



Faculty of Science

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MEETING OF THE FACULTY COUNCIL OF THE FACULTY OF SCIENCE

A regular meeting of the Faculty Council of the Faculty of Science will be held on Wednesday, May 17, at 1:00 p.m. by WebEx and in-person (Room: C- 2045).

AGENDA

1. **Regrets**
2. **Adoption of the Minutes of March 15, 2023**
3. **Business Arising from the Minutes**
4. **Correspondence:** No Correspondence
5. **Reports of Standing Committees:**
 - A. **Undergraduate Studies Committee:**

Presented by Shannon Sullivan, Chair, Undergraduate Studies Committee

 - a. Department of Mathematics and Statistics - Calendar Changes, New Course – M1006, Paper 5.A.a. (pages 15-70)
 - B. **Graduate Studies Committee:**

Presented by Alison Leitch, Chair, Graduate Studies Committee

 - a. Scientific Computing Program, proposal for changes to the MSc in Scientific computing, Paper 5.B.a. (pages 71 to 79).
 - b. Department of Computer Science, Request for Approval of a Graduate Course, COMP 6984, Future Networks and Applications of Machine Learning, Paper 5.B.b. (pages 80 to 84).
 - c. Department of Mathematics and Statistics, Special Topics Graduate Course, M6114, Mathematics of Numerical Relativity, approved by the committee and presented to Faculty Council for information only, Paper 5.B.c. (pages 85 to 87).
 - d. Department of Mathematics and Statistics, Special Topics Graduate Course, M6115, Mathematical Epidemiology, approved by the committee and presented to Faculty Council for information only, Paper 5.B.d. (pages 88 to 91).
 - C. **Library Committee:** No business
6. **Presentation on the GSO funding (outbound mobility funding) – Chris Hibs, Internationalization Office**
7. **Report of the Dean:** COI memo (Attached)
8. **Question Period**
9. **Adjournment**

A handwritten signature in black ink, appearing to read "Travis Fridgen".

Travis Fridgen, Ph.D.
Interim Dean of Science



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FACULTY OF SCIENCE FACULTY COUNCIL OF SCIENCE Minutes of Meeting of March 15, 2023

A meeting of the Faculty Council of the Faculty of Science was held on Wednesday, March 15, 2023, at 1:00 p.m. using a hybrid model of Webex and in-person (C-2045).

FSC 3002 Present

Biochemistry

M. Berry, V. Booth, R. Bertolo, R. Brown, J. Brunton, S. Cheema, S. Christian, Z. Farahnak, M. Codner, S. Harding, D. Hunt, S. Mayengbam, M. Mulligan, J. Park, F. Shahidi, A. Todd, K. Wilson

Biology

D. Bignell, A. Chaulk, S. Dawe, E. Edinger

Chemistry

C. Bottaro, L. Cahill, H. Grover, k. Jobst, M. Katz, F. Kerton, C. Kozak, S. Pansare, B. Power, H. Reader, N. Ryan, S. Smith, J. Stockmann, H. Therien-Aubin

Computer Science

S. Anthony, A. Fiech, M. Hatcher, C. Hyde, T. Tricco

Earth Sciences

H. Corlett, G. Dunning, A. Langille, A. Leitch, M. Miskell, P. Morrill, K. Welford

Mathematics & Statistics

I. Booth, D. Dyer, C. Evans, D. Harvey, A. Hatefi, R. Haynes, J.C. Loredó-Osti, E. Martínez, T. Sheel, S. Sullivan, A. Variyath, Y. Yilmaz-Cigsar

Ocean Sciences

I. Fleming, P. Gagnon, M. Rise

Physics & Physical Oceanography

D. Coombs, M. Evstigneev, M. Geng, E. Hayden, J. LeBlanc, L. Men, H. Neilson, I. O'Brien, K. Poduska, I. Siaka-Voivod, K. Shorlin, M. Strong, A. Yethiraj, S. Wallin, L. Zedel

Psychology

A. Brown, D. Hallett, C. Hyde, G. Sherren, A. Swift-Gallant, C. Thorpe, C. Walsh

Dean of Science Office

J. Blundell, J. Bowering, M. Fitzpatrick, S. Garasym, C. Hussey, S. Dufour, K. Foss, J. Major, T. Fridgen, G. Jackson, J. Kavanagh, R. Newhook, T. Mackenzie

Student Representatives:

E. Dormody, W. Kinden, G. Sherren

FSC 3003 Adoption of Minutes

Moved: Minutes of the meeting of December 6, 2022, be adopted. (Sullivan/Berry)
Carried.

