DEPARTMENT OF ACADEMIC UPGRADING
COURSE OUTLINE – Fall 2024
CH0120 (A2): Chemistry Grade 11 Equivalent 5(4-0-2) 90 hours for 15 weeks

Northwestern Polytechnic acknowledges that our campuses are located on Treaty 8 territory, the ancestral and present-day home to many diverse First Nations, Metis, and Inuit people. We are grateful to work, live and learn on the traditional territory of Duncan's First Nation, Horse Lake First Nation and Sturgeon Lake Cree Nation, who are the original caretakers of this land.

We acknowledge the history of this land and we are thankful for the opportunity to walk together in friendship, where we will encourage and promote positive change for present and future generations.

INSTRUCTOR:	Tanya Keller	**PHONE:**	Office: 780-539-2980
OFFICE:	J216	**E-MAIL:**	tkeller@nwpolytech.ca
OFFICE HOURS:	Wednesday 8:30am-9:50am or Friday 9:30am-10:30am; by appointment		

CALENDAR DESCRIPTION: Major concepts include: inorganic nomenclature; atomic structure, orbitals; ionic and covalent bonding, hydrogen bonding, metallic bonding, Van der Waal forces, ionization, electronegativity, VSEPR; solutions, stoichiometry, empirical formulas, percent composition, pH, molarity, equilibrium, Arrhenius acids and bases.

- **PREREQUISITE(S):**

  Complete all of the following:

  - SC0110 (Science 10)
  - A student may register in CH0120 if the student has achieved a mark of 60% or better in Alberta Education Science 10 within the previous five years or permission of the instructor.
  - MA0110 (Math 10C)

REQUIRED TEXT/RESOURCE MATERIALS:
Nelson Chemistry (Alberta 20-30) (Recommended)
Chemistry Data Booklet (colour copies in the bookstore, or can be printed from myClass)
Scientific non-programmable calculator (if you need to purchase, TI-30XIIS is recommended)
Lab coat (can be purchased from the NWP Bookstore)
Graph Paper (fine lined 10 lines/cm-may be printed from myClass).

DELIVERY MODE(S):

- On-campus (attend on-campus, in-person) – This type of course will be delivered on campus in a specific location which will be indicated on the student timetable. Students are expected to fully attend in person.
- Classroom instruction and labs. Use of myClass required.

LEARNING OUTCOMES:

Students will:

Unit A: The Diversity of Matter and Chemical Bonding

- describe the role of modelling, evidence and theory in explaining and understanding the structure, chemical bonding and properties of ionic compounds
- describe the role of modelling, evidence and theory in explaining and understanding the structure, chemical bonding and properties of molecular compounds.

Unit B: Quantitative Relationships in Chemical Changes:

- explain how balanced chemical equations indicate the quantitative relationships between reactants and products involved in chemical changes.
- use stoichiometry in quantitative analysis

Unit C: Forms of Matter: Gases

- explain molecular behaviour, using models of the gaseous state of matter.

Unit D: Matter as Solutions, Acids and Bases

- investigate solutions, describing their physical and chemical properties
- describe acidic and basics solutions qualitatively and quantitatively

Please see detailed course outline, which follows on pages 5-8.

TRANSFERABILITY:

Please consult the Alberta Transfer Guide for more information. You may check to ensure the transferability of this course at the Alberta Transfer Guide main page http://www.transferalberta.alberta.ca.

** Grade of D or D+ may not be acceptable for transfer to other post-secondary institutions. **Students are cautioned that it is their responsibility to contact the receiving institutions to ensure transferability**

**Although 50% (D) is considered a pass for this course, it is strongly recommended that you achieve a mark of 65% (C) to be successful in Chemistry 30.

EVALUATIONS: Course final grade will be based on the following components.

