Advanced Inorganic Chemistry
Chem 5520 | Fall 2013 | Room Widtsoe 330 (Chem Library)

Instructor

Prof. Siddhartha Das
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Office hours: By appointment

Class Time: Wed, 7:30 AM & Fri 4:30 PM

Required Text:


Reference Textbooks (Relevant sections will be discussed in the class and will be provided, if required):


Prerequisites: Chem 3070, 3510

Grading: Points are distributed as follows:

Quizzes (3 x 15 points) 45 pts
Literature presentation (11/22, 11/25/2013) 50 pts
Problem analysis (2 page writing) 150 pts
Assignments (3 x 25 pts) 75 pts
Midterm Exam #1 (09/27/2013, during class) 50 pts
Midterm Exam #2 (10/25/2013, during class) 50 pts
Midterm Exam #3 (11/20/2013, during class) 50 pts
Group Discussion Involvement 30 pts

Total points 500 pts
*Gain Score Assessment Tests (Extra credit) 10 pts

Tentative Grading Scale. (Brackets could be lowered to consider a weighted avg. - they will not be raised):

A-/A 90-100%
B-/B/B+ 80-89%
C-/C/C+ 70-79%
D/D+ 60-69%
COURSE RESOURCES:

Canvas

Canvas is the Learning Management System that we will use for our course. You can login to Canvas at https://online.usu.edu. Your username is your A#, and your password is your global password (the same one you use for Banner or Aggiemail). **Materials for the class will be available through Canvas.

COURSE ACTIVITIES:

Quizzes: Quizzes will be given on selected dates and will consist of 5-10 short questions that are relevant to the topics discussed in lectures going back to the previous quiz or exam. There will be no make-up quizzes.

Exams: Exams will include multiple choice questions, short-answer type questions and subjective questions (such as drawing MO energy level diagrams, drawing symmetry elements, writing basic reaction mechanisms, etc).

Literature Presentation: To facilitate your familiarity with the field of inorganic chemistry and the application of the course in recent seminal works, each student is required to make a formal ~15 minute presentation on a current literature article (2008-2012). Each student is expected to make a PowerPoint – Presentation. The article will be chosen by each student and approved by Prof. Das in advance (no later than Nov 08). The presentations will take place during two class periods on Nov 22 and 25, 2013. Grading will be based on your ability to present the core information of the article with your own insights, on the clarity of the presentation, on proper citation of reference sources and on your demonstration of a good understanding of the material (based on answering questions during presentation). This is expected to prepare students to get familiar with the current scientific world.

Problem Analysis: An ongoing scientific problem will be chosen (the same problem for all the students). The problem will be relevant to and can be approached with what you have learned in the course. It will be announced in the class by the 1st week of November. The students are expected to write 2 pages (including figures and references) proposing a feasible approach towards the problem (a detailed format for the paper will be provided). *High emphasis will be placed on valid reasoning with a creative, analytical, stepwise and scientifically sound approach.* A student can choose a different problem, but it should be approved by Prof. Das before Nov. 16, 2013. The paper is due by midnight, Dec 4, 2013 (NO EXCEPTION). This is expected to help students in future endeavor in attacking unsolved scientific problems (there are a lot of them, really!!)

Group Discussion Involvement: Discussion of science with friends and colleagues, leading to productive collaborations, is a cornerstone of current scientific research. During several classes Dr. Das will raise certain questions pertaining to what is being taught in the class, without any advance notice. The students will be encouraged to have informal discussions among themselves and present their thoughts to answer the problem or approach towards solving the problem in an analytical fashion. Students will be graded based on (a) their active involvement, (b) their presentation
of thoughts in a clear fashion, and (c) creativeness of their idea. This is expected to prepare students for impromptu discussions, which is highly important both in academia and in industries.

Following the DUE DATES: Students are expected to follow the deadlines or due dates. For assignments delay in their submission will cost a 5% deduction in points per day. In case of medical/family emergency supported by appropriate documentation (e.g. note from physician), an exception may be made.

"Gain-Score" Assessment Tests: Two short tests (~10 min) will be given — one in the 1st week and another in the beginning of the last week of classes. These short tests are given to assess your ability to apply, analyze, and synthesize information that is delivered throughout the course. You will receive 5 extra credit points for simply taking each "gain-score" assessment test, regardless of performance.

Missed Exam Policy: If a student misses, or will miss an exam, due to illness or family emergency, the student should speak to Prof. Das as soon as possible. A make-up exam will be offered if the absence is supported by appropriate documentation (e.g. note from physician or parent).