FSC 3004 Business Arising: No Business

FSC 3005 Correspondence: No Report

FSC 3006 Reports of Standing Committees:

A. Undergraduate Studies Committee: No report

B. Graduate Studies Committee:

Presented by Alison Leitch, Chair, Graduate Studies Committee

a. Faculty of Medicine – Calendar Change - secondary changes for Biology (re; cross listing of courses), (Leitch/Berry) **Carried.**

b. Science Interdisciplinary Programs – Master’s of Data Science – Calendar Changes - DSCI 6659 and DSCI 6619 are the DSCI designations for STAT 6559 and STAT 6519, DSCI 6650 is the new, graduate version of MATH 4650, with which it will be run concurrently, (Leitch/Variyath) **Carried.**

C. Library Committee: No business.

FSC 3007 Reports of Delegates from Other Councils: No Reports

FSC 3008 Report of the Dean:

SEA Conference: Dr. Jacqueline Blundell, Associate Dean (Research) said there are near 340 registered for oral and poster presentations as well as volunteers, judges and participants.

This year for the first time there will be a Gong Show, which is a public engagement event where students will present a short presentation about their research on April 5. Celebrity judges are invited to judge, such as Amanda Mews.

The event needs judges and if you would like to participate please contact the Dean’s Office.

MUNFA Collective Agreement Summarized (attached): Dr. Travis Fridgen, Dean
This will be in effect on the date of signing; however, there are some retroactive items.

The search committee changes cannot be applied to searches that are in progress now, but if the department does have searches being advertised the Dean will find out if we can use the new collective agreement.

During a new search, all applicants are considered for the search (including international applicants). On a go forward basis, we do not divide the international and national applicants as per the previous collective agreement.

If a religious holiday falls within the exam period, the ASM should take this into account when scheduling their exam.

The salary changes apply to all ASMs, Heads and Deans included.

FSC 3009 Question Period:

Mark Berry is concerned with calendar changes not being approved due to the Job Action, however, Shannon Sullivan ensures that all changes will be approved without delay.

No update on the AI and CSF space. There is an assumption that it will be ready for September.

The 3 million in tuition that will be reimbursed back to students is assumed to be the money that was not paid to Faculty.

FSC 3010 Adjournment

Meeting adjourned at 1:46 pm.

MUNFA Collective Agreement Summarized from presentation Geoff Williams made at Dean's Council

- Tentative agreement has been ratified by the Board of Regents and MUNFA
- Final text of the CA has been recently agreed upon
- Not yet signed.

- Searches
 - We can designate positions as equity deserving ASM positions and have targeted searches without requesting approval from MUNFA.
 - currently still require HRC approval (being checked and trying to get blanket approval)
 - Equity deserving defined as those who self-identify as Indigenous Peoples; members of racialized groups; people of a minority sexual orientation, gender identity or expression; people with disabilities; and women.

- Search Committees
 - Review application files of all applicants (incl international)
 - If candidates are judged equivalent, equity deserving members are given preference
 - Consult with Head prior to finalizing short list
 - Unless non-Canadian candidate is demonstrably more qualified than a Canadian or PR, Committee shall recommend Canadian or PR
 - we have suggested a matrix to keep track of qualifications for Labour Market Impact Assessment
 - Commitment to include appropriate land acknowledgements in position advertisements

- Promotion and Tenure
 - New language included with P&T criteria regarding Indigenous knowledges to assist P&T Committees

Indigenous knowledges include, but are not limited to, knowledge of the language and customs, rites, rituals, histories, teachings of a particular group of Indigenous People or Peoples. Many Indigenous Faculty Members will have scholarship based in and informed by principles and methods appropriate to an exploration and explication of Indigenous knowledges as well as those of the Western academic disciplinary tradition.

- Promotion and Tenure
 - Assessment Files
 - Provision requiring candidates submit last 3 years of student course evaluations removed
 - New language requiring Committee members and Head/Dean to destroy copies
 - All unsuccessful applications for extension or tenure may be offered a one-year terminal appointment

- Promotion and Tenure
 - Tenure
 - Associate Professor can elect, by Sept. 15 of 2nd year, to be considered for tenure in fourth year of appointment (normally third year)
 - Referees can include Indigenous Elders/Traditional Knowledge Carriers/Keepers
 - No longer reference to early tenure, have one opportunity and assessed on criteria for tenure, not superior performance

- Leaves
 - Include Truth and Reconciliation Day as Day of Recognition
 - Clarification that ASMs can rearrange their duties to observe religious holidays
 - More inclusive language regarding Pregnancy/Birthing/Maternity and Parental Leave
 - Providing an additional 20 weeks of supplemented parental leave

