Chemistry at Memorial University of Newfoundland

\*\*General Degree - Major in Chemistry:\*\*

- Requirements:

1. Completion of high school diploma or equivalent.
2. Basic understanding of mathematics, including algebra.

-Required Courses:

1. Chemistry 1050 and 1051 (or 1200 and 1001)
2. Chemistry 2100, 2210, 2301, 2302, 2400, 2401, 3110, 3210, 3211, 3303, and 3411.
3. Physics 1050 (or 1020) and 1051 (or 1021)
4. Mathematics 1000, 1001, 2000, and 2050.
5. Human Biosciences 2001 or former Biochemistry 2101 or 2201, and Human Biosciences 2901 or former Biochemistry 2901.

\*\*Honours Degree in Chemistry:\*\*

-Requirements:

1. Chemistry 1050 and 1051 or (1010, the former 1011 and the former 1031 (or 1200 and 1001), 2100, 2210, 2301, 2302, 2400, 2401, 3110, 3210, 3211, 3303, 3411, and 490A/B.
2. -2 credit hours selected from the 4000 level Chemistry courses in consultation with the 490A/B supervisor.
3. Physics 1050 (or 1020) and 1051 (or 1021).
4. Mathematics 1000, 1001, 2000, and 2050.
5. Human Biosciences 2001 or former Biochemistry 2101 or 2201, and Human Biosciences 2901 or former Biochemistry 2901.

-Recommended Courses:

1. Mathematics 2051 and Mathematics 2260
2. Physics 2820 and/or 2750

\*\*General Degree - Major in Computational Chemistry:\*\*

-Requirements:

1. - Chemistry 1050 and 1051 (or 1200 and 1001), 2100, 2210, 2301, 2302, 2400, 2401, 3210 or 3211, 3303, 4304, 4305.
2. - Physics 1050 (or 1020) and 1051, and 2820.
3. - Mathematics 1000, 1001, 2000, 2050, 2051, 2260 (or the former Mathematics 3260), and 3202.
4. Computer Science 1001, 1002, 1003, and 1510.
5. Computer Science 2500 or 2002.
6. Computer Science 2001.
7. Computer Science 3731 or Mathematics 3132.
8. Six credit hours in Critical Reading and Writing courses.

\*\*Honours Degree in Computational Chemistry:\*\*

-Requirements:

1. Chemistry 1050 and 1051 (or 1200 and 1001), 2100, 2210, 2301, 2302, 2400, 2401, 3210 or 3211, 3303, 4304, and 4305.
2. Physics 1050 (or 1020), 1051, and 2820.
3. Mathematics 1000, 1001, 2000, 2050, 2051, 2260 (or the former Mathematics 3260), and 3202.
4. Computer Science 1001, 1002, 1003, and 1510.
5. Computer Science 2500 and 2002.
6. Computer Science 2001.
7. Computer Science 1001, 1002, 1003, and 1510.

\*\*General Degree in Chemistry (Biological):\*\*

1. Required Courses
2. Chemistry 1050 and 1051, 2100, 2210, 2301, 2302, 2400, 2401, 3110, 3211, and 4410.
3. At least 6 credit hours from Chemistry 3210, 3303, 3411, or any 4000-level Chemistry course.
4. Biology 1001, 1002, 2250, 2060, and 3050, and at least 6 credit hours chosen from Biology 3530, 3950, 3951, 4010, 4050, 4200, 4245, 4251, 4404, 4605, Ocean Sciences 3002, and 3600.
5. Human Biosciences 2001 or the former Biochemistry 2101 or 2201, Human Biosciences 2901 or the former Biochemistry 2901, and at least 6 credit hours from Human Biosciences 2003, 3105, 3207, 4101, and 4201 or the former Biochemistry 3105, 3206 or 3106, 3207 or 3107, 4101, and 4201.
6. Mathematics 1000 and 1001. Statistics 2550 is strongly recommended.
7. Physics 1050 (or 1020) and Physics 1051 (or 1021).
8. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses.

\*\*Degree in Chemistry (Biological):\*\*

-Required Courses

1. Chemistry 1050 and 1051, 2100, 2210, 2301, 2302, 2400, 2401, 3110, 3211, 4410, and 490A/B.
2. At least 3 credit hours from Chemistry 3210, 3303, 3411, or any 4000-level Chemistry course not used to fulfill clause 3 below.
3. At least 3 credit hours from Chemistry 4151, 4201, 4206, 4305, or 4701.
4. Biology 1001, 1002, 2060, 2250, and 3050, and at least 6 credit hours chosen from Biology 3530, 3950, 3951, 4010, 4050, 4200, 4245, 4251, 4404, 4605, Ocean Sciences 3002, and 3600.
5. Human Biosciences 2001 or the former Biochemistry 2101 or 2201, Human Biosciences 2901 or the former Biochemistry 2901, and at least 6 credit hours from Human Biosciences 2003, 3105, 3207, 4101, and 4201 or the former Biochemistry 3105, 3206 or 3106, 3207 or 3107, 4101, and 4201.
6. Mathematics 1000 and 1001. Statistics 2550 is strongly recommended.
7. Physics 1050 (or 1020) and Physics 1051 (or 1021).
8. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses.

