

CHEMISTRY (CHEM)

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Chair: A. Ata; **Professors Emeriti:** B. Blackburn, H. Hutton; **Professors:** D. Craig, K.J. Friesen, D. Goltz, C. Wiebe, C. Wong; **Associate Professors:** M. Eze, J. Hollett, A. McCubbin, J. Ritch, D. Vanderwel, T. Wood; **Instructors:** K. Buffie, J. Galka, D. Latimer, E. Segstro.

DEGREES/PROGRAMS OFFERED

3-Year BSc
3-Year BSc (Business Stream)
4-Year BSc
4-Year BSc (Business Stream)
Honours BSc
Honours BSc (Business Stream)
4-Year BSc (UW/RRC)

INTRODUCTION

Chemistry is the study of the property and composition of matter, the transformations that matter may undergo, and the energies associated with such transformations. There are five main areas of chemistry: analytical chemistry, inorganic chemistry, organic chemistry, physical chemistry, and biochemistry. The department offers a solid foundation in each of these areas, plus more advanced courses for specialization at the senior level.

The Department of Chemistry offers 3-year, 4-year, and Honours BSc degrees in Chemistry. The department is also involved in several other interdisciplinary programs, most notably Biochemistry, Chemical Physics, and Environmental Studies (Chemistry Stream). An additional option available is the 4-year BSc program in Applied Chemistry, offered jointly by the University of Winnipeg and Red River College. Students pursuing a 3-year or 4-year BSc in Chemistry have the opportunity to take a Business Stream – a set of core courses in the Faculty of Business that will provide them with the skills needed to enter and succeed in industry and business. After completing the requirements of the BSc degree and the set of core courses indicated in the "Science with a Business Stream" section of the Calendar, it will be noted on the student's transcript that they have satisfied the requirements of a BSc degree with a Business stream.

Chemists are involved in many fields, including environmental protection, pharmaceutical science, forensic science, toxicology, agricultural science, food science, education, geochemistry, biochemistry, materials science, biotechnology, oceanography, computer modelling, and plant management. Graduates from a 3-year BSc in Chemistry may proceed to professional schools in a health-related area (such as pharmacy, medicine, veterinary medicine, or dentistry), or to careers as diverse as education, library science, business administration, public administration, engineering and law. Graduates with 4-year or Honours degrees in Chemistry usually proceed directly to employment or to graduate school (to obtain an MSc or PhD degree). Ultimately, most obtain jobs either as technicians, managers, consultants or research scientists in industry or in government.

Arts students, with the required prerequisites, may take **CHEM-1111(3)** Introduction to the Chemical Properties of Matter, **CHEM-1112(3)** Basic Principles of Reactivity, or **CHEM-2801(3)** Environmental Issues: A Chemistry Perspective towards their Science requirement.

GENERAL INFORMATION

Prerequisites

Chemistry 40S **AND** either Pre-Calculus **OR** Applied Mathematics 40S are required for acceptance to the Chemistry Major program.

Laboratory Work

Laboratory work has been designed to complement the lecture material; students are able to work in small lab sections with the possibility of individual projects. In advanced labs, modern instrumental techniques and computer facilities are used extensively.

Pre-professional Program Requirements

Students planning to enter the Faculties of Dentistry or Medicine are required to take the following courses:

CHEM-1111(3)	Introduction to the Chemical Properties of Matter
CHEM-1112(3)	Basic Principles of Chemical Reactivity
CHEM-2202(3)	Organic Chemistry I
CHEM-2203(3)	Organic Chemistry II
CHEM-3502(3)	Intermediate Biochemistry I
CHEM-3503(3)	Intermediate Biochemistry II

Students planning to enter professional faculties would normally take the above courses in sequence. However, provided that a minimum grade of 75 (or equivalent) was obtained in Chemistry 40S, the course **CHEM-1111(3)** may be taken concurrently with **CHEM-2202(3)**, while **CHEM-1112(3)** may be taken concurrently with **CHEM-2203(3)**. Also, provided that a minimum grade of B+ was obtained in both **CHEM-1111(3)** and **CHEM-1112(3)**, the course **CHEM-2202(3)** may be taken concurrently with **CHEM-3502(3)**, while **CHEM-2203(3)** may be taken concurrently with **CHEM-3503(3)**.