- Term Appointments
 - An additional month added to teaching term appointments whereby start dates normally August 1, December 1, April 1
 - Conversion language (23.19) amended permitting term appointment conversion to RTA or tenure-track position
 - ASM must agree in writing
 - Deleted language (23.20) requiring a new position be created for conversion

- Salary and Benefits
 - Salary - Sept. 1/22 – 6%, Sept. 1/23 – 2%, Sept. 1/24 – 2%, Sept. 1/25 – 2%
 - All term appointments receive a \$2000 signing bonus
 - PDTER is increased to \$1800 for all ASMs
 - Overload teaching rates increase
 - Sept. 1/22 - \$6,890; Sept. 1/23 – \$7,028; Sept. 1/24 - \$7,169; Sept. 1/25- \$7,312

- Collegial Governance Committee
 - Within 60 days of signing of CA, committee formed to review collegial governance within the university
 - Broad consultation, and shall review Memorial's bicameral system of collegial governance including the Collective Agreement, university policy and procedures
 - Produce a public report delivered to the Board of Regents and Senate within twenty-four (24) months
- Permanent Teaching Stream Committee
 - Within 45 days of signing of CA, committee formed to develop recommendations regarding qualifications, duties, workload and evaluation for permanent teaching stream
 - Submit recommendations to the Parties within twenty-four (24) months

Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form

MATH 1006 – Calculus for the Life Sciences

LIST OF CHANGES

Indicate the Calendar change(s) being proposed by checking and completing as appropriate:

New course(s): MATH 1006

Amended or deleted course(s): MATH 1000, 1001, 1005, 1050, 1051, STAT 2550

New program(s):

Amended or deleted program(s):

New, amended or deleted Glossary of Terms Used in the Calendar entries

New, amended or deleted Admission/Readmission to the University (Undergraduate) regulations

New, amended or deleted General Academic Regulations (Undergraduate)

New, amended or deleted Faculty, School or Departmental regulations

Biochemistry, Biology, Chemistry, Mathematics and Statistics, Ocean Sciences, Psychology, Grenfell campus (Mathematics and Statistics), Kinesiology, Physical Education.

Other:

ADMINISTRATIVE AUTHORIZATION

By signing below, you are confirming that the attached Calendar changes have obtained all necessary Faculty/School approvals, and that the costs, if any, associated with these changes can be met from within the existing budget allocation or authorized new funding for the appropriate academic unit.

Signature of Dean/Vice-President: _____

Date: _____

Date of approval by Faculty/Academic Council: _____

**Memorial University of Newfoundland
Undergraduate Calendar Change Proposal Form
Senate Summary Page for Courses**

COURSE NUMBER AND TITLE

MATH 1006: Calculus for Life Sciences

ABBREVIATED COURSE TITLE

Calculus for Life Sciences

RATIONALE

Many of the students who take MATH 1000: Calculus I have a strong interest in the life sciences. These students include Bachelor of Science majors in Biology, Biochemistry, Ocean Sciences, and Psychology; and Bachelor of Kinesiology; and Bachelor of Physical Education. These programs are termed 'life science-relevant'.

The content of MATH 1000 is important for students with an interest in the life sciences, but without examples that consistently reinforce relationships between foundational concepts in MATH 1000 (i.e., the Mean Value Theorem), and life sciences applications, students lose motivation in pursuing further mathematics and statistics learning, which can discourage them from entering life science-related quantitative careers, for example, interdisciplinary careers involving data science, statistics, and modelling.

In Fall 2022, St. John's campus offered 8 sections of MATH 1000. Our proposal is that MATH 1006: Calculus for Life Sciences is equivalent to MATH 1000 for life science-related programs, and could be offered in place of MATH 1000 sections without affecting resources. In degree programs that are life science-relevant, we propose that in the Calendar MATH 1000 is replaced with MATH 1006 (or MATH 1000). The pre-requisites for MATH 1001 are changed to MATH 1000 (or MATH 1006), and MATH 1000 and 1006 are to be credit-restricted.

There is a precedent for this course structure at Queen's University where MATH 121 is calculus 'with applications to biology, physics, chemistry, economics, and social sciences', while MATH 120 is calculus 'intended for students who plan to pursue a Major or Joint Honours Plan in Mathematics, Statistics, or Physics'. Both courses are alternative pre-requisites to MATH 221 Vector Calculus, and are credit-restricted.