Withdrawal Policy and "I" Grade Policy: The administration of Chem 5520 will adhere strictly to the academic regulations stipulated in the most recent Schedule of Classes and the USU General Catalog. Withdrawal from the course will follow official USU procedures. Students are required to complete all courses for which they are registered by the end of the semester. In some cases, a student may be unable to complete all of the coursework because of extenuating circumstances, but not due to poor performance or to retain financial aid. The term 'extenuating' circumstances includes: (1) incapacitating illness which prevents a student from attending classes for a minimum period of two weeks, (2) a death in the immediate family, (3) financial responsibilities requiring a student to alter a work schedule to secure employment, (4) change in work schedule as required by an employer, or (5) other emergencies deemed appropriate by the instructor.

UNIVERSITY POLICIES:

Honor Pledge

Students will be held accountable to the Honor Pledge which they have agreed to: "I pledge, on my honor, to conduct myself with the foremost level of academic integrity."

Academic Dishonesty

The Instructor of this course will take appropriate actions in response to Academic Dishonesty, as defined the University's Student Code.

Full text of the Student Code available at

http://www.usu.edu/studentservices/pdf/StudentCode.pdf:
Students with Disabilities

Students with ADA-documented physical, sensory, emotional or medical impairments may be eligible for reasonable accommodations. Veterans may also be eligible for services. All accommodations are coordinated through the Disability Resource Center (DRC) in Room 101 of the University Inn, (435)797-2444 voice, (435)797-0740 TTY, (435)797-2444 VP, or toll free at 1-800-259-2966. Please contact the DRC as early in the semester as possible. Alternate format materials (Braille, large print or digital) are available with advance notice.

Plagiarism

Plagiarism includes knowingly "representing, by paraphrase or direct quotation, the published or unpublished work of another person as one's own in any academic exercise or activity without full and clear acknowledgment. It also includes the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials." The penalties for plagiarism are severe. They include warning or reprimand, grade adjustment, probation, suspension, expulsion, withholding of transcripts, denial or revocation of degrees, and referral to psychological counseling.

Sexual Harassment

Sexual harassment is defined by the Affirmative Action/Equal Employment Opportunity Commission as any "unwelcome sexual advances, requests for sexual favors, and other verbal or physical conduct of a sexual nature." If you feel that you are a victim of sexual harassment, you may talk to or file a complaint with the Affirmative Action/Equal Employment Opportunity Office located in Old Main, Room 161, or call the AA/EEO Office at 797-1266.

Course Objectives:

The objective of the course is to grow a critical and analytical thinking in metal-related chemistry:

- Use group theory to draw MO energy levels of small molecules.
- Use MOT and VBT to understand and predict the bonding nature of a molecule.
- Use LFT to predict (a) the geometry, (b) stability, (c) absorption spectra (i.e. color) of a transition metal complex.
- Count electrons in a metal complex and predict their relative closeness to metal vs. ligand.
- Make predictions on the reactivity of metal complexes towards specific bonds and small molecules.
- Have a broad perspective on the application of inorganic chemistry to answer today's important scientific problems.
- Critically read and analyze current journal reports that are relevant to inorganic chemistry.
TOPICS TO BE COVERED:

Bonding. Lewis representation, the VSEPR model, Ionic Bonding and Covalent Bonding, Valence Bond Theory, Hybridization, Molecular Orbital Theory.

Valence, Oxidation number and Formal charge (electron counting)

Symmetry and Molecular Orbital Theory. Understanding of symmetry elements, symmetry operations, point groups and their application in deriving MO energy levels, SALC.

Acid-Base chemistry. Hard and soft acids and bases; Lewis acids and bases.

Coordination chemistry of transition metals. Ligand field theory (LFT): its origin and applications; 18-electron rule, σ-donor, π-donor, π-acceptor, backbonding, spectator vs. actor ligands, CFSE, color of transition metal complexes (i.e. electronic absorptions).

Reactivity of metal sites. Rates of ligand substitution (based on CFSE and/or LFT), effect of electron transfer (inner sphere ET).

Inorganic reaction mechanisms. Substitution, oxidative addition & reductive elimination, α-bond metathesis ligand-based reactions, reactions of high oxidation-state metals (applications in bioinorganic chemistry).

Molecular chemistry to Materials, advancement of inorganic chemistry in 21st century and its impact on (a) industrial catalysis, (b) biomedical applications, (c) environmental applications, (d) renewable energy. (will be discussed separately as well as with relevant sections).