REQUIREMENTS FOR THE 3-YEAR BSc IN CHEMISTRY

ADMISSION REQUIREMENT	Students must consult with a department advisor in planning their course of study.
GRADUATION REQUIREMENT	90 credit hours
RESIDENCE REQUIREMENT	
Degree:	Minimum 30 credit hours
Major:	Minimum 18 credit hours
GENERAL DEGREE REQUIREMENT	
Humanities:	12 credit hours in Humanities
Writing:	Minimum 3 credit hours of Academic Writing.
Indigenous:	3 credit hours in designated Indigenous requirement courses
Maximum Introductory Courses:	Students may use a maximum of 42 credit hours at the 1000 level. Of these, a maximum of 6 credit hours may be below the 1000 level. As a result, students must take a minimum of 48 credit hours at the 2000-level or above in order to not exceed the maximum number of introductory courses.
Distribution:	Minimum three (3) credit hours from each of five (5) different subjects.
MAJOR REQUIREMENT	
Single Major:	Minimum 33 credit hours/Maximum 48 credit hours in Major subject.
Double Major:	33 credit hours in Chemistry and specified number of credit hours in the other department/program.

Required courses:

CHEM-1111(3) Introduction to the Chemical Properties of Matter	CHEM-2302(3) Quantitative Chemical Analysis
CHEM-1112(3) Basic Principles of Chemical Reactivity	CHEM-2401(3) Inorganic Chemistry I
CHEM-2102(3) Thermodynamics and Kinetics	MATH-1101(6) Introduction to Calculus
OR CHEM-2103(3) Atoms, Molecules and Spectroscopy	OR MATH-1103(3) Introduction to Calculus I
CHEM-2202(3) Organic Chemistry I	AND MATH-1104(3) Introduction to Calculus II
CHEM-2203(3) Organic Chemistry II	PHYS-1101(6) Foundations of Physics I
	OR PHYS-1301(6) Introduction to Physics

Plus an additional 12 credit hours of 2000-, 3000-, and/or 4000-level Chemistry courses.

Combined Major:

Prescribed Courses:

15 credit hours from CHEM-2102(3) Thermodynamics, CHEM-2202(3) Organic Chemistry I, CHEM-2203(3) Organic Chemistry II, CHEM-2302(3) Quantitative Chemical Analysis, CHEM-2401(3) Inorganic Chemistry I.

3 credit hours from CHEM-3101(3) Physical Chemistry of Condensed Phases, CHEM-3102(3) Quantum Chemistry and Spectroscopy, CHEM-3202(3) Reaction Mechanisms in Organic Chemistry, CHEM-3204(3) Organic Structure Determination, CHEM-3205(3) Organic Synthesis, CHEM-3302(3) Methods of Chemical Analysis, CHEM-3401(3) Inorganic Chemistry II, CHEM-3502(3) Intermediate Biochemistry I, CHEM-3503(3) Intermediate Biochemistry II, CHEM-3601(3) Environmental Chemistry.

Students must complete a Declaration of Major in a three-year Degree Program form, available from Student Central, before entering Year 2 of their studies.

Students are advised to consult with the Department when planning their studies.

REQUIREMENTS FOR THE 3-YEAR BSc IN CHEMISTRY WITH A BUSINESS STREAM

Students must complete the requirements of the 3-year BSc in Chemistry degree (see previous section) and the set of core courses indicated in the "Science with a Business Stream" section of the Calendar.

REQUIREMENTS FOR THE 4-YEAR BSc IN CHEMISTRY

ADMISSION REQUIREMENT	Students must consult with a department advisor when planning their studies.
GRADUATION REQUIREMENT	120 credit hours, that is, 90 credit hours meeting the requirements for the 3-Year BSc plus 30 additional credit hours.
RESIDENCE REQUIREMENT	
Degree:	Minimum 60 credit hours

Major: Minimum 30 credit hours

GENERAL DEGREE REQUIREMENT

Humanities: 12 credit hours in Humanities.
Writing: Minimum 3 credit hours of Academic Writing.
Indigenous: 3 credit hours in designated Indigenous requirement courses
Maximum Introductory Courses: Students may use a maximum of 42 credit hours at the 1000 level. Of these, a maximum of 6 credit hours may be below the 1000 level. As a result, students must take a minimum of 78 credit hours at the 2000-level or above in order to not exceed the maximum number of introductory courses.
Distribution: Minimum three (3) credit hours from each of five (5) different subjects.

MAJOR REQUIREMENT

Single Major: Minimum 54 credit hours/Maximum 78 credit hours in the Major subject.
Maximum total of cognate and major courses is 84 credit hours combined.
Double Major: Minimum 54 credit hours in Chemistry and specified number of credit hours in other Major.