This equivalency between MATH 1000 and 1006 is to be achieved by using the textbook '*Biocalculus: Calculus for the Life Science*' which is written by James Stewart and Troy Day for MATH 1006 (available at [here](#)). This textbook has a near identical structure to Calculus by James Stewart, the textbook that is used for MATH 1000. MATH 1006 will cover all the same topics as MATH 1000, so as to be an appropriate pre-requisite for MATH 1001, but the examples in MATH 1006 will be life science-relevant to engage life science students with the relevance of mathematics for their future careers.

MATH 1006 could be taught by Dr. Amy Hurford who is a joint appointment in Biology and Mathematics and Statistics. With no additional resource requirements, the proposed course strengthens the degree program in Mathematics and Statistics, by motivating the relevance of mathematics in life science-related programs, and strengthens life science-related degree programs because a required course (MATH 1006 in place of MATH 1000) has increased degree-specific content.

It would be appropriate for MATH 1006: Calculus for the Life Sciences to be designated as a 'pre-health care option', an option noted in the Faculty of Science Strategic Plan 2022-2027. The offering would strengthen data science education amongst undergraduate students as students in disciplines that are traditionally data collection-oriented (i.e., the life science-related programs) are more motivated and capable of engaging with students in traditionally data analysis-oriented disciplines (i.e., Applied Mathematics, Statistics, and Computer Science).

MATH 1006 aims to connect students interested in the life sciences with the power of mathematics and statistics to make compelling quantitative arguments, and to highlight the value of collaboration with experts in data analysis-related disciplines.

A sample syllabus and comparison of topics covered in MATH 1000 and MATH 1006 are provided in Appendix A beginning on p35.

LIST OF CHANGES

Indicate the Calendar change(s) being proposed by checking and completing as appropriate:

New course(s): MATH 1006

CALENDAR CHANGES

MATH 1006. Calculus for Life Sciences is an introduction to differential calculus, including algebraic, trigonometric, exponential, logarithmic and inverse trigonometric functions. Applications include biomechanics, ecology, infectious diseases, physiology, and modelling.

CR: MATH 1000 and the former MATH 1081.

LC: 4

PR: MATH 1090 or 109B or a combination of placement test and high school Mathematics scores acceptable to the Department

UL: at most 9 credit hours in Mathematics will be given for courses successfully completed from the following list subject to normal credit restrictions: Mathematics 1000, 1005, 1006, 1031, 1050, 1051, the former 1080, the former 1081, 1090, 109A/B, the former 1150 and 1151.

CALENDAR ENTRY AFTER CHANGES

MATH 1006. Calculus for Life Sciences is an introduction to differential calculus, including algebraic, trigonometric, exponential, logarithmic and inverse trigonometric functions. Applications include biomechanics, ecology, infectious diseases, physiology, and modelling.

CR: MATH 1000 and the former MATH 1081.

LC: 4

PR: MATH 1090 or 109B or a combination of placement test and high school Mathematics scores acceptable to the Department

UL: at most 9 credit hours in Mathematics will be given for courses successfully completed from the following list subject to normal credit restrictions: Mathematics 1000, 1005, 1006, 1031, 1050, 1051, the former 1080, the former 1081, 1090, 109A/B, the former 1150 and 1151.

LIST OF CHANGES

Indicate the Calendar change(s) being proposed by checking and completing as appropriate:

Amended or deleted course(s): MATH 1000, 1001, 1005, 1050, 1051, STAT 2550

1000 Calculus I is an introduction to differential calculus, including algebraic, trigonometric, exponential, logarithmic, inverse trigonometric and hyperbolic functions. Applications include kinematics, related rates problems, curve sketching and optimization.

CR: MATH 1006 and the former MATH 1081

LC: 4

PR: MATH 1090 or 109B or a combination of placement test and high school Mathematics scores acceptable to the Department

UL: at most 9 credit hours in Mathematics will be given for courses successfully completed from the following list subject to normal credit restrictions: Mathematics 1000, 1006, 1031, 1050, 1051, the former 1080, the former 1081, 1090, 109A/B, the former 1150 and 1151

1001 Calculus II is an introduction to integral calculus, including Riemann sums, techniques of integration and improper integrals. Applications include exponential growth and decay, areas between curves and volumes of solids of revolution.

PR: MATH 1000 or MATH 1006 or the former MATH 1081

1005 Calculus for Business is an introduction to differential calculus, including algebraic, exponential, and logarithmic functions. Applications include related rates and optimization in a business context and partial differentiation. This is a terminal course, not intended for those planning on taking further calculus courses. Business students who plan to take further calculus courses should complete MATH 1000 instead of MATH 1005.