\*\*CHEM 1010 Introductory Chemistry I\*\*

- \*\*Course Information:\*\* Descriptive chemistry; measurements; atoms; molecules; mole calculations; reaction stoichiometry; redox reactions; gases; thermochemistry; kinetics; equilibrium; acids and bases. Prepares for CHEM 1050, 1051.

- \*\*AR:\*\* Mandatory lab attendance.

- \*\*CR:\*\* CHEM 1810; excludes CHEM 1050, 1200 registrants/completers.

- \*\*LC:\*\* 4

- \*\*LH:\*\* 3 hours biweekly, alternating with tutorials.

- \*\*OR:\*\* 1.5-hour tutorial alternating with labs.

- \*\*PR:\*\* Science 1807, 1808. Recommended: High school Academic Mathematics 3201 or university-level math.

- \*\*UL:\*\* Max 6 science credit hours for Chemistry major/honours from specific course groups.

\*\*CHEM 1050 General Chemistry I\*\*

- \*\*Course Information:\*\* Advanced topics in gases, thermochemistry, atomic structure, periodic properties, chemical bonding, liquids, and solids.

- \*\*AR:\*\* Mandatory lab attendance.

- \*\*CR:\*\* CHEM 1200.

- \*\*LC:\*\* 4

- \*\*LH:\*\* 3

- \*\*PR:\*\* Science 1807, 1808; CHEM 1010 with min 60% or high school CHEM 3202 with min 65%. Recommended: High school Mathematics 3200, 3201.

- \*\*UL:\*\* Credit hour restrictions for major/honours in Chemistry.

\*\*CHEM 1051 General Chemistry II\*\*

- \*\*Course Information:\*\* Advanced topics in solutions, kinetics, chemical equilibrium, acids, bases, thermodynamics, electrochemistry.

- \*\*AR:\*\* Mandatory lab attendance.

- \*\*CR:\*\* CHEM 1001, former CHEM 1011.

- \*\*LC:\*\* 4

- \*\*LH:\*\* 3

- \*\*PR:\*\* Science 1807, 1808; CHEM 1050 or CHEM 1200 with min 65%.

- \*\*UL:\*\* Credit hour limitations for major/honours in Chemistry.

\*\*CHEM 2100 Analytical Chemistry I\*\*

- \*\*Course Information:\*\* Sample preparation, calibration methods, statistical data treatment, spectrophotometric analysis, gravimetric and volumetric analysis, extractions, chromatography.

- \*\*AR:\*\* Mandatory lab attendance.

- \*\*CR:\*\* Former CHEM 3100.

- \*\*LH:\*\* 3

- \*\*PR:\*\* Science 1807, 1808; min 60% in CHEM 1051 or CHEM 1001/former CHEM 1031.

\*\*CHEM 2210 Introductory Inorganic Chemistry\*\*

- \*\*Course Information:\*\* Chemistry of s, p, d block elements and compounds. Periodic trends, molecular symmetry, molecular orbital diagrams, crystal structures, Lewis acid/base theory, coordination chemistry.

- \*\*AR:\*\* Mandatory lab attendance.

- \*\*LH:\*\* 3

- \*\*PR:\*\* Science 1807, 1808; min 60% in CHEM 1051 or CHEM 1001/former CHEM 1031.

\*\*CHEM 2301 Thermodynamics and Kinetics\*\*

- \*\*Course Information:\*\* Laws of thermodynamics, chemical kinetics, thermodynamics of gases, phases, solutions, Maxwell relations, phase equilibria, electrolyte solutions.

- \*\*AR:\*\* Mandatory lab attendance.

- \*\*CR:\*\* Former CHEM 2300.

- \*\*LH:\*\* 3

- \*\*PR:\*\* Science 1807, 1808; min 60% in CHEM 1051, CHEM 1001/former CHEM 1031; Mathematics 1001. Physics 1051/1021 recommended.

\*\*CHEM 2302 Quantum Chemistry and Spectroscopy\*\*

- \*\*Course Information:\*\* Quantum mechanics of simple systems, orbital quantum numbers, many electron atoms, quantum methods, electronic structures, bonding, symmetry, spectroscopy, lasers.