Unit Tests (equally weighted)	40%	
Labs	15%	Late penalty 20% per day for up to 2 days.
Assignments, Quizzes	15%	Late penalty 20% per day for up to 2 days.
Final Exam (Cumulative)	30%	

All tests and exams MUST be written at the scheduled times unless PRIOR arrangements have been made with the instructor. A missed test (exam) will result in a score of ZERO on that test (exam). Only in very specific cases may student be given an opportunity to make up a missed exam (student will be presented with a different version of the exam). Doctor, lawyer or police documentation may be required. The final exam is 3 hours long and is scheduled by the registrars' office during NWP Exam weeks. Do not book vacation in this time period.

- Attendance is compulsory in all labs.
- Missed labs result in a score of zero. **There are NO make-up labs.**
- In particular, you **MUST** attend the Lab Safety and Orientation. If you miss it, you will be excluded from participating in the lab component of the course.
- If you are late and have missed the lab safety discussion for that lab, you may be excluded from participating in the lab and will receive a mark of zero.
- Lab reports are due at the beginning of the following week's lab block. Late lab reports will result in a penalty of 20% per day. Labs over two days late will not be graded without PRIOR approval.

- Download the lab manuals and complete the Pre-lab assignment, if required, **BEFORE** the lab period (the Pre-lab assignment is due at the beginning of each lab), data tables are completed during the lab and analysis and questions after the lab.

Lab Schedule will be provided as part of your course schedule, posted on myClass.

A LATE ASSIGNMENT WILL NOT BE ACCEPTED FOR MARKS ONCE THE ASSIGNMENT HAS BEEN RETURNED TO THE OTHER STUDENTS. You may still submit it and I will mark it (so that you have feedback on how well you understood the concepts) but the mark WILL NOT count towards your grade.

GRADING CRITERIA:
Please note that most universities will not accept your course for transfer credit **IF** your grade is **less than C-**.

Alpha Grade	4-point Equivalent	Percentage Guidelines		Alpha Grade	4-point Equivalent	Percentage Guidelines
A+	4.0	90-100		C+	2.3	67-69
A	4.0	85-89		C	2.0	63-66
A-	3.7	80-84		C-	1.7	60-62
B+	3.3	77-79		D+	1.3	55-59
B	3.0	73-76		D	1.0	50-54
B-	2.7	70-72		F	0.0	00-49

COURSE SCHEDULE: A Course Schedule is provided on myClass. Please print it off and keep a copy to refer to as it will contain a day-by-day breakdown of the topics we will be covering each day, the readings in the textbook, workbook questions, lab schedule, due dates and exam dates that you will be held to, whether or not those dates are referred to during class time.

STUDENT RESPONSIBILITIES: Refer to the Polytechnic's Policy on Student Rights and Responsibilities at https://www.nwpolytech.ca/about/administration/policies/fetch.php?ID=69
The Academic Upgrading Department is an adult education environment. Students are expected to show respect for each other as well as faculty and staff. Students are expected to participate fully in achieving their educational goals.

Certain activities are disruptive and not conducive to an atmosphere of learning. In addition to the *Student Rights and Responsibilities* as set out in the Polytechnic's calendar, the following guidelines will maintain an effective learning environment for everyone. We ask the cooperation of all students in the following areas of classroom deportment.

1. Attendance: Regular attendance and class participation is expected of all students and is crucial to good performance in the course. Class interruption due to habitual late arrival or leaving early will not be permitted. You may be debarred from the final exam if your absences exceed 15% of class days (10 lecture classes).
2. Check myClass as well as NWP email on a regular basis. Any changes to the Course Schedule or Exam Dates will be communicated on myClass. Students will be held to the deadlines listed on the Course Schedule whether or not those deadlines are spoken about in class.
3. Once in class – remain in class. Leaving to get a coffee is disruptive for others.
4. Assignments must be submitted on time.
5. Exams must be written on the days announced in class.
6. If an emergency prevents attendance on an exam day, students must contact me before the end of the exam (as soon as possible) via phone or email and may be asked to provide documentation to justify their absence.
7. No unspecified electronic devices will be permitted during exams.
8. Complete daily homework. At least **1.5 hours** of study per day outside of class time is required.