Required courses:

CHEM-1111(3) Introduction to the Chemical Properties of Matter	CHEM-2502(3) Introduction to Biochemistry OR CHEM-3502(3) Intermediate Biochemistry I
CHEM-1112(3) Basic Principles of Chemical Reactivity	CHEM-3302(3) Methods of Chemical Analysis
CHEM-2102(3) Thermodynamics and Kinetics	CHEM-3401(3) Inorganic Chemistry II: Coordination Chemistry
CHEM-2103(3) Atoms, Molecules and Spectroscopy	MATH-1101(6) Introduction to Calculus
CHEM-2202(3) Organic Chemistry I	OR MATH-1103(3) Introduction to Calculus I
CHEM-2203(3) Organic Chemistry II	AND MATH-1104(3) Introduction to Calculus II
CHEM-2302(3) Quantitative Chemical Analysis	PHYS-1101(6) Foundations of Physics I
CHEM-2401(3) Inorganic Chemistry I	OR PHYS-1301(6) Introduction to Physics

Minimum 3 credit hours selected from the following courses:

PSYC-2101(3) Introduction to Data Analysis
STAT-1301(3) Statistical Analysis I (or the former **STAT-1201(6)** Intro to Stat Analysis)
STAT-1501(3) Elementary Biological Statistics I
Any Mathematics course numbered 2000 or above (MATH-2xxx) with the exceptions of MATH-2901(3) (History of Calculus) MATH-2902 (Math Prior to 1640), MATH-2905 (MATH/PHIL-2305 Philosophy and Mathematics) and MATH-2801(6) (Fundamentals of Computing), MATH-2903 Math for Early/Middle Year Teachers I.

Plus an additional 21 credit hours of 2000-, 3000- and/or 4000-level Chemistry courses.

Selection of Chemistry Courses: The 4-Year major requires a minimum of 54 credit hours in Chemistry. Since some senior courses are given in alternate years, all 4-Year majors are urged to seek academic advising within the Department **EACH YEAR** to avoid potential scheduling problems.

The following pattern of Chemistry courses is suggested:

Year 1 - 6 credit hours: **CHEM-1111(3)** Introduction to the Chemical Properties of Matter; **CHEM-1112(3)** Basic Principles of Chemical Reactivity.

Year 2 - 12 to 18 credit hours of the following required courses: **CHEM-2102(3)** Thermodynamics and Kinetics; **CHEM-2103(3)** Atoms, Molecules and Spectroscopy; **CHEM-2202(3)** Organic Chemistry I; **CHEM-2203(3)** Organic Chemistry II; **CHEM-2302(3)** Quantitative Chemical Analysis; **CHEM-2401(3)** Inorganic Chemistry I; **CHEM-2502(3)** Introduction to Biochemistry; **CHEM-3302(3)** Methods of Chemical Analysis; **CHEM-3401(3)** Inorganic Chemistry II.

Note: If **CHEM-3401(3)** is selected then **CHEM-2202(3)** and **CHEM-2203(3)** must also be taken in Year 2. Students are advised to consult with the Department.

Year 3 - 18 credit hours in Chemistry, including the required courses that were not taken in Year 2.

Year 4 - 18 credit hours in Chemistry.

Note: A student would normally specialize in one or more areas of Chemistry (Analytical, Organic, Physical, Inorganic, Biochemistry) in Years 3 and 4 and should seek advice concerning course selection.

Note: It is recommended the following be taken in :

Year 1: **MATH-1101(6)** Introduction to Calculus **OR MATH-1103(3)** Introduction to Calculus I
AND MATH-1104(3) Introduction to Calculus II

Year 1 or 2: **PHYS-1101(6)** Foundations of Physics I **OR PHYS-1301(6)** Introduction to Physics

Students must complete a 4-Year BSc Degree form, available from Student Services.

Combined Major:

Prescribed Courses:

15 credit hours from CHEM-2202(3) Organic Chemistry I, CHEM-2203(3) Organic Chemistry II, CHEM-2102(3) Thermodynamics and Kinetics, CHEM-2302(3) Quantitative Chemical Analysis, CHEM-2401(3) Inorganic Chemistry I.

BIOL-2301(3) Genetics
BIOL-3303(3) Molecular Genetics and Genomics
BIOL-3221(3) Cell Biology
BIOL-3901(3) Microorganisms and Disease
GEOG-1201(3) Introductory Atmospheric Science
GEOG-1202(3) Introductory Earth Science
GEOG-2213(3) Introductory Soil Science
GEOG-2214(3) Soil-Vegetation Systems
MATH-1201(3) Linear Algebra I
MATH-2101(6) Intermediate Calculus
MATH-2102(3) Differential Equations I
MATH-2103(3) Differential Equations II
MATH-2203(3) Linear Algebra II

MATH-3101(6) Advanced Calculus
PHYS-2105 (3) Mathematical Physics I
PHYS-2106 (3) Mathematical Physics II
PHYS-2201(6) Electricity and Magnetism
PHYS-2302(6) Foundations of Physics II
STAT-1301 (3) Statistical Analysis I
STAT-1302 (3) Statistical Analysis II
STAT-1201 (6) Introduction to Statistical Analysis

STAT-2001(3) Statistical Analysis for Chemists and Biologists
STAT-2501(3) Statistical Quality Control
STAT-2903(3) Introduction to Statistical Computing

Students must complete an Honours BSc Degree form, available from Student Central.

