OFFICIAL UNDERGRADUATE COURSE OUTLINE (page 1)

COURSE IMPLEMENTATION DATE:
COURSE REVISED IMPLEMENTATION DATE: September 2012
COURSE TO BE REVIEWED: June 2018
(six years after UEC approval) *(month, year)*

OFFICIAL UNDERGRADUATE COURSE OUTLINE INFORMATION

Students are advised to keep course outlines in personal files for future use.
Shaded headings are subject to change at the discretion of the department – see course syllabus available from instructor

CHEM 451	Science / Chemistry	3
COURSE NAME/NUMBER	FACULTY/DEPARTMENT	UFV CREDITS

Bio-inorganic Chemistry
COURSE DESCRIPTIVE TITLE

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: CHEM 221 and one of CHEM 321, CHEM 341, CHEM 350, or BIO 320.
COREQUISITES: None
PRE or COREQUISITES:

SYNONYMOUS COURSE(S):
(a) Replaces: **n/a**
(b) Cross-listed with:
(c) Cannot take: for further credit.

SERVICE COURSE TO: *(department/program)*

TOTAL HOURS PER TERM: **42**

STRUCTURE OF HOURS:

Lectures:	**42**	Hrs
Seminar:		Hrs
Laboratory:		Hrs
Field experience:		Hrs
Student directed learning:		Hrs
Other (specify):		Hrs

TRAINING DAY-BASED INSTRUCTION:
Length of course:
Hours per day:

OTHER:
Maximum enrolment: **24**
Expected frequency of course offerings: every second year
(every semester, annually, every other year, etc.)

WILL TRANSFER CREDIT BE REQUESTED? (lower-level courses only)	☐ Yes	☐ No
WILL TRANSFER CREDIT BE REQUESTED? (upper-level requested by department)	☐ Yes	☒ No
TRANSFER CREDIT EXISTS IN BCCAT TRANSFER GUIDE:	☐ Yes	☒ No

Course designer(s): **Nigel Dance**

Department Head:	**David Fenske**	Date approved:	**April 13, 2012**
Supporting area consultation (Pre- UEC)		Date of meeting:	**April 27, 2012**
Curriculum Committee chair:	**David Fenske**	Date approved:	**May 18, 2012**
Dean/Associate VP:	**Ora Steyn**	Date approved:	**June 1, 2012**
Undergraduate Education Committee (UEC) approval		Date of meeting:	**June 22, 2012**

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 uponseveral examples by which proteins tune the properties of metals to achieve specific functions.

METHODS: *(Guest lecturers, presentations, online instruction, field trips, etc.)*

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

METHODS OF OBTAINING PRIOR LEARNING ASSESSMENT RECOGNITION (PLAR):

☐ Examination(s) ☐ Portfolio assessment ☐ Interview(s)

☒ Other (specify): Course Challenge

☐ PLAR cannot be awarded for this course for the following reason(s):

TEXTBOOKS, REFERENCES, MATERIALS:

[Textbook selection varies by instructor. An example of texts for this course might be:]

S.J. Lippard and J.M. Berg. Principles of Bioinorganic Chemistry

SUPPLIES / MATERIALS:

STUDENT EVALUATION:

[An example of student evaluation for this course might be:]

Evaluation will be based on the following system:

First in-term test	20%
Second in-term test	20%
Collected assignments or seminar presentations	20%
Final examination	40%

COURSE CONTENT:

[Course content varies by instructor. An example of course content might be:]

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.**

Course content continued:

4. **Metals in Photosynthesis** - Role of magnesium and manganese.
5. **Dioxygen Carriers and Storage** - Hb Mb Hc and Hr and O_2 binding. Synthetic models for oxygen-binding proteins. O_2 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.

Reading Resources:

Lippard, Stephen J. and Berg, Jeremy M. Principles of Bioinorganic Chemistry, 1st ed., University Science Books, 1994.

Kaim, Wolfgang and Schwederski, Brigitte. Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life, 1st ed., Wiley, 1994.

Cowan, James A. Inorganic Biochemistry: An Introduction, 1st ed., VCH, 1993.

Frausto da Silva, J.J.R. and Williams, R.J.P. The Biological Chemistry of the Elements: the Inorganic Chemistry of Life,1st ed., Oxford University Press, 1991.

Ochiai, Ei-ichiro. General Principles of Biochemistry of the Elements., 1st ed., Plenum Press, 1987, Inc., 1967.

Hay, Robert W. Bio-Inorganic Chemistry, 1st ed., Halsted Press, 1984.