Douglas College

EFFECTIVE: SEPTEMBER 2004
CURRICULUM GUIDELINES

A. Division:	**Academic**	Date: **September 2004**	
B. Department / Program Area	**Science and Technology**	New Course [ ]	Revision [X]
		If Revision, Section(s) Revised	**K, P**
		Date Last Revised:	**Oct 13, 2001**

C: **CHEM 2410**	D: **Physical and Inorganic Chemistry**	E: **5**
Subject & Course No.	Descriptive Title	Semester Credits

F: Calendar Description:

This course investigates several topics in physical chemistry, including phase equilibria, spectroscopy, kinetics, and the thermodynamics of electrolyte solutions, and then applies the principles of thermodynamics and bonding to the study of coordination compounds. The laboratory stresses instrumental methods in inorganic chemistry.

G: Allocation of Contact Hours to Type of Instruction / Learning Settings

Primary Methods of Instructional Delivery and/or Learning Settings:
Lecture/Laboratory

Number of Contact Hours: (per week / semester for each descriptor)
Lecture 4 hours
Laboratory 3 hours

Number of Weeks per Semester: **15**

H: Course Prerequisites:

CHEM 1210 (C or better)

I: Course Corequisites:

None

J: Course for which this Course is a Prerequisite

None

K: Maximum Class Size:

18

L: PLEASE INDICATE:

[ ] Non-Credit
[ ] College Credit Non-Transfer
[X] College Credit Transfer: Requested [ ] Granted [X]

SEE BC TRANSFER GUIDE FOR TRANSFER DETAILS (www.bccat.bc.ca)

M: Course Objectives / Learning Outcomes

With the aid of the relevant thermodynamic data, a periodic table, an equation sheet, and a calculator, the student will be able to:

1. solve problems of the following general types:

   (a) interpretation of NMR, IR, and UV/VIS spectra
   (b) use of Beer-Lambert Law for systems containing one or two absorbing species
   (c) calculation of activities of strong electrolytes in solution.
   (d) use of activity coefficients in the calculation of pH, K, and K_{sp}.
   (e) calculations involving one or two component phase equilibria
   (f) calculation of the order and rate constant of a chemical reaction
   (g) calculation of the rate, amount of decomposition, and activation energy of a reaction
   (h) derivation of the rate law for a reaction given the mechanism
   (i) calculations involving use of the formation constants of a coordination compound.

2. explain or define any of the terms used in the course

3. compare the Collision and Transition State theories of chemical kinetics with the basic assumptions and interpretation of experimental rate data

4. derive some of the simpler formulas used in the course (eg. integrated rate equations for zero, first, and simple second order reactions)

5. given experimental data, draw and interpret the phase diagram for a two component system

6. given the phase diagram of a two component system interpret the diagram (eg. what phases are present at a given T, and P, compound formation etc)

7. give the systematic name of any coordination compound

8. explain the bonding in coordination compounds using the Valence Bond Theory, the Crystal Field Theory, or the Molecular Orbital Theory.

9. draw and name all of the possible isomers of a given coordination compound

10. given the formulas of two coordination compounds, predict their relative kinetic and thermodynamic stabilities

11. describe and explain the two limiting mechanisms for substitution in octahedral complexes.

N: Course Content:

1. **<u>Applications of Spectroscopy</u>**

   Electromagnetic spectrum and molecular transitions; UV/Visible spectroscopy: instrumentation, use and limitations of Beer's Law; Infrared Spectroscopy: instrumentation, interpretation of spectra; NMR: theory and instrumentation, prediction and identification of spectra; atomic absorption; gas-liquid chromatography.

2. **Phase Equilibria**

One and two component systems, Gibbs phase rule, review of ideal solutions, tie-line rule, P vs X and boiling point diagrams for two liquid components, distillation, partially miscible pairs, binary phase diagrams for condensed phases.

3. **Solutions of Electrolytes**

Theories of strong and weak electrolytes, ionic strength, activity and activity coefficient; use of activities of electrolytes in pH and equilibrium calculations.

4. **Chemical Kinetics**

(a) **Elementary Reactions**

Rate, rate law, half-life, integrated rate equation for zero, first, and second order reactions, determination of order, rate and activation energy; collision theory and transition state theory.

(b) **Composite Reaction Mechanisms**

Parallel and consecutive reactions, steady-state treatment, rate-determining steps, equilibrium constants, free radical mechanisms, enzyme catalyzed reactions.

5. **Coordination Compounds**

Nomenclature, Werner Coordination Theory, bonding: Valence Bond Theory, Crystal Field Theory, Molecular Orbital Theory; isomerism, stability constants: factors effecting stability, determination of stability constants; kinetics and mechanisms of reactions of coordination complexes.

Laboratory Content

The following experiments will be performed during the laboratory period:

1. Quantitative UV/Vis Spectroscopy
2. Determination of Keto-Enol Equilibrium Constants by NMR
3. Binary Solid-Liquid Phase Diagram
4. Geometric Isomers of a Cr(III) Complex
5. Gas Chromatography
6. Kinetics of H_2O_2 Decomposition
7. Kinetics of the Iodination of Acetone
8. Preparation and Identification of Co(III) Complexes
9. Paramagnetic Susceptibility: (a) Gouy Balance (b) NMR
10. Inorganic Term Project

O: Methods of Instruction

The course will be presented using lectures, classroom demonstrations, problem sessions and class discussions. Films and audio-visual materials will be used where appropriate. Problem sets will be assigned regularly to be handed in and marked. The laboratory consists of performance of ten experiments and a two-week inorganic chemistry project.

P: Textbooks and Materials to be Purchased by Students

Laidler, K.J.; Meiser, J.H. and Sanctuary, B.C. *Physical Chemistry,* 4rd Edition, Houghton Mifflin, Boston, New York, 2003

Douglas College, *Chemistry 410 Laboratory Manual,* 2000.

Basolo, F.; Johnson, R.C.; *Coordination Chemistry;* Science Reviews, 1986.

Q: Means of Assessment

The student's performance in the course will be based on the following evaluations:

1. Lecture Material (70%)

(a) Three tests will be given, each worth 20%. These tests will cover (a) spectroscopy, phase equilibria, and electrolytes, (b) kinetics, and (c) coordination chemistry. The last of these tests will be given during the final examination period.

(b) Problem assignments will be assigned on a regular basis (about seven) to be handed in and marked (10%).

2. Laboratory (30%)

The laboratory grade will be based on the written report (including accuracy of any experimentally obtained values) of each experiment performed (24%). The report for the inorganic project must be written in the style appropriate for submitting to a scientific journal (conforming to the ACS Style Guide) (6%).

R: Prior Learning Assessment and Recognition: specify whether course is open for PLAR

Not open for PLAR at this time.

Course Designer(s)

Education Council / Curriculum Committee Representative

Dean / Director

Registrar