- \*\*AR:\*\* Mandatory lab attendance.

- \*\*CO:\*\* Recommended Mathematics 2000.

- \*\*CR:\*\* Former CHEM 3301.

- \*\*LH:\*\* 3

- \*\*PR:\*\* Science 1807, 1808; min 60% in CHEM 1051 or CHEM 1001/former CHEM 1031; Mathematics 1001, Physics 1051/1021.

\*\*CHEM 2400 Introductory Organic Chemistry I\*\*

- \*\*Course Information:\*\* Bonding in carbon, stereochemistry, functional groups, hydrocarbons, alkyl halides, alcohols, ethers.

- \*\*AR:\*\* Mandatory lab attendance.

- \*\*CO:\*\* CHEM 1051 or CHEM 1001.

- \*\*CR:\*\* CHEM 2440.

- \*\*LH:\*\* 3

- \*\*OR:\*\* 2-hour tutorial weekly.

- \*\*PR:\*\* Science 1807, 1808; 60% in CHEM 1050 or CHEM 1200; or CHEM 1010 and former CHEM 1011 with 80% in each; or former CHEM 1011 with 85%; or 60% in former CHEM 1031.

\*\*CHEM 2401 Introductory Organic Chemistry II\*\*

- \*\*Course Information:\*\* Interpretation of mass, infrared, NMR spectra; aromatic compounds, ketones, aldehydes, amines, carboxylic acids, aldol reactions.

- \*\*AR:\*\* Mandatory lab attendance.

- \*\*CR:\*\* CHEM 2440.

- \*\*LH:\*\* 3

- \*\*OR:\*\* 2-hour tutorial weekly.

- \*\*PR:\*\* Science 1807, 1808; CHEM 2400; 60% in CHEM 1051 or CHEM 1001.

\*\*CHEM 2610 Introductory Chemical Oceanography\*\*

- \*\*Course Information:\*\* Chemical properties of seawater, processes governing element concentrations in oceans, air-sea interactions, organic matter production, ocean carbon cycle, stable isotopes, trace elements.

- \*\*EQ:\*\* Ocean Sciences 2100.

- \*\*PR:\*\* Former CHEM 1011, 1051, 1001 (may be concurrent).

\*\*CHEM 3110 Analytical Chemistry II\*\*

- \*\*Course Information:\*\* Advanced instrumental quantitative analysis, error treatment, emission and absorption spectroscopy, chromatography, electrophoresis, mass spectrometry, x-ray spectroscopy, surface analysis.

- \*\*AR:\*\* Mandatory lab attendance.

- \*\*CR:\*\* Former CHEM 4100, 4101.

- \*\*EQ:\*\* Former CHEM 4110.

- \*\*LH:\*\* 3

- \*\*PR:\*\* Science 1807, 1808; CHEM 2100 or former CHEM 3100.

\*\*CHEM 3210 Main Group and Materials Chemistry\*\*

- \*\*Course Information:\*\* Detailed examination of s, p block elements, applications in materials, nanotechnology.

- \*\*AR:\*\* Mandatory lab attendance.

- \*\*LH:\*\* 3

- \*\*PR:\*\* Science 1807, 1808; CHEM 2210, CHEM 2301 or 2302; CHEM 2401; or instructor permission.

\*\*CHEM 3211 Inorganic Chemistry\*\*

- \*\*Course Information:\*\* Structure, bonding, chemistry of d block elements.

- \*\*AR:\*\* Mandatory lab attendance.

- \*\*LH:\*\* 3

- \*\*PR:\*\* Science 1807, 1808; CHEM 2210; CHEM 2301 or 2302; CHEM 2401; or instructor permission.

\*\*CHEM 3303 Statistical Thermodynamics and Rate Theories\*\*

- \*\*Course Information:\*\* Physical chemistry from microscopic viewpoint. Probability distributions, quantum statistical mechanics, ensembles, kinetics, statistical rate theories, computational chemistry.

- \*\*AR:\*\* Mandatory lab attendance.

- \*\*CR:\*\* Former CHEM 3300.

- \*\*LH:\*\* 3

- \*\*PR:\*\* Science 1807, 1808; CHEM 2301 (or Process Engineering 4002/former Engineering 4602), CHEM 2302, Mathematics 2000 (or Engineering 3424).

\*\*CHEM 3411 Synthetic Organic Chemistry I\*\*

- \*\*Course Information:\*\* Principles of organic synthesis, reactions for functional group interconversion, skeleton-building, transition metal-catalyzed reactions, pericyclic reactions.

- \*\*AR:\*\* Mandatory lab attendance.

- \*\*LH:\*\* 3

- \*\*PR:\*\* Science 1807, 1808, CHEM 2401.

\*\*CHEM 3600 Marine Chemistry - Inactive Course\*\*

\*\*CHEM 4151 Analytical Separations and Organic Mass Spectrometry\*\*

- \*\*Course Information:\*\* Advances in chromatographic techniques, mass spectrometers interfacing, mass spectrometric techniques.

- \*\*AR:\*\* Mandatory lab attendance.

- \*\*LH:\*\* 3

- \*\*PR:\*\* Science 1807, 1808; CHEM 3110 or former CHEM 4100, 4101, 4110.

\*\*CHEM 4152 Electroanalytical Techniques\*\*

- \*\*Course Information:\*\* Dynamic electrochemistry, voltammetry, stripping analysis, electrochemical sensors, detectors.

- \*\*PR:\*\* CHEM 3110 or former CHEM 4100, 4101, 4110.

\*\*CHEM 4156 Analytical Method Development and Sampling\*\*

- \*\*Course Information:\*\* Development, evaluation of analytical methods, sampling protocols for complex matrices including environmental, medical, food, forensic sciences.

- \*\*PR:\*\* CHEM 3110.

\*\*CHEM 4190-4199 Special Topics in Analytical Chemistry\*\*

- \*\*Course Information:\*\* Advanced topics in analytical chemistry.

- \*\*PR:\*\* Determined at time of offer

\*\*CHEM 4190-4199 Special Topics in Analytical Chemistry\*\*

- \*\*Course Information:\*\* Advanced courses covering current interest topics in analytical chemistry.

- \*\*PR:\*\* Determined at the time of offer.

\*\*CHEM 4201 Coordination Chemistry in Biological Molecules\*\*

- \*\*Course Information:\*\* Examines transition elements in proteins and enzymes, covering structural features, ligands, magnetic properties, mechanisms. Includes magnetic theory for polynuclear transition metal complexes.

- \*\*PR:\*\* CHEM 3211.

\*\*CHEM 4203 Organometallic Chemistry\*\*

- \*\*Course Information:\*\* Principles and applications of organometallic chemistry, focusing on transition metals, lanthanides, and actinides. Covers synthetic methods, structure, bonding, reactions, and applications in organic synthesis and catalysis.

- \*\*PR:\*\* CHEM 3211.

\*\*CHEM 4204 Inorganic Reaction Mechanisms and Catalysis\*\*

- \*\*Course Information:\*\* Survey of inorganic and organometallic reactions, mechanisms, kinetics, stereochemical non-rigidity, reactions of coordinated ligands, and homogeneous catalysis.

- \*\*PR:\*\* CHEM 3211.

\*\*CHEM 4205 Photochemistry of Transition Metal Complexes\*\*

- \*\*Course Information:\*\* Introduction to electronic excited states in transition metal complexes and their applications in areas like artificial photosynthesis and molecular electronics.

- \*\*CO:\*\* CHEM 3211 and CHEM 2302.

- \*\*PR:\*\* CHEM 3211 and either the former CHEM 3301 or CHEM 2302.

\*\*CHEM 4206 Green Chemistry\*\*

- \*\*Course Information:\*\* Explores methods to reduce environmental impact in chemical processes, including waste prevention and hazard reduction.

- \*\*PR:\*\* CHEM 2401 and CHEM 3211.

\*\*CHEM 4290-4299 Special Topics in Inorganic Chemistry\*\*

- \*\*Course Information:\*\* Advanced courses covering various subjects of current interest in inorganic chemistry.

- \*\*PR:\*\* To be determined at the time of offer.

\*\*CHEM 4304 Advanced Quantum Chemistry\*\*

- \*\*Course Information:\*\* Explores exact solutions to the Schrodinger equation, approximate methods, wavefunction and density functional theories, spectroscopy, and computational chemistry applications.

- \*\*CR:\*\* Former CHEM 4300.

- \*\*PR:\*\* CHEM 2302 (or the former CHEM 3301) and Mathematics 2260.

\*\*CHEM 4305 Advanced Statistical Thermodynamics\*\*

- \*\*Course Information:\*\* Covers intermolecular forces, properties of liquids, solvation of molecules and ions, and macromolecular structure and dynamics within statistical thermodynamics.

- \*\*CR:\*\* Former CHEM 4303.

- \*\*PR:\*\* CHEM 3303 or the former CHEM 3301.

\*\*CHEM 4310 Surface and Interface Science\*\*

- \*\*Course Information:\*\* Studies the structure and properties of surfaces and interfaces, thermodynamics of interfacial processes, and applications in various fields.