LC: 4

PR: MATH 1090 or 109B or a combination of placement test and high school Mathematics scores acceptable to the Department

UL: at most 9 credit hours in Mathematics will be given for courses successfully completed from the following list subject to normal credit restrictions: Mathematics 1000, 1005, 1006, 1031, 1050, 1051, the former 1080, the former 1081, 1090, 109A/B, the former 1150 and 1151

1050 Finite Mathematics I covers topics which include sets, logic, permutations, combinations and elementary probability.

CR: MATH 1052 and MATH 1053

LC: 4

PR: a combination of placement test and high school mathematics scores acceptable to the department or the former MATH 103F

UL: At most 9 credit hours in Mathematics will be given for courses successfully completed from the following list subject to normal credit restrictions: Mathematics 1000, 1006, 1031, 1050, 1051, 1052, 1053, the former 1080, the former 1081, 1090, 109A/B, the former 1150 and 1151. Students who have already obtained 6 or more credit hours in Mathematics or Statistics courses numbered 2000 or above should not register for this course, and cannot receive credit for it.

1051 Finite Mathematics II covers topics which include elementary matrices, linear programming, elementary number theory, mathematical systems, and geometry.

CR: MATH 1052 and MATH 1053

LC: 4

PR: a combination of placement test and high school mathematics scores acceptable to the department or the former MATH 103F

UL: At most 9 credit hours in Mathematics will be given for courses successfully completed from the following list subject to normal credit restrictions: Mathematics 1000, 1006, 1031, 1050, 1051, 1052, 1053, the former 1080, the former 1081, 1090, 109A/B, the former 1150 and 1151. Students who have already obtained 6 or more credit hours in Mathematics or Statistics courses numbered 2000 or above should not register for this course, and cannot receive credit for it.

2550 Statistics for Science Students is an introduction to basic statistics methods with an emphasis on applications to the sciences. Material includes descriptive statistics, elementary probability, binomial distribution, Poisson distribution, normal distribution, sampling distribution, estimation and hypothesis testing (both one and two sample cases), chi-square test, one way analysis of variance, correlation and simple linear regression.

CR: Engineering 4421, STAT 2500, the former STAT 2510, Psychology 2910, Psychology 2925 and the former Psychology 2900.

LH: 1.5

OR: Statistical computer package will be used in the laboratory, but no prior computing experience is assumed

PR: MATH 1000 or MATH 1006 or the former MATH 1081

Grenfell Campus 13.21 Mathematics and Statistics

At most 9 credit hours in Mathematics will be given for courses successfully completed from the following list subject to normal credit restrictions: Mathematics 1000, 1005, 1006, 1031, 1050, 1051, 1052, 1053, 1080, 1081, 1090, 109A/B, 1150, 1151. Students who have already obtained credit for 6 or more Mathematics credit hours numbered 2000 or above are not permitted to register for Mathematics 1052 or 1053, nor can they receive credit for either of these courses.

1000 Calculus I is an introduction to differential calculus, including algebraic, trigonometric, exponential, logarithmic, inverse trigonometric and hyperbolic functions. Applications include kinematics, related rates problems, curve sketching and optimization.

CR: MATH 1006 and the former MATH 1081

LH: 1.5

PR: MATH 1090 or 109B or a combination of placement test and high school Mathematics scores acceptable to the School of Science and the Environment

1001 Calculus II is an introduction to integral calculus, including Riemann sums, techniques of integration and improper integrals. Applications include exponential growth and decay, area between curves and volumes of solids of revolution.

LH: 1.5

PR: MATH 1000, MATH 1006 or the former MATH 1081

2550 Statistics for Science Students

is an introduction to basic statistics methods with an emphasis on applications to the sciences. Material includes descriptive statistics, elementary probability, binomial distribution, Poisson distribution, normal distribution, sampling distribution, estimation and hypothesis testing (both one and two sample cases), chi-square test, one way analysis of variance, correlation and simple linear regression.

CR: Engineering 4421, STAT 2500, the former STAT 2510, Psychology 2910, Psychology 2925 and the former Psychology 2900.

LH: 1.5

OR: Statistical computer package will be used in the laboratory, but no prior computing experience is assumed

PR: MATH 1000, 1006 or the former MATH 1081

SECTION OF CALENDAR

Indicate the section of the Calendar impacted by the proposed change(s):

Department of: **BIOCHEMISTRY**

11.1.1.1 Admission to the Major in Biochemistry

Entry to the Biