Alexander College
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# CURRICULUM GUIDE: OFFICIAL COURSE OUTLINE

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| Course Code | CHEM 101 | Course Title | Principles of Chemistry I | | | |
| Credit Value | 4 | Department | Mathematics and Science | | | |
| No. of weeks | 14 | Hrs. per week | *Lecture* | *Tutorial* | *Laboratory* | *Total* |
| | | | 3 | 0 | 3 | 6 |
| Course Description | This laboratory-lecture course is designed for students who want to pursue a major or minor degree program in science. The course provides an introduction to the principles of chemistry with emphasis on the theory of atomic and molecular structure and bonding. The course consists of lectures, tutorials and integrated laboratory experiments. | | | | | |
| Prerequisite(s) | ENGL 098, MATH 12 or MATH 100, CHEM 12 or CHEM 100 | | | | | |

| Initial Articulation Targets | *UBC* | *SFU* | *UVic* | *UNBC* | *TRU* |
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| | CHEM_V 1st (4); ALEX CHEM 101 (4) & ALEX CHEM 102 (4) = UBCV CHEM_V 121 (4) & UBCV CHEM_V 123 (4) | CHEM 121 (4), Q/B-Sci | CHEM 101 (1.5); ALEX CHEM 101 (4) & ALEX CHEM 102 (4) = UVIC CHEM 101 (1.5) & UVIC CHEM 102 (1.5) | CHEM 1XX (4); ALEX CHEM 101 (4) & ALEX CHEM 102 (4) = UNBC CHEM 100 (3) & UNBC CHEM 101 (3) & UNBC CHEM 120 (1) & UNBC CHEM 121 (1) | CHEM 1510 (3) |
| | For updated information on the transferability of this course, please consult the BC Transfer Guide, www.bctransferguide.ca | | | | |

**Learning Outcomes**

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

- Explain and solve problems (both quantitative and qualitative) relating to stoichiometry, gravimetry, gases, energy changes (enthalpy) of chemical reactions, calorimetry, concentration units, and the energy of light and emitted electrons.
- Demonstrate calculations using correct significant figures and units.
- Define electronic configuration and atomic orbitals and understand periodic trends.
- Recognize different types of chemical bonding, draw Lewis structures, and predict molecular shapes using VSEPR theory.
- Apply valence bond and molecular orbital theories to explain various types of chemical bonding.
- Apply essential laboratory skills and identify the safety equipment of a scientific laboratory.
- Collect observations and analyze data effectively.
- Generate laboratory reports using the provided scientific writing templates.



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| Content | **Core** topics – all of the following will be covered:<br><br>Components of the atom (electron, proton and neutron, isotopes)<br><br>Electronic Structure of Atoms and Periodic Trends<br>• Electromagnetic radiation<br>• Electronic theories of Rutherford, Bohr, Planck and Einstein<br>• The hydrogen line spectrum<br>• Wave/particle duality<br>• de Broglie hypothesis<br>• Heisenberg uncertainty principle<br>• Schrodinger wave equation<br>• Quantum numbers<br>• atomic orbitals<br>• electron configurations (Aufbau principle, Pauli exclusion principle, Hund's rule)<br>• Periodic trends in atomic radius<br>• Ionization energy<br>• Electron affinity and electronegativity<br>• Relationship of periodic trends to electron configuration and effective nuclear charge<br><br>Chemical bonding<br>• Ionic and covalent bonds and Lewis structures<br>• Electronegativity<br>• Lewis structures, valence shell electron pair repulsion theory (VSEPR)<br>• Valence bond theory<br>• Molecular orbital theory for H2 and first-row diatomic molecules<br><br>Thermochemistry<br>• First Law - conservation of energy<br>• Change in internal energy (ΔE) and enthalpy (ΔH) of a system<br>• Relationship between ΔE and ΔH<br>• First Law of thermodynamics<br>• Hess' Law<br>• Enthalpies of formation<br>• Bond energies<br><br>Intermolecular interactions<br>• Intramolecular and intermolecular forces, Dipole-dipole and dispersion forces<br>• Hydrogen bonding<br>• Properties of crystalline solids<br><br>Liquids<br>• Vapour pressure, evaporation, boiling point, |