- \*\*PR:\*\* CHEM 3303.

\*\*CHEM 4390-4399 Special Topics in Physical Chemistry\*\*

- \*\*Course Information:\*\* Advanced courses on various subjects of current interest in physical chemistry.

- \*\*PR:\*\* To be determined at the time of offer.

\*\*CHEM 4410 Bio-organic Chemistry\*\*

- \*\*Course Information:\*\* Studies biomolecules, their structure, function, chemistry, and biosynthesis, including carbohydrates, amino acids, lipids, nucleic acids, and secondary metabolites.

- \*\*CR:\*\* Former CHEM 3410.

- \*\*PR:\*\* CHEM 2401.

\*\*CHEM 4411 Topics in Medicinal Chemistry\*\*

- \*\*Course Information:\*\* Inactive course.

\*\*CHEM 4420 Physical Organic Chemistry\*\*

- \*\*Course Information:\*\* Introduction to theories of reactions and reactivity, organic reaction mechanisms, and mechanism elucidation.

- \*\*CR:\*\* Former CHEM 4400 and CHEM 4401.

- \*\*PR:\*\* CHEM 2302 or the former CHEM 3301, and CHEM 3411 or the former CHEM 3401.

\*\*CHEM 4430 Synthetic Organic Chemistry II\*\*

- \*\*Course Information:\*\* Focuses on modern synthetic methods, synthesis of enantiomerically enriched compounds, and carbon-carbon bond formation.

- \*\*CR:\*\* Former CHEM 4410.

- \*\*PR:\*\* Former CHEM 3401 or 3411. CHEM 4420 recommended.

\*\*CHEM 4431 Heterocyclic Chemistry\*\*

- \*\*Course Information:\*\* Covers the synthesis, nomenclature, and reactivity of heterocyclic compounds, with emphasis on new synthetic approaches and advanced organic mechanisms.

- \*\*PR:\*\* CHEM 3411.

\*\*CHEM 4432 C-H Functionalization\*\*

- \*\*Course Information:\*\* Explores C–H functionalization in synthetic chemistry, focusing on metal-catalyzed processes, radical chemistry,

and photocatalysis.

- \*\*PR:\*\* CHEM 3411.

\*\*CHEM 4490-4499 Special Topics in Organic Chemistry\*\*

- \*\*Course Information:\*\* Advanced courses covering various subjects of current interest in organic chemistry.

- \*\*PR:\*\* To be determined at the time of offer.

\*\*CHEM 4500 Advanced Nuclear Magnetic Resonance Spectroscopy\*\*

- \*\*Course Information:\*\* Advances in NMR techniques, applications of solution and solid-state NMR spectroscopy, and micro imaging.

- \*\*AR:\*\* Mandatory lab attendance.

- \*\*LH:\*\* 3

- \*\*PR:\*\* CHEM 2302 and 2401.

\*\*CHEM 4590-4599 Special Topics in Interdisciplinary Chemistry\*\*

- \*\*Course Information:\*\* Advanced courses covering various subjects of current interest in interdisciplinary chemistry.

- \*\*PR:\*\* To be determined at the time of offer.

\*\*CHEM 4620 Environmental Chemistry\*\*

- \*\*Course Information:\*\* Applies chemistry principles to environmental reactions and processes. Covers environmental issues like pollutant transport, smog, and climate change.

- \*\*CO:\*\* CHEM 3110.

- \*\*CR:\*\* Environmental Science 4249.

- \*\*PR:\*\* CHEM 2400, CHEM 2301, CHEM 3110.

\*\*CHEM 4690-4699 Special Topics in Environmental Chemistry\*\*

- \*\*Course Information:\*\* Advanced courses covering various subjects of current interest in environmental chemistry.

- \*\*PR:\*\* To be determined at the time of offer.

\*\*CHEM 4701 Principles of Pharmaceutical Chemistry\*\*

- \*\*Course Information:\*\* Principles of drug discovery, pharmacokinetics, drug-structure relationships, toxicity, and pharmaceutical regulatory affairs.

- \*\*PR:\*\* Human Biosciences 3105 or the former Biochemistry 3105 or CHEM 3411 or instructor's permission.

\*\*CHEM 490A/B Honours Research in Chemistry\*\*

- \*\*Course Information:\*\* Independent research under faculty supervision for Honours Chemistry students. Involves a written thesis.

- \*\*CH:\*\* 6

- \*\*PR:\*\* Admission to an Honours Chemistry Program or Chemistry Joint Honours Program and honours standing, or permission of the Head of Department and a research supervisor.