SYLLABUS
Chem 402/502
Spring 2022

ADVANCED INORGANIC CHEMISTRY

Instructor: William R. McNamara, PhD
ISC 2035
Phone: (757) 221-4868
Email: wrmcnamara@wm.edu

Office Hours:
Monday 8:30-10:00 AM
Wednesday 8:30-10:00 AM
(and by appointment!!!)

Course Description: This course is intended for chemistry majors and is designed to introduce students to advanced topics in inorganic/organometallic chemistry. The course expands upon what is learned in Inorganic Chemistry (Chem 312) by providing new ways of understanding how ligands and molecules interact with metal centers. The pedagogical mission of this course is to teach students how to read primary literature, communicate science through writing, and to construct new thoughts that tackle real-world problems.

Supplementary Texts: (On reserve in Swem)
Miessler & Tarr, Inorganic Chemistry, 5th ed.; Prentice Hall: Upper Saddle Riv., NJ, 2014.
F. A. Cotton, Chemical Applications of Group Theory, 3rd ed.; Wiley: New York, 1990.
A. F. Hill, Organotransition Metal Chemistry; Wiley-Interscience: New York, 2002.
E. A. V. Ebsworth, D. W. H. Rankin, and S. Cradock, Structural Methods in Inorganic Chemistry, 2nd ed.; CRC Press: Boca Raton, FL, 1991.

Lectures: TR 9:30-10:50 AM, ISC 2018. This course is an **in person** and is a discussion-based course. Owing to the current state of the pandemic (thanks, Omicron), there will be a live zoom of the course which will be recorded. Lectures will begin with introductory material needed to further the discussion of the primary literature. The second half of the class will be spent discussing the assigned piece of literature.

COVID-19 Policy: Your health is more important than inorganic chemistry. If you feel unwell at all (even if you don't suspect it to be COVID), please stay home and tune in to the zoom link. The current state of the pandemic is sneaky and symptoms can range significantly. If you are ill for any reason and need flexibility with respect to a due date, please try to reach out before-hand. I will never ask for specifics regarding illness and will work together with you for any necessary accommodations.

Primary Literature: Manuscripts will be made available the week before they are discussed on blackboard.

Guided Questions (10%): During the beginning of the course, problem sets containing questions on the manuscripts will be made available the week before a manuscript is discussed in class. Students are welcome to work in groups and the questions will be due before the manuscripts are discussed in class.

Literature Quizzes (30%, 10% each): Quizzes in Chem 402 will be short and will ask specific questions about an assigned piece of literature. The literature will be distributed 24 hours before the quiz and students will complete the quiz during the first 30-45 minutes of the class. All questions on the quiz will be regarding the assigned manuscript, however, key concepts learned in class will be woven into these questions.

Grant Writing Exercise - Make it Rain (30%): In modern science, principal investigators must often acquire funding from outside agencies in order to conduct research. The art of asking for money is therefore important to the modern chemist. Students will write a 2-3 page grant (single spaced, Chem 502: 3-4 pages) on a current topic in modern inorganic chemistry. Topics include synthetic inorganic/organometallic chemistry, metal organic frameworks/materials, physical inorganic chemistry, inorganic spectroscopy, electrochemistry, sustainable catalysis/green chemistry, bioinorganic, and renewable energy. Some specific topics are listed below. Students can chose a topic not on this list, but must get clearance from the instructor.

Possible Grant Topics (highlighted in class):
Lanthanide Catalysts, Carbon Dioxide Reduction. Metal Organic Frameworks, Water Oxidation (Bioinorganic), Electronic Structure of Complexes, Energy and Sustainability, Organometallic Catalysis (Organic Applications), Biological Imaging, Nanocrystal Fabrication, Bioinorganic chemistry, etc.

Grant Writing Exercise – Broader Impacts (20%): The National Science Foundation requires that successful grant applicants have a 1 page document for wide dissemination. These public documents describe to tax payers which projects are being funded and how the broader impacts of these projects can affect society in a positive way. Students will write a 1 page document outlining the broader impacts of the proposal from their 2-3 page grant.

Grading: 93-100 A; 89-92.5 A-; 85-88.5 B+; 81-84.5 B; 77-80.5 B-; 73-76.5 C+; 69-72.5 C; 65-68.5 C-; 55-64.5 D/D-; <55 F. This scale is tentative and the instructor reserves the right to curve the course. No grades will be curved downward.

Attendance and Participation (10%): Attendance for the course is mandatory (provided you are not ill, please see COVID-19 policy). If you are too ill to attend the Zoom stream, this will be excused. Interviews, graduate school visits, and other professional obligations will be excused absences. Discussions will drive the course and questions are highly encouraged!

Tentative Order of Topics:

Week 1: Intro and CBC Method for Metal Complex Characterization.
Week 2: CBC Method and back-bonding (CBC method exercise)
Week 3: Carbonyls and Tolman Parameters
Week 4: Other Important Ligands
Week 5: Oxidative Additions
Week 6: Reductive Elimination and other Elementary Steps
Week 7: Catalysis: Hydrogenations

Week 8: Hydrogenation: Transfer Hydrogenation
Week 9: Catalysis: Hydroformylation
Week 10: Catalysis: Coupling and Click Chemistry
Week 11: Green Chemistry
Week 12: Spectroscopy
Week 13: BioInorganic Chemistry (anti-cancer agents)
Week 14: Electrochemistry and Rewewable Energy
Week 15: Batteries and Flow Batteries