9. Behaviors that interfere with learning are not acceptable.
10. Take responsibility for your learning.
11. Communicate all requests regarding appointments, etc. via email.

STATEMENT ON ACADEMIC MISCONDUCT:

Academic Misconduct will not be tolerated. For a more precise definition of academic misconduct and its consequences, refer to the Student Rights and Responsibilities policy available at https://www.nwpolytech.ca/about/administration/policies/index.html.

**Note: all Academic and Administrative policies are available on the same page.

Additional Information:

CHEMISTRY 0120 DETAILED COURSE OUTLINE AND LEARNING OBJECTIVES

UNIT A CHEMICAL BONDING – EXPLAINING THE DIVERSITY OF MATTER

Key Concepts:

- chemical bond
- ionic bond
- covalent bond
- electronegativity
- polarity
- valence electron
- intramolecular and intermolecular forces
- hydrogen bond
- Lewis structures
- electron dot diagrams
- valence-shell electron-pair repulsion (VSEPR) theory

1. **Students will describe the role of modelling, evidence and theory in explaining and understanding the structure, chemical bonding and properties of ionic compounds.**
   - recall principles for assigning names to ionic compounds
   - explain why formulas for ionic compounds refer to the simplest whole-number ratio of ions that result in a net charge of zero
   - define valence electron, electronegativity, ionic bond and intramolecular force
   - use the periodic table and electron dot diagrams to support and explain ionic bonding theory
   - explain how an ionic bond results from the simultaneous attraction of oppositely charged ions
   - explain that ionic compounds form lattices and that these structures relate to the compounds' properties: e.g., melting point, solubility, reactivity
2. **Students will describe the role of modelling, evidence and theory in explaining and understanding the structure, chemical bonding and properties of molecular substances.**
   - recall principles for assigning names to molecular substances
   - explain why formulas for molecular substances refer to the number of atoms of each constituent element
   - relate electron pairing to multiple and covalent bonds
   - draw electron dot diagrams of atoms and molecules, writing structural formulas for molecular substances and using Lewis structures to predict bonding in simple molecules
   - apply VSEPR theory to predict molecular shapes for linear, angular (V-shaped, bent), tetrahedral, trigonal pyramidal and trigonal planar molecules
   - illustrate, by drawing or by building models, the structure of simple molecular substances
   - explain intermolecular forces, London (dispersion) forces, dipole-dipole forces and hydrogen bonding
   - relate properties of substances (e.g., melting and boiling points, enthalpies of fusion and vaporization) to the predicted intermolecular bonding in the substances
   - determine the polarity of a molecule based on simple structural shapes and unequal charge distribution
   - describe bonding as a continuum ranging from complete electron transfer to equal sharing of electrons.

UNIT B: QUANTITATIVE RELATIONSHIPS IN CHEMICAL CHANGES

Key Concepts:

- chemical reaction equations
- net ionic equations
- spectator ions
- reaction stoichiometry
- precipitation
- limiting and excess reagents
- actual, theoretical and percent yield

1. **Students will explain how balanced chemical equations indicate the quantitative relationships between reactants and products involved in chemical changes.**
   - predict the product(s) of a chemical reaction based upon the reaction type
   - recall the balancing of chemical equations in terms of atoms, molecules and moles
   - contrast quantitative and qualitative analysis
   - write balanced ionic and net ionic equations, including identification of spectator ions, for reactions taking place in aqueous solutions
   - calculate the quantities of reactants and/or products involved in chemical reactions, using gravimetric, solution or gas stoichiometry.
2. **Students will use stoichiometry in quantitative analysis**.
   - explain chemical principles (i.e., conservation of mass in a chemical change), using quantitative analysis
   - identify limiting and excess reagents in chemical reactions
   - define theoretical yields and actual yields
   - explain the discrepancy between theoretical and actual yields

