UNIVERSITY OF THE FRASER VALLEY

ORIGINAL COURSE IMPLEMENTATION DATE: September 1997
REVISED COURSE IMPLEMENTATION DATE: September 2019
COURSE TO BE REVIEWED (six years after UEC approval)**:** October 2022
Course outline form version: 10/27/2017

OFFICIAL UNDERGRADUATE COURSE OUTLINE FORM

Note: The University reserves the right to amend course outlines as needed without notice.

Course Code and Number: CHEM 451	**Number of Credits: 3** Course credit policy (105)

Course Full Title: Bio-inorganic Chemistry

Course Short Title:

(Transcripts only display 30 characters. Departments may recommend a short title if one is needed. If left blank, one will be assigned.)

Faculty: Faculty of Science	**Department (or program if no department):** CHEMISTRY

Calendar Description:

Bio-inorganic chemistry is a rapidly expanding area and provides an important bridge between chemistry and biology. Students will study a variety of biological systems involving both main-group and transition metals.

Prerequisites (or NONE):	CHEM 221 and one of the following: CHEM 320, CHEM 341, CHEM 350, or BIO 320.
Corequisites (if applicable, or NONE):	NONE
Pre/corequisites (if applicable, or NONE):	NONE

Antirequisite Courses *(Cannot be taken for additional credit.)*

Former course code/number:

Cross-listed with:

Dual-listed with:

Equivalent course(s):

(If offered in the previous five years, antirequisite course(s) will be included in the calendar description as a note that students with credit for the antirequisite course(s) cannot take this course for further credit.)

Typical Structure of Instructional Hours

Lecture/seminar hours	45
Tutorials/workshops	
Supervised laboratory hours	
Experiential (field experience, practicum, internship, etc.)	
Supervised online activities	
Student directed learning	
Total hours	**45**

Labs to be scheduled independent of lecture hours: ☒ No ☐ Yes

Special Topics

This course is offered with different topics:

☒ No ☐ Yes *(Double-click on box to select it as checked.)*

If yes, different lettered courses may be taken for credit:

☐ No ☐ Yes, repeat(s) ☐ Yes, no limit

(The specific topic will be recorded when offered.)

Transfer Credit

Transfer credit already exists: *(See **bctransferguide.ca**.)*

☒ No ☐ Yes

Submit outline for (re)articulation:

☐ No ☐ Yes *(If yes, fill in transfer credit form.)*

Grading System

☒ Letter Grades ☐ Credit/No Credit

Expected Frequency of Course Offerings:

every second year

(Every semester, Fall only, annually, every other Fall, etc.)

Department / Program Head or Director: Cory Beshara	**Date approved:**	March 9, 2018
Faculty Council approval	**Date approved:**	September 7, 2018
Dean/Associate VP: Greg Schlitt (Acting)	**Date approved:**	September 7, 2018
Campus-Wide Consultation (CWC)	**Date of posting:**	October 19, 2018
Undergraduate Education Committee (UEC) approval	**Date of meeting:**	October 26, 2018

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. Describe the properties of biological molecules (proteins, nucleic acids, and other metal-binding biomolecules) that contain metal ions.
2. Describe critically the type of information relating to metal ions that can be obtained from certain physical methods, such as X-ray diffraction, NMR and EPR, Mossbauer spectroscopy, FT-IR spectroscopy, circular dichroism, and UV-Visible spectroscopy.
3. Describe the choice, uptake, and assembly of metal-containing units in biology.
4. Explain the means by which organisms regulate metal ion concentrations in the cell.
5. Summarize the involvement of metal ions in determining the correct folding and cross-linking of biomolecules.
6. Discuss critically the factors that determine the binding of metal ions and complexes to proteins and nucleic acids.
7. Explain the role of metals in electron-transfer proteins.
8. Outline the role of metal ions in specific enzyme reactions involving non-redox reactions, and atom- and group-transfer reactions.
9. Expound upon several examples by which proteins tune the properties of metals to achieve specific functions.

Prior Learning Assessment and Recognition (PLAR)

☒ Yes ☐ No, PLAR cannot be awarded for this course because

Typical Instructional Methods *(Guest lecturers, presentations, online instruction, field trips, etc.; may vary at department's discretion.)*

Presentation of the course will be by interrelated theory classes ("lectures"), and discussion periods ("seminars"). Audio visual aids will be used where appropriate, and students will be expected to use the UFV library for literature research. Students may be required to present seminars or research papers.

NOTE: The following sections may vary by instructor. Please see course syllabus available from the instructor.

Typical Text(s) and Resource Materials *(If more space is required, download Supplemental Texts and Resource Materials form.)*

	Author (surname, initials)	Title (article, book, journal, etc.)	Current ed.	Publisher	Year
1.	Lippard, S.J. and J.M. Berg	Principles of Bioinorganic Chemistry	☐		
2.	Wolfgang Kaim, Brigitte Schwederski, Axel Klein	Bioinorganic Chemistry, Inorganic Elements in the Chemistry of Life	☐	Wiley	2013
3.	Dieter Rehder	Bioinorganic Chemistry	☐	Oxford University Press	2014
4.			☐		
5.			☐		

Typical Evaluation Methods and Weighting

Final exam	40%	Assignments and seminar presentations:	20%	Field experience:	%	Portfolio:	%
Midterm exam(s):	40%	Project:	%	Practicum:	%	Other:	%
Quizzes/tests:	%	Student Proposal	%	Oral Presentations:	%	Total:	100%

Details (if necessary):

Typical Course Content and Topics

The course will be based on the required text. The course will also make use of reprint materials.

1. **Introduction** - Essential and non-essential elements. Cycles of macronutrients and trace elements. Biological ligands and ligand specificity. Hard and soft acids and bases. Stability constants. Kinetics of aquo exchange processes. Binding residues in amino acids.
2. **Phosphorus Chemistry** - Transport enzymes involving ATP. Kinases, role of group IA and IIA cations. Cell membranes.
3. **Review of Protein Structure, Enzymes, Coenzymes.**
4. **Metals in Photosynthesis** - Role of magnesium and manganese.
5. **Dioxygen Carriers and Storage** - Hb Mb Hc and Hr and O2 binding. Synthetic models for oxygen-binding proteins. O2 activation. Monooxygenases. Cytochrome P450. Tyrosinase. Methene mono--oxygenase. Role of copper. Dioxygenases and oxidases. Superoxide Dismutase. Horse Radish Peroxidases. Catalase.
6. **Electron Transfer Processes** - Cytochrome a, b and c. Blue copper protein. Fe-S protein. Molybdoenzymes and cobalamins.
7. **Non-Redox Metalloenzymes.**
8. **Nitrogen Fixation** - Nitrogenases. Nitrate reductase. Fe and Mo proteins and enzymes.
9. **Pharmaceuticals** - Therapeutic activity of chelating agents. Platinum complexes in chemotherapy. Biological chemistry of gold complexes. Radiopharmaceuticals.
10. **Toxicity of Heavy Metals and Other Elements** - Toxicity of Cu, Cd, Pb, Hg, Se, As, Be, V, Cr, Mn, Ni.
11. **Physical Methods** - Illustrative examples involving.