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| | • Changes of state and phase<br><br>Gases<br>• Properties of gases<br>• The gas laws<br>• Ideal gas equation<br>• Stoichiometry involving gases<br>• Kinetic molecular theory<br>• Deviations from ideal behaviour for real gases<br><br>Additional topics may also be covered, at the discretion of the instructor.<br><br>Labs (8 from the following list):<br>• Gravimetric Analysis of a Plant Food<br>• Determination of Density of Liquid and Solids<br>• Determination of Iron in Water Samples by Spectrophotometry<br>• Acid-base Titrations and Vinegar Analysis<br>• Calorimetry<br>• Vitamin C Analysis<br>• Standardization of Sodium Thiosulfate<br>• Molar Mass of a Volatile Liquid<br>• Calcium Carbonate Analysis<br>• Determination of the Molar Volume of Carbon Dioxide<br>• Determination of the Molar Mass of a Solid. Antacid Analysis<br>• Hard Water Analysis |
| Methods of Instruction | Lectures, group discussions, problem solving, hands-on labs, quizzes, assignments, labs, simulations |
| Required Textbook(s) | The following textbook(s) is/are required, or approved equivalent(s).<br><br>Ball, David W and Jessie A. Key. Introductory Chemistry – 1st Canadian Ed. Open Textbook Library, 2014.<br><br>Flowers, Paul, et al. Chemistry. 2nd Ed. OpenStax, 2022.<br><br>Olmsted, John A. et al. Chemistry. 4th Canadian Edition. Wiley, 2021 |
| Required Equipment and Technology | Students are required to have a computer with internet access.<br>The following resources are provided by the College:<br>• Office 365<br>• Student email |
| Homework Hours | At minimum, students can expect one hour of homework for every hour of instructional time. |
| Evaluation | *Component* \| *% Value* |

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| | Quizzes and assignments<br>Laboratory experiments and activities<br>• Weight divided over 8 labs<br>Midterm exam (2)<br>Comprehensive final exam | 10-15%<br>15-20%<br><br>30-40%<br>30-35% | |
| Completion Requirements | The minimum grade to pass this course is D (50%). Unless otherwise stated, a minimum grade of C- (55%) is required for this course to fulfil a prerequisite. | | |
| Course Designer(s) | Lesley Spier, Ph.D., and Nigel S. Dance, Ph.D., Department of Chemistry, University of the Fraser Valley | Consultant(s), *if applicable* | |
| Dean's Approval | Barbara Moon, Ph.D., Dean of Arts and Sciences, Alexander College | Dean's Approval Date | September 29, 2010 |
| Curriculum Committee Approval Date | September 29, 2010 | First Term Offered | Fall 2011 |
| Last Review Date | September 1, 2024 | Next Review Date | September 1, 2029 |
| Revision History | June 30, 2015-CHEM 100 Prerequisite added by Barbara Moon.<br><br>June 30, 2016-CHEM 100 prerequisite added by Barbara Moon, Dean of Arts and Sciences<br><br>January 24, 2020-Review and minor revision or topics, texts, and evaluation weighting by Jason Mirzei, Ph.D. and Miriam Grob, Ph.D. faculty, Chemistry discipline, Alexander College, and Patrick Duffy, Ph.D. Department of Chemistry, Kwantlen Polytechnic University<br><br>March 1, 2023-Minor updates (e.g., assessment ranges, textbooks) by Jason Mirzaei, Miriam Grob, and Patrick Duffy.<br><br>September 1, 2024. Lab assignments and assessments detailed by Kelly Cheung. | | |