Syllabus for CHMD69H3 *Bioinorganic Chemistry*

Course Instructor: Kagan Kerman, e-mail: kkerman@utsc.utoronto.ca

Kagan's office: Room 533, Science Wing, office phone: (416) 287 - 7249

Kagan's office hours: Friday, 2:00 - 5:00 pm or e-mail me (kkerman@utsc.utoronto.ca) for an appointment (please, suggest at least two possible times for the appointment).

Recommended Reading: Students are strongly encouraged to follow the lectures from the notes of the instructor for guidance in readings from online chemistry journals and also from the following textbooks:

1) Bertini, I.; Gray, H. B.; Stiefel, E. I.; Valentine, J. S., Editors. **Biological Inorganic Chemistry** (978-1-891389-43-6, University Science Books, 2007)
2) Kraatz, H.-B.; Metzler-Nolte, N., Editors. **Concepts and Models in Bioinorganic Chemistry** (978-3-527-31305-1, Wiley 2006)
3) Lippard, S. J.; Berg, J. M., Editors. **Principals of Bioinorganic Chemistry** (ISBN 978-0-935702-72-9, University Science Books, 1994)

These recommended readings are available in the Reserves section of the UTSC Library.

Course Description: This course will explore the inorganic chemistry behind the requirement of biological cells for metals. The course will begin with the principles of coordination chemistry and a survey of the abilities of various functional groups within proteins and nucleic acids to form coordination complexes with metal ions. The reactivity of coordination complexes of metal ions will be discussed in the context of the reaction mechanisms of specific metalloenzymes. A large portion of the course will be devoted to medically-relevant topics such as the mechanisms by which organisms obtain required metal ions from their environment, metal-related diseases and the toxicity of metals such as cadmium, arsenic, lead and mercury. The use of metal-containing anti-cancer agents, contrast agents for medical imaging and radiopharmaceuticals will be discussed in detail.

Prerequisites: BGYC12H: *Biochemistry I: Proteins and Enzymes* and BGYC13H *Biochemistry II: Bioenergetics and Metabolism*, CHMB41H and CHMB42H *Organic Chemistry I and II*, CHMB31H: *Introduction to Inorganic Chemistry*, CHMC31: *Intermediate Inorganic Chemistry*.

Course Topics:

September 11
Lecture 1. Introduction to Bioinorganic Chemistry & Principals of Coordination Chemistry

September 18
Lecture 2. Metal ions and proteins: Binding, Stability, and Folding

September 25
Lecture 3. Metallotherapeutics-1: Imaging and Diagnostics

October 2
Lecture 4. Metallotherapeutics-2: Molecular targets

October 9
Lecture 5. Guest Lecturer: Professor Andrew Ellington, Dept. of Chemistry & Biochemistry, University of Texas at Austin
"Living systems without cells"
The seminar will be in the Davenport Seminar Room in Chemistry Dept. (80 St. George Street) at 10 am.
Homepage of the Lecturer: http://ellingtonlab.org/main/static.php?page=aboutus

October 16
Lecture 6. Metals in Brain: Neurodegenerative diseases

October 23
Lecture 7. **Mid-term Test (1 h)**
Metals in Toxicology-1

October 30
Lecture 8. Metals in Toxicology-2
Transport, storage and homeostasis of metals

November 6
Lecture 9. Sodium & Potassium: Channels and Pumps
Magnesium: Phosphate metabolism and photoreceptors
Calcium: Cellular signalling

November 13
Lecture 10. Zinc: Lewis acid and gene regulator
Iron: Essentials
Manganese: Water splitting

November 20
Lecture 11. Copper: Coping with dioxygen
Nickel and Cobalt: Evolutionary relics
Molybdenum, Tungsten, Vanadium and Chromium

November 27
Lecture 12. Biominerals and Biomineralization
Bioinorganic Electrochemistry

Course Instruction: The course will consist primarily of lectures.

Lectures: Friday, 10:00 - 12:00 in Arts and Administration Building, Room AA206

Evaluation:

Evaluation components	**Percent**
Mid-term Exam	**40%**
Quiz	**5%**
Assignments	**15%**
Final Exam	**40%**

Mid-term and Final Exams will contain multiple-choice and short answer questions.

During each lecture, there is going to be a quiz about the topics of the previous lecture. Quizzes will be open-book with multiple-choice and short answer questions.

Assignments:
1) Students will prepare an oral presentation for 10 min about one of the articles that the Instructor is going to provide. The list of articles will be announced on the course websites. Each student will present a different article. The presentations will be made after the mid-term exam. (10% of 15%)
2) Students will prepare 10 multiple-choice and short answer questions about one of the topics of the lectures. Each student will prepare questions about a different topic. The deadline for this assignment is November 30. (5% of 15%)

Course Policies and General Information:

Course Announcements: Announcements, updates to readings, assignment topics, requirements, and evaluation, etc. will be posted to the course site on Blackboard and Intranet. Students are responsible for checking the course websites regularly.

