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CHM 1258H S 2024: REACTIONS OF LIGANDS
COURSE SYLLABUS: 2024 Winter

I CONTACTS

INSTRUCTOR

Prof. Robert H. Morris
robert.morris@utoronto.ca
Office: Davenport Labs, room 344, 80 Saint George St.
Student hour: 4-5 pm Mondays

Research: https://www.chemistry.utoronto.ca/people/directories/all-faculty/robert-morris

II COURSE OVERVIEW

COURSE DESCRIPTION:

CHM1258 Reactions of ligands
Robert Morris
Robert.morris@utoronto.ca

The success and power of homogeneous catalysis derives in large part from the wide choice of transition metal ions and their ligands. This tutorial review introduces examples where the reactivity of a ligand is completely reversed (umpolung) from Lewis basic/nucleophilic to acidic/electrophilic or vice versa on changing the metal and co-ligands. Understanding this phenomenon will assist in the rational design of catalysts. First the ways ligands and metal ions affect the electronics and sterics in metal complex and catalysts will be examined. The concept of the stereoelectronic map will be examined. Then labelling a metal and ligand with Seebach donor and acceptor labels will identify whether a reaction involving the intermolecular attack on the ligand is displaying native or reactivity umpolung. This has been done for complexes of nitriles, carbonyls, isonitriles, dinitrogen, Fischer carbenes, alkenes, alkynes, hydrides, methyls, methylidenes and alkylidenes, silylenes, oxo/oxide, imide/nitrene, alkylidyne, methylidyne, and azo/nitride. The electronic influence of the metal and co-ligands is discussed in terms of the energy of (HOMO) *d* electrons. The energy can be related to the pK_a^{LAC} (LAC is ligand acidity constant) of the theoretical hydride complexes $[H\text{-}[M]\text{-}L]^+$ formed by the protonation of a lone pair of *d* electrons. We will apply this knowledge to selected homogeneous catalytic systems. From Lewis acid-base reactivity we will then look at redox and radical reactivity for selected ligands and homogenous catalysts.

STUDENT LEARNING OUTCOMES:
At the end of the course, successful students will be able to:
1. Recognize how the fundamental principles of inorganic and organic chemistry apply to reactions of small molecules coordinated in transition metal complexes
2. Appreciate how these principles can be used to understand and design catalytic cycles.
3. Understand how reactivity can be reversed from electrophilic to radical to nucleophilic as the ancillary ligands in the metal complex change.
4. Discuss critically current articles on the subject.
5. Organize a small review of a current topic.

PREREQUISITE COURSES:
Strongly recommended: Advanced transition metal chemistry course, organometallic chemistry course

READINGS:
Course notes from the QUERCUS website at CHM1258H S LEC0101 20241:Reactions of Coordinated Ligands (utoronto.ca)

III HOW THE COURSE IS ORGANIZED

- one class each week starting on Friday January 12 2:00-4:00 pm, 2024, on Zoom (please let me know if this time does not work for you).

Zoom link: https://utoronto.zoom.us/j/84673245487
Meeting ID: 846 7324 5487
Passcode: 342147
Robert Morris is inviting you to a scheduled Zoom meeting.

COURSE SCHEDULE & RELEVANT SESSIONAL DATES:

DATES	**WEEK**	DETAILS
Jan. 12	1	Introduction to CHM1258, Zoom
Jan. 12-Feb. 16	1-6	Assignment due Feb. 16 Steric and electronic effects, parameters, umpolung, (sp-L) carbonyls, isonitriles, dinitrogen, (sp^2-L) Fischer carbenes, olefins
Feb. 19-23		Reading week
Mar. 1-Mar. 22	6-9	Report on chosen topic due Mar 22 (X) Hydride, methyl, (X_2) methylidene, take up assignment, oxo, azo, (X_3) carbyne, nitride, hydrogenation
March 29		Holiday
April. 5	11	Student presentations in person
April 10-30	12	**Final assessment period**

IV EVALUATION/GRADING SCHEME

ASSIGNMENT (Due Feb. 16) worth 20%
REPORT (Due Mar. 22) worth 25%
PRESENTATION (due April 5) worth 25%
FINAL EXAM worth 30%
Total 100%

V COURSE POLICIES

- Each member of this course is expected to maintain a:

(i) professional and respectful attitude during all course activities, including classes and online activity.
(ii) personal calendar/schedule/organizer to ensure that all course activities are completed, and due dates are met.
(iii) collection of notes recorded independently based on concepts covered in course activities (students registered with Accessibility Services requiring a class note-taker will have access to this accommodation)
(iv) familiarity with the university policy on Academic Integrity (see below)

- The University of Toronto is committed to equity, human rights and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. As a Course Instructor, I will neither condone nor tolerate behaviour that undermines the dignity or self-esteem of any individual in this course and wish to be alerted to any attempt to create an intimidating or hostile environment. It is our collective responsibility to create a space that is inclusive and welcomes discussion. Discrimination, harassment and hate speech will not be tolerated. If you have any questions, comments, or concerns, we encourage you to reach out to the staff in our Equity Offices.

- I will respond to email within 24 hrs. on weekdays.

- Privacy language and appropriate use of course materials: For additional information, see the syllabus "Copyright" section.

- 10% will be deducted daily for late work.

- If you miss the presentation of your topic in the case of illness, your mark will be reweighted 25% Assignment, 30% Report, 45% Final exam.

