UNIVERSITY COLLEGE OF THE FRASER VALLEY

COURSE INFORMATION

DISCIPLINE/DEPARTMENT: CHEMISTRY **IMPLEMENTATION DATE**: Fall 1997

Revised:

CHEM 231	Transition Metal Chemistry	4
SUBJECT/NUMBER OF COURSE CREDITS	**DESCRIPTIVE TITLE**	**UCFV**

CALENDAR DESCRIPTION: This course involves the study of the coordination chemistry of the transition metals. Topics covered include isomerism, symmetry, group theory, molecular orbital theory, uv-visible spectroscopy, and the kinetics and mechanisms of ligand substitution and redox reactions. If time permits, organometallic chemistry and bioinorganic chemistry will also be introduced.

RATIONALE: With the introduction of an upper level Bio-Inorganic Chemistry course (Chem 451), it will be necessary for students to take an introductory inorganic chemistry course prior to taking Chem 451. Chem 231 is designed to fulfil this role. This course includes much of the material found in the present Intermediate Inorganic Chemistry course, Chem 321, and it is not intended that students will take both Chem 231 and Chem 321.

COURSE PREREQUISITES: Chemistry 221

COURSE COREQUISITES: None

HOURS PER TERM FOR EACH STUDENT	**Lecture**	**42**	**hrs**	**Student Directed Learning**	**hrs**
	Laboratory	**42**	**hrs**		
	Seminar	**10**	**hrs**	**Other - specify:**	
	Field Experience		**hrs**		**hrs**
	TOTAL	**94**	**HRS**		

MAXIMUM ENROLMENT: 24

Is transfer credit requested? : Yes 9 No

AUTHORIZATION SIGNATURES:

Course Designer(s): N. Dance/L. Martin **Chairperson**: T. Cooper

Curriculum Committee

Department Head: A. Last **Dean**: W. Welsh

PAC: Approval in Principle **PAC: Final Approval**: January 29, 1997

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SYNONYMOUS COURSES:

(a) replaces Chem 321
(course #)

(b) cannot take Chem 321 for further credit
(course #)

SUPPLIES/MATERIALS:

All lab supplies are provided.

TEXTBOOKS, REFERENCES, MATERIALS (List reading resources elsewhere)

TEXT:
G.L. Miessler and D.A. Tarr, Inorganic Chemistry, 1991 edition, Prentice Hall Publishers, ISBN| 01-346-56598.

REFERENCE:
J.E. Huheey, E.A. Keiter, R.L. Keiter, Inorganic Chemistry--Principles of Structure and Reactivity, 4th Ed., Harper Collins Publishers, ISBN 0--6-042995-X

OBJECTIVES:

This course is designed to enable students to relate theories of bonding and structure to the properties of inorganic materials. Specifically, students should be able to use symmetry, group theory and molecular orbital theory to explain the uv-visible and ir spectra of transition metal coordination complexes. Students should be able to explain the kinetics and mechanisms of several types of ligand substitution and redox reactions. The course will prepare students for subsequent courses in Bio-Inorganic and Organometallic Chemistry.

METHODS:

The course will involve traditional lectures, tutorials, use of audio visual materials and problem solving.

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STUDENT EVALUATION PROCEDURE:

Evaluation will be based on the following. However, individual instructors may vary this system somewhat.

First in-term test	15%
Second in-term test	15%
Problem sets	10%
Laboratory reports	25%
Final exam	35%

COURSE CONTENT

Text: Miessler and Tarr "Inorganic Chemistry"

1. Introduction (Ch. 10)
   Coordination numbers, geometry, isomerism and types of ligands in coordination compounds. 2 hours

2. Review of Symmetry and Group Theory (Chs. 4, 5)
   The time spent on this topic will be dependent on the students' prior learning. 4-8 hours

3. Electronic Structure of Transition Metals (Ch. 2, pp. 34-48)
   Aufbau Principle, shielding, quantum numbers of multielectron atoms, free ion terms, spin-orbit coupling 2 hours

4. The Metal-Ligand Bond (Chs, 3,8,9)
   MO theory, correlation diagrams and group orbitals, application of group theory to molecular orbitals, octahedral, tetrahedral and square-planar geometries, magnetic moments, visible spectra, the spectrochemical series, Jahn-Teller distortion, application of the angular overlap model 12 hours

5. Complex Stability (Ch. 8)
   Stability constants, the effect of CFSE and choice of ligands on the thermodynamic stability of complexes 3 hours

6. Kinetics (Ch. 11)
   Inert and labile compounds, dissociative, associative and interchange mechanisms, kinetic chelate effect, the trans effect, inner and outer-sphere redox reactions 5 hours

7. Organo-transition Metal Chemistry (Ch. 12)
   Nomenclature, the 16-18 electron rule and electron counting, application of the 18 electron rule to various geometries, bonding of carbonyl, alkyl, alkene, alkyne and allyl and arene ligands 7 hours
8. Bioinorganic Chemistry (Ch. 15)
   Structures, electron configurations and properties of iron porphyrins and related compounds 3 hours

9. Recent Advances in Inorganic Chemistry
   Reprint material will be used to illustrate recent advances in the area 3 hours

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LABORATORY EXPERIMENTS:

An in-house laboratory manual will be prepared prior to the course running.

Eight or nine experiments will be chosen from the following:

1. Synthesis of Geometric Isomers of a Cr(III) complex.
2. Composition of the Fe(III)/SCN^- Complex using Job's Method.
3. Determination of the Formula of the Cuprammonium Ion.
4. Composition of Ni/ethylenediamine Complexes using Job's Method.
5. Synthesis and Identification of Co(III) Complexes.
6. Linkage Isomers: Synthesis of Nitro- and Nitritopentaamminecobalt(III) Chloride.
7. Kinetics: The Aquation of $[Co(NH_3)_5Cl]^{2+}$.
8. Kinetics: Isomerization of cis-dichlorobis(1,2-diaminoethane)cobalt(III) Chloride.
9. The Redox Chemistry of Vanadium.
10. Determination of a_0 in Cr(III) Complexes.
11. The Trans Effect: Synthesis of cis- and trans-Dichloro(dipyridine)platinum(II).
12. Determination of Magnetic Moments.