UNIVERSITY COLLEGE OF THE FRASER VALLEY

COURSE INFORMATION

DISCIPLINE/DEPARTMENT: Chemistry **IMPLEMENTATION DATE**: June 1994

Revised: Nov. 1996

Chemistry 111	Principles of Chemistry	4
SUBJECT/NUMBER OF COURSE CREDITS	**DESCRIPTIVE TITLE**	**UCFV**

CALENDAR DESCRIPTION: Chemistry 111 begins with a review of the mathematical operations that are of importance to chemists, the nature of matter, basic atomic theory, chemical equations, and stoichiometry. Atomic structure is then studied in detail, with particular reference to the way in which electron configuration is related to the periodic table. Following a discussion of bonding and molecular geometry, the course concludes with a study of the properties of solids, liquids, and gases. Work performed in the laboratory complements the material covered in lectures.

RATIONALE: With CHEM 112, this course will satisfy requirements for students wishing to pursue an honours or majors program in science or engineering.

COURSE PREREQUISITES: Chemistry 11, Chemistry 12 and Math 12; or UCFV Chem 101 plus Math 12, or UCFV Chem 093 plus Math 12. Students without Chemistry 12 must consult the instructor before registering.

COURSE COREQUISITES: Math 111 and Phys 111 or 101 are strongly recommended.

HOURS PER TERM FOR EACH STUDENT	**Lecture**	**46**	**hrs**	**Student Directed Learning**	**hrs**
	Laboratory	**32**	**hrs**		
	Seminar		**hrs**	**Other - specify:**	
	Field Experience		**hrs**	**Exams**	**6 hrs**
				TOTAL	**84 HRS**

MAXIMUM ENROLMENT: 35

Is transfer credit requested? : Yes 9 No

AUTHORIZATION SIGNATURES:

Course Designer(s): P.W. Slade, N.S. Dance, L. Martin, A.M. Last **Chairperson**: T. Cooper

Curriculum Committee

Department Head: E. Kroeker **Dean**: K. Wayne Welsh

PAC: Approval in Principle _____ **PAC: Final Approval**: November 20, 1996

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SYNONYMOUS COURSES:

(a) replaces N/A
(course #)

(b) cannot take CHEM 101 for further credit
(course #)

SUPPLIES/MATERIALS:

Laboratory supplies required.

TEXTBOOKS, REFERENCES, MATERIALS (List reading resources elsewhere)

TEXTS:

Chemistry, Principles and Practice, 2nd ed., Reger, Good, Mercer (Saunders)
UCFV Laboratory Manual for Chemistry 111 and 112

REFERENCES:

Chemistry and Chemical Reactivity, 1st/2nd ed., John Kotz and Keith Purcell (Saunders)
Chemistry, A Conceptual Approach, 6th ed., Charles E. Mortimer (Wadsworth)
Chemistry: Experiment and Theory, Allen and Keefer (Harper and Row)
Chemical Principles, 4th ed., Dickerson, Gray, Darensbourg and Darensbourg (W.A. Benjamin)

OBJECTIVES:

Students enrolling in this course should have a strong background in chemistry, hence an "in-depth" approach to most topics can be attempted.

General: Students should be able to demonstrate a knowledge of basic principles and apply them to new situations and calculations using mathematics where required. The critical and rational thought processes will be continually challenged and developed.

Specific: Students should be able to perform the following:

a) Develop fundamental theories from experimental data and/or observations.
b) Appreciate the connection between the theoretical and experimental.
c) Be aware of the need for an ordered yet flexible approach to the varied topics.
d) Be aware of the need for care, precision, and accuracy in the subject generally, and in the laboratory particularly.

e) Appreciate and be competent in combining the uncertainties inherent in experimental data.

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METHODS:

Presentation of the course will be through interrelated class (theory), seminar, and laboratory sessions. Class sessions will promote active student participation to ensure continual mutual feedback in order to reinforce the learning process. Films and audio-visual aids will be used where appropriate.