UNIT C: FORMS OF MATTER: GASES

Key Concepts

- Celsius and Kelvin temperature scales
- Boyle's law
- ideal gas law
- standard temperature and pressure (STP)
- standard ambient temperature and pressure (SATP)
- absolute zero
- real and ideal gases
- law of combining volumes
- Charles's law

1. **Students will explain molecular behaviour, using models of the gaseous state of matter.**
   - describe and compare the behaviour of real and ideal gases in terms of kinetic molecular theory

- convert between the Celsius and Kelvin temperature scales
- explain the law of combining volumes
- illustrate how Boyle's and Charles's laws, individually and combined, are related to the ideal gas law (PV = nRT)
  - express pressure in a variety of ways, including units of kilopascals, atmospheres and millimetres of mercury
  - perform calculations, based on the gas laws, under STP, SATP and other defined conditions.

UNIT D: MATTER AS SOLUTIONS, ACIDS AND BASES

Key Concepts

- homogeneous mixtures
- solubility
- electrolyte/nonelectrolyte
- concentration
- dilution
- strong acids and bases
- weak acids and bases
- monoprotic/polyprotic acid
- monoprotic/polyprotic base
- Arrhenius (modified) theory of acids and bases
- indicators
- hydronium ion/pH
- hydroxide ion/pOH
- neutralization
- titration
- end point
- equivalence point
- titration curves for strong acids and bases

1. Students will investigate solutions, describing their physical and chemical properties.

- recall the categories of pure substances and mixtures and explain the nature of homogeneous mixtures
- provide examples from living and nonliving systems that illustrate how dissolving substances in water is often a prerequisite for chemical change
- explain dissolving as an endothermic or exothermic process with respect to the breaking and forming of bonds
- differentiate between electrolytes and nonelectrolytes
- express concentration in various ways: i.e., moles per litre of solution, percent by mass and parts per million
- calculate, from empirical data, the concentration of solutions in moles per litre of solution and determine mass or volume from such concentrations
- calculate the concentrations and/or volumes of diluted solutions and the quantities of a solution and water to use when diluting
- use data and ionization/dissociation equations to calculate the concentration of ions in a solution
- define solubility and identify related factors: i.e., temperature, pressure and miscibility
- explain a saturated solution in terms of equilibrium: i.e., equal rates of dissolving and crystallization
- describe the procedures and calculations required for preparing and diluting solutions

2. Students will describe acidic and basic solutions qualitatively and quantitatively

- recall International Union of Pure and Applied Chemistry (IUPAC) nomenclature of acids and bases
- recall the empirical definitions of acidic, basic and neutral solutions determined by using indicators, pH and electrical conductivity
- calculate $H_3O^+_{(aq)}$ and $OH^-_{(aq)}$ concentrations and the pH and pOH of acidic and basic solutions based on logarithmic expressions; i.e., pH = $-\log[H_3O^+]$ and pOH = $-\log[OH^-]$
- use appropriate Système International (SI) units to communicate the concentration of solutions and express pH and concentration answers to the correct number of significant digits: i.e., use the number of decimal places in the pH to determine the number of significant digits of the concentration
- compare magnitude changes in pH and pOH with changes in concentration for acids and bases
- explain how the use of indicators, pH paper or pH meters can be used to measure $H_3O^+_{(aq)}$
- define Arrhenius (modified) acids as substances that produce $H_3O^+_{(aq)}$ in aqueous solutions and recognize that the definition is limited
- define Arrhenius (modified) bases as substances that produce $OH^-_{(aq)}$ in aqueous solutions and recognize that the definition is limited
- define neutralization as a reaction between hydronium and hydroxide ions
- differentiate, qualitatively, between strong and weak acids and between strong and weak bases on the basis of ionization and dissociation: i.e., pH, reaction rate and electrical conductivity
- identify monoprotic and polyprotic acids and bases and compare their ionization/dissociation.
- draw and interpret titration curves, using data from titration experiments involving strong monoprotic acids and strong monoprotic bases
- describe the function and choice of indicators in titrations
- identify equivalence points on strong monoprotic acid–strong monoprotic base titration curves and differentiate between the indicator end point and the equivalence point.