REQUIREMENTS FOR THE HONOURS BSc IN CHEMISTRY WITH A BUSINESS STREAM

Students must complete the requirements of the Honours BSc in Chemistry degree (see previous section) and the set of core courses indicated in the "Science with a Business Stream" section of the Calendar.

REQUIREMENTS FOR THE UNIVERSITY OF WINNIPEG / RED RIVER COLLEGE 4-YEAR BSc (JOINT PROGRAM IN APPLIED CHEMISTRY)

INTRODUCTION

This is a joint degree program whereby students take courses at both The University of Winnipeg and Red River College in a prescribed sequence.

Students are required to complete courses at both institutions. Students will begin their program of study by completing 60 credit hours of course work at The University of Winnipeg. The next 30 credit hours are completed at Red River College and then students return to The University of Winnipeg to complete the final 30 credit hours. Students successfully completing the entire program will receive a joint degree parchment from Red River College and The University of Winnipeg. **N.B. Transfer of courses between institutions applies only to students who are officially registered in the joint program.**

ADMISSION REQUIREMENT

Students must meet the entrance requirements for admission to The University of Winnipeg. Applications to the program in Applied Chemistry must be completed through the Admissions Office of The University of Winnipeg by March 1st in order to enter the program in September.

GRADUATION REQUIREMENT

120 credit hours, that is, 90 credit hours meeting the requirements for the BSc General plus 30 additional credit hours.

RESIDENCE REQUIREMENT

Degree: Minimum 60 credit hours
 Major: Minimum 30 credit hours

GENERAL DEGREE REQUIREMENT

Humanities: 12 credit hours in Humanities.
 Writing: Minimum 3 credit hours of Academic Writing.
 Indigenous: 3 credit hours in designated Indigenous requirement courses
 Maximum Introductory Courses: Students may use a maximum of 42 credit hours at the 1000 level. Of these, a maximum of 6 credit hours may be below the 1000 level. As a result, students must take a minimum of 78 credit hours at the 2000-level or above in order to not exceed the maximum number of introductory courses.
 Distribution: Minimum three (3) credit hours from each of five (5) different subjects.

Required Courses: (These are the Core courses for all Applied Chemistry BSc students)

UW COURSES

CHEM-1111(3) Introduction to the Chemical Properties of Matter
CHEM-1112(3) Basic Principles of Chemical Reactivity
CHEM-2102(3) Thermodynamics and Kinetics
CHEM-2103(3) Atoms, Molecules and Spectroscopy
CHEM-2202(3) Organic Chemistry I
CHEM-2203(3) Organic Chemistry II
CHEM-2302(3) Quantitative Chemical Analysis
CHEM-2401(3) Inorganic Chemistry I
CHEM-3302(3) Methods of Chemical Analysis
CHEM-3401(3) Inorganic Chemistry II: Coordination Chemistry
CHEM-3601(3) Environmental Chemistry
CHEM-4302(3) Instrumentation for Quantitative Analysis

CHEM-4303 (3) Analytical Separations

PLUS

BIOL-1115(3) Cells and Cellular Process
BIOL-1116(3) Evolution, Ecology and Biodiversity
RHET-1103(3) Academic Writing: Sciences
MATH-1101(6) Introduction to Calculus
OR **MATH-1103(3)** Introduction to Calculus I
AND **MATH-1104(3)** Introduction to Calculus II
PHYS-1301(6) Introduction to Physics
 PLUS
12 Credit hours Humanities
18 Credit hours Electives

RRC COURSES

CBST-1014 Microbiology 1
CBST-1025 Data Analysis
CBST-1031 Introductory Biochemistry
CBST-1040 Quality Systems
CBST-1041 Regulatory Compliance
CBST-1070 Principles of Hazardous Materials Management
CBST-1090 Introductory Statistics
CBST-2017 Microbiology 2
CBST-3001 Advanced Biochemistry
ENVI-1011 Environmental Chemistry/Toxicology

The following pattern of courses is suggested:

4-Year Program	
Year 1 - University of Winnipeg	Year 2 - University of Winnipeg
CHEM-1111(3) Introduction to the Chemical Properties of Matter CHEM-1112(3) Basic Principles of Chemical Reactivity BIOL-1115(3) Cells and Cellular Processes BIOL-1116(3) Evolution, Ecology and Biodiversity RHET-1103(3) Academic Writing: Sciences MATH-1101(6) Introduction to Calculus <u>OR</u> the equivalent MATH-1103(3) Introduction to Calculus I <u>AND</u> MATH-1104(3) Introduction to Calculus II PHYS-1301(6) Introduction to Physics 3 Credit hours Humanities	CHEM-2102(3) Thermodynamics and Kinetics CHEM-2103(3) Atoms, Molecules and Spectroscopy CHEM-2202(3) Organic Chemistry I CHEM-2203(3) Organic Chemistry II CHEM-2302(3) Quantitative Chemical Analysis CHEM-3302(3) Methods of Chemical Analysis 6 Credit hours Electives 6 Credit hours Humanities
Year 3 - Red River College	Year 4 - University of Winnipeg
CBST-1014 Microbiology 1 CBST-1025 Data Analysis CBST-1031 Introductory Biochemistry CBST-1040 Quality Systems CBST-1041 Regulatory Compliance CBST-1070 Principles of Hazardous Materials Management CBST-1090 Introductory Statistics CBST-2017 Microbiology 2 CBST-3001 Advanced Biochemistry ENVI-1011 Environmental Chemistry/Toxicology	CHEM-2401(3) Inorganic Chemistry I CHEM-3401(3) Inorganic Chemistry II: Coordination Chemistry CHEM-3601(3) Environmental Chemistry CHEM-4302(3) Instrumentation for Quantitative Analysis CHEM-4303 (3) Analytical Separations 3 Credit hours Humanities 12 Credit hours Electives

COURSE LISTINGS

Students should consult Web Advisor or the appropriate Timetable on the website for courses to be offered in the upcoming term. **A number of senior courses are offered on a rotation basis and are given in alternate years.** Students are advised to consult with the Department **in advance** when planning their curriculum.

CHEM-0100(3)	Foundations of Chemistry	CHEM-3206(3)	Advanced Organic Chemistry Laboratory
CHEM-1111(3)	Introduction to the Chemical Properties of Matter	CHEM-3302(3)	Methods of Chemical Analysis
CHEM-1112(3)	Basic Principles of Chemical Reactivity	CHEM-3401(3)	Inorganic Chemistry II: Coordination Chemistry
CHEM-2102(3)	Thermodynamics and Kinetics	CHEM-3502(3)	Intermediate Biochemistry I: Structure, Function, and Energetics of Biomolecules
CHEM-2103(3)	Atoms, Molecules and Spectroscopy	CHEM-3503(3)	Intermediate Biochemistry II: Intermediary Metabolism
CHEM-2202(3)	Organic Chemistry I	CHEM-3601(3)	Environmental Chemistry
CHEM-2203(3)	Organic Chemistry II	CHEM/ENV-3611(3)	Environmental Toxicology
CHEM-2302(3)	Quantitative Chemical Analysis	CHEM-3701(3)	Directed Studies in Chemistry
CHEM-2401(3)	Inorganic Chemistry I	CHEM-4101(3)	Quantum Chemistry
CHEM-2502(3)	Introduction to Biochemistry	CHEM-4204(3)	Medicinal Chemistry
CHEM-2701(3)	Computer Techniques and Applications for Chemistry	CHEM-4302(3)	Instrumentation for Quantitative Analysis
CHEM-2801(3)	Environmental Issues: A Chemistry Perspective	CHEM-4303(3)	Analytical Separations
CHEM-3101(3)	Physical Chemistry of Condensed Phases	CHEM-4401(3)	Organometallic d-Block Chemistry
CHEM-3102(3)	Quantum Chemistry and Spectroscopy	CHEM-4403(3)	Advanced Main Group Chemistry
CHEM-3202(3)	Reaction Mechanisms in Organic Chemistry	CHEM-4502(3)	Molecular Enzymology
CHEM-3204(3)	Organic Structure Determination	CHEM-4506(3)	Methods in Biochemistry
CHEM-3205(3)	Organic Synthesis	CHEM-4701(6)	Research Projects in Chemistry
		CHEM-4703(3)	Topics in Chemistry

EXPERIMENTAL COURSE LISTINGS

CHEM-3504(3) Plant Biochemistry

COURSE DESCRIPTIONS

All course descriptions for all undergraduate programs can now be found in one large PDF called "All Course Descriptions" in the "Academic Calendar" section of the University website:
<http://uwinnipeg.ca/academics/calendar/index.html>