Problem assignments will be continually given. Some selected problems will be collected and marked.

STUDENT EVALUATION PROCEDURE:

Students will be evaluated according to the following scheme:

Laboratory (reports and techniques)	20%
In-term examinations (2 or 3)	35 - 34%
Instructor assessment: assignments, class participation, attendance	5 - 10%
Final examination	30 - 35%

COURSE CONTENT:

Introduction: Relationship between lectures, tutorials, assignments, laboratory, and private study. Course outline, teaching methods, and evaluation.

Mathematical Review: Uncertainties (accuracy and precision), significant figures, SI units.

Atomic Theory Review: Components of the atom, isotopes, mass spectrometer, atomic mass, molar mass.

Stoichiometry: (Empirical formula, molecular formula) - will not be covered in class but problem assignments will be given. Nomenclature; the mole, molar mass/kilogram molar mass; chemical equations and net ionic equations; calculations on chemical equations (using the conversion factor method) particularly limiting reagent, combustion analysis, theoretical yield, % conversion, impure materials.

Electronic Structure of the Atom: Electromagnetic radiation; Rutherford, Planck, Einstein theories; hydrogen line spectra; Bohr theory and calculations for one electron systems. Duality of light, de Broglie hypothesis, Heisenberg Uncertainty Principle, Schrodinger Wave Equation. Quantum numbers, atomic orbitals, application of modified Bohr Model to multi-electron systems, electron configurations (Aufbau principle, Pauli Exclusion Principle, Hund's rule).

Periodic properties: Periodicity of atomic properties: atomic radius, ionic radius, ionization energy, electron affinity, electronegativity. Identification of elements as metals and non-metals from periodic properties.

Chemical Bonding and Molecular Geometry: Ionic and covalent bonding using electronegativity. Lewis structures, VSEPR theory and application, valence bond theory and energy level diagrams (including

multiple bonds), hybrid orbitals and some molecular orbital theory.

COURSE CONTENT: (contd.)

Gas State: Ideal Gas Laws, stoichiometry calculations, Dalton's Law of Partial Pressures, Kinetic-Molecular Theory, kinetic energy, root-mean-square speed, Graham's Laws of Diffusion, deviations from ideality, van der Waals' equation, (liquefaction of gases - time permitting).

Solid State: Types of solids (metallic, ionic, network, polar and non-polar molecular), their physical properties as related to their inter- and intra- molecular bonding. Crystal lattice, unit cells, types of crystal packing in metals and ionic solids, density, unit cell dimension and simple atomic/ionic radius calculations for metals (faced-centred cubic, body-centred cubic) and common ionic solids (CsCl, NaCl types).

Liquid State: Inter-molecular forces, vapour pressure, evaporization, boiling point, change of state. Enthalpies of vaporization and fusion. Phase diagrams (for example: water, carbon dioxide and examples with a liquid crystal phase).

LABORATORY EXPERIMENTS

Selected for recommendation to Lab Instructors:
(These may be varied from year to year at the Lab Instructor's discretion)

1. Measurement and Uncertainty: Heat Effects and Calorimetry
2. Stoichiometry: Water of Hydration
3. Spectrophotometric Study of Chromium (III) Ions
4. Gravimetric Analysis of Nickel
5. Periodic Properties
6. Determination of the Molar Mass of an Unknown Acid
7. Percentage Purity of a Carbonate by Back Titration
8. Qualitative Analysis of Anions (lab transferred from Chemistry 112)
9. Water Pollution Studies OR Determination of Sodium, Calcium, and Magnesium Ions in Sea Water
10. Gas Laws: Determination of the Ideal Gas Constant

Alternate labs that can be used at the Lab Instructor's discretion:

3. Gas Laws: Molecular Weight of a Volatile Compound
4. Spectrophotometric Determination of Copper
6. Solid State: Metallic Models of the Cubic System (may be done in class as integrated theory/lab exercise).