Lab Skills and objectives are included in labs and assignments in each unit of the course.

Specific Outcomes for Skills (focus on scientific inquiry)

Initiating and Planning

Students will:

- formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues
  - design an investigation to determine the properties of ionic compounds (solubility, conductivity and melting point)

- describe procedures for the safe handling, storage and disposal of materials used in the laboratory, with reference to WHMIS and consumer product labelling information
- state a hypothesis and make a prediction about the properties of molecular substances based on attractive forces: e.g., melting or boiling point, enthalpies of fusion and vaporization
- state hypotheses and make predictions based on information about the pressure, temperature and volume of a gas
- design a procedure to identify the type of solution
- design a procedure to determine the concentration of a solution containing a solid solute
- design an experiment to differentiate among acidic, basic and neutral solutions
- design an experiment to differentiate between weak and strong acids and between weak and strong bases
- predict the approximate equivalence point for a strong monoprotic acid–strong monoprotic base titration and select an appropriate indicator
- plan and predict states, products and theoretical yields for chemical reactions
- design an experiment to identify an ion: e.g., precipitation, flame test
- design a procedure, using crystallization, filtration or titration, to determine the concentration of a solution

Performing and Recording

Students will:

- conduct investigations into relationships among observable variables and use a broad range of tools and techniques to gather and record data and information
  - draw electron dot diagrams
  - build models depicting the structure of simple covalent molecules, including selected organic compounds
  - perform an experiment, in which variables are identified and controlled, to illustrate gas laws
  - use a conductivity apparatus to differentiate solutions
  - perform an experiment to determine the concentration of a solution
  - use a balance and volumetric glassware to prepare solutions of specified concentrations
  - perform an investigation to determine the solubility of a solute in a saturated solution
  - construct a table or graph to compare pH and hydronium ion concentration, illustrating that as the hydronium ion concentration increases, the pH decreases
  - translate word equations for chemical reactions into chemical equations, including states of matter for the products and reactants
  - balance chemical equations for chemical reactions, using lowest whole-number coefficients
  - perform a titration to determine the concentration of an acid or a base restricted to strong monoprotic acid–strong monoprotic base combinations

Analyzing and Interpreting

Students will:

- analyze data and apply mathematical and conceptual models to develop and assess possible solutions
  - analyze experimental data to determine the properties of ionic compounds
  - graph and analyze data, for trends and patterns, on the melting and boiling points of a related series of molecular substances
  - graph and analyze experimental data that relate pressure and temperature to gas volume
  - use experimental data to determine the concentration of a solution
  - use indicators to determine the pH for a variety of solutions
  - interpret stoichiometric ratios from chemical reaction equations
  - perform calculations to determine theoretical yields
  - use appropriate SI notation, fundamental and derived units and significant digits when performing stoichiometric calculations
  - calculate theoretical and actual yield and percent yield and error, and account for discrepancies between the theoretical and actual yields
  - analyze and evaluate experimental data of a precipitation reaction to determine the concentration of a solution
  - graph and analyze titration curves for acid-base experiments restricted to strong monoprotic acid–strong monoprotic base combinations

Communication and Teamwork

Students will:

- work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results
  - use appropriate Système international (SI) units, fundamental and derived units and significant digits
  - use appropriate numeric, symbolic, graphical and linguistic modes of representation to communicate ideas, plans and results
  - analyze and evaluate, objectively, models and graphs constructed by others

- communicate questions, ideas and intentions and receive, interpret, understand, support and respond to the ideas of others while collecting data on gases
- compare personal concentration data with the data collected by other individuals or groups
- select and use appropriate numeric, symbolic, graphical and linguistic modes of representation to communicate ideas, plans and results
- standardize an acidic or a basic solution and compare group results