- All submissions are done at the website

- If you believe an assignment should be regraded, please contact Prof. Morris by email within one day of receiving the marked work to make an appointment.

- In case of missed work caused by illness, please contact Prof. Morris immediately by email. No extensions or make-up work will be considered.

VI TECHNOLOGY REQUIREMENTS

Specific guidance from the U of T Vice-Provost, Students regarding student technology requirements is available here: https://www.viceprovoststudents.utoronto.ca/covid-19/tech-requirements-online-learning/

Using Zoom

Go to https://utoronto.zoom.us **Register with your UTORONTO e-mail address for Zoom.** This is very important – access to Zoom meetings may be restricted to utoronto users, and if you use a different e-mail address for your registration, you will not get access to an online class that has this restriction in place. Be sure to **be logged into Zoom when attending** Zoom meetings (don't just attend as a guest). The Zoom link for your class is listed under (III) above.

Tips for Zoom use:

- In your Zoom profile, add a profile picture, normally a picture of yourself. Both your instructors and your fellow students will remember you better if they can link a face to a name. An online learning experience does not have to be cold and impersonal.
- While you can attend Zoom meetings just using your web browser and the Zoom web site, it is strongly recommended that you download and install the Zoom desktop app. You have more features and a smoother experience.
- If you have a choice, use a desktop computer or laptop and not a cell phone. Zoom on cell phones works poorly. Also, if you have a choice, faster Internet connections will give you a better experience. Often a wired Internet connection is faster than wireless.
- At the beginning of the meeting, make sure your microphone (bottom left of your screen) is muted. You can turn it on later if needed. You can leave your camera on but be prepared to turn it off if Internet bandwidth is low.

Notice of Video Recording and Sharing:

This course, including your participation, will be recorded on video and will be available to students in the course for viewing remotely and after each session. Course videos and materials belong to your instructor(s), the University, and/or other source depending on the specific facts of each situation, and are protected by copyright. In this course, you are permitted to download session videos and materials for your own academic use, but you should not copy, share, or use them for any other purpose without the explicit permission of the instructor. For questions about recording and use of videos in which you appear please contact your instructor.

General tips for the online learning experience:

Multitasking. Simply put, multitasking does not work. Avoid unnecessary open tabs on your web browser and unnecessarily open apps. Close e-mail etc. during class time. While you will need a

couple of tabs and apps open (say, your course web site and the Zoom App or Bb Collaborate page), have open only what you need (not Facebook).

Advice for students more broadly regarding online learning is available here: https://onlinelearning.utoronto.ca/getting-ready-for-online/

This course requires the use of computers, and of course sometimes things can go wrong when using them. You are responsible for ensuring that you maintain regular backup copies of your files, use antivirus software (if using your own computer), and schedule enough time when completing an assignment to allow for delays due to technical difficulties. Computer viruses, crashed hard drives, broken printers, lost or corrupted files, incompatible file formats, and similar mishaps are common issues when using technology, and are not acceptable grounds for a deadline extension.

VII INSTITUTIONAL POLICIES AND SUPPORT

ACADEMIC INTEGRITY

Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously. The University of Toronto's Code of Behaviour on Academic Matters (https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences include, but are not limited to:

In assignments and laboratory reports:

1. Using someone else's ideas or words without appropriate acknowledgement.
2. Submitting your own work in more than one course without the permission of the instructor.
3. Making up sources or facts.
4. Obtaining or providing unauthorized assistance on any assignment.

On tests and exams:

1. Using or possessing unauthorized aids.
2. Looking at someone else's answers during an exam or test.
3. Misrepresenting your identity.

In academic work:

1. Falsifying institutional documents or grades.
2. Falsifying or altering any documentation required by the University.

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, you are expected to seek out additional information on academic integrity from

your instructor or from other institutional resources (see https://www.academicintegrity.utoronto.ca/).

Plagiarism detection tool

Normally, students will be required to submit their course essays to the University's plagiarism detection tool for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the tool's reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of this tool are described on the Centre for Teaching Support & Innovation web site (https://uoft.me/pdt-faq)."

COPYRIGHT
If a student wishes to copy or reproduce lecture presentations, course notes or other similar materials provided by instructors, he or she must obtain the instructor's written consent beforehand. Otherwise all such reproduction is an infringement of copyright and is absolutely prohibited. More information regarding this is available here: https://teaching.utoronto.ca/ed-tech/audio-video/copyright-considerations/

ACCESSIBILITY NEEDS
Students with diverse learning styles and needs are welcome in this course. The University of Toronto is committed to accessibility: if you require accommodations for a disability, or have any other accessibility concerns about the course, please contact Accessibility Services (https://studentlife.utoronto.ca/department/accessibility-services/) as soon as possible.

ADDITIONAL SERVICES and SUPPORT
The following are some important links to help you with academic and/or technical service and support

- General student services and resources at Student Life (https://studentlife.utoronto.ca/)
- Full library service through University of Toronto Libraries (https://onesearch.library.utoronto.ca/)
- Resources on conducting online research through University Libraries Research (https://onesearch.library.utoronto.ca/research)
- Resources on academic support from the Academic Success Centre (https://studentlife.utoronto.ca/department/academic-success/)
- Learner support at the Writing Centre (https://writing.utoronto.ca/)
- Information for Technical Support/Quercus Support (https://q.utoronto.ca/courses/46670/)