Lecture/Lab Attendance: Attendance at lectures is expected. In the event you arrive late, check in with the Instructor. However, 20 minutes late is considered absent.

Participation: Participation in class discussions is expected. Your participation will be evaluated based on completion of assessments and grades on unannounced quizzes that will be given during lectures.

Office Hours: Students are welcome to ask questions or resolve course-related problems by contacting the Course Instructor either by dropping in during scheduled office hours or by making an appointment. Students are responsible for work missed as a result of absence. Course Instructor will not re-teach material covered in the lectures and lab sessions.

e-mail Communication: The Course Instructor may be contacted via the course e-mail address (kkerman@utsc.utoronto.ca) to get clarification on course-related issues, to submit assignments, or to ask brief questions. The Course Instructor will endeavour to provide responses to emails within 48 hours. Urgent issues must be communicated in person or by telephone (with a follow up email message).

Assignment Submission: Late assignments should be e-mailed to my e-mail address (kkerman@utsc.utoronto.ca). Work submitted more than seven days (not including Sat. and Sun.) after the due date will not be accepted. Extensions *may* be granted when students present the Course

Instructor with a compelling reason for their inability to meet the deadline with satisfactory documentation (e.g., a doctor's note indicating the reason for the late submission). A technical or computer glitch will not be accepted as a valid reason for an extension.

Missed mid-term Test & Quizzes: The exact date of the mid-term test will be provided when the examination is scheduled. Quizzes will be given during each lecture. Students who miss the term test or any of the quizzes will be assigned a mark of zero for the test or quiz, unless they can document a compelling reason for missing it. Students in that position must submit a written request to the Course Instructor with appropriate documentation. If a request is accepted for the mid-term test, the weighting of the final examination will be increased to 50%. If a request is accepted for any of the quizzes, the weighting of the remaining quizzes will be adjusted accordingly. **There will be no make-up quizzes or mid-term tests**.

Final Examination: The final examination will take place during the UTSC examination period in December following the end of the course. The exact date will be provided when the examination is scheduled.

Access*Ability*: Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the Access*Ability* Services Office as soon as possible. The UTSC Access*Ability* Services staff (located in **S302**) are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations (416) 287-7560 or ability@utsc.utoronto.ca. The sooner you let us know your needs the quicker, we can assist you in achieving your learning goals in this course.

Cell Phones: During lectures and labs please turn off your cell phones to avoid disruption of the class. If circumstances warrant use of your cell phone and you must receive an emergency call, please inform the Course Instructor at the beginning of the session in advance and then excuse yourself from the session to respond to the call outside the lecture or lab.

Academic Calendar: Further information about academic regulations and course withdrawal deadlines can be found in the UTSC Calendar. You are encouraged to read this material.

Centre for Teaching and Learning: If you need assistance with effective writing skills, study skills, exam preparation, note taking, or time management, free workshops and advice are available from the Centre for Teaching and Learning, which can be reached at:
http://www.utsc.utoronto.ca/~ctl/Student_Support/index.html

Computer Use: Ethical use of University computers is expected at the University of Toronto at Scarborough. Guidelines are set out in the UTSC Calendar. It is expected that the equipment and/or resources accessed in the UTSC Library and the computer labs are to be used for academic research, assignments, and course activities only.

Academic Integrity: Honesty and fairness are considered fundamental to the University's mission, and, as a result, all those who violate those principles are dealt with as if they were damaging the integrity of the University itself. When students are suspected of cheating or a similar academic offence, they are

typically surprised at how formally and seriously the matter is dealt with - and how severe the consequences can be if it is determined that cheating did occur. The University of Toronto treats cases of cheating and plagiarism very seriously.

Examples of offences for which you will be penalized include (but are not limited to):

- Using any unauthorized aids on an exam or test (e.g., "cheat sheets")
- Representing someone else's work or words as your own - plagiarism (see web document "How not to plagiarize" available online at http://www.utoronto.ca/writing/plagsep.html
- Falsifying documents or grades
- Purchasing an essay
- Submitting someone else's work as your own
- Submitting the same essay or report in more than one course (without permission)
- Looking at someone else's answers during an exam or test
- Impersonating another person at an exam or test or having someone else impersonate you
- Making up sources or facts for an essay or report.

As a student it is your responsibility to ensure the integrity of your work and to understand what constitutes an academic offence. If you have any concerns that you may be crossing the line, please, read from the website http://www.utoronto.ca/academicintegrity/resourcesforstudents.html and always consult your instructor. Your instructor can explain, for example, the nuances of plagiarism and how to use secondary sources appropriately; he or she will also tell you what kinds of aids - calculators, dictionaries, etc. - are permitted in a test or exam. Ignorance of the rules does not excuse cheating or plagiarism.

This information is taken from the brochure, "Academic Integrity" and website, part of a series of UT publications to help students understand the University's rules and decision making structures. For copies, visit the Office of the Registrar at UTSC. All of the policies and procedures surrounding academic offences are dealt with in one policy: "The Code of Behaviour on Academic Matters". The full text is located in the back of the UTSC Calendar.