online: 509-335-3417 <http://accesscenter.wsu.edu>, Access.Center@wsu.edu

Spokane: <http://spokane.wsu.edu/students/current/studentaffairs/disability/>

Tri-Cities: <http://www.tricity.wsu.edu/disability/>

Vancouver: 360-546-9138 <http://studentaffairs.vancouver.wsu.edu/student-resource-center/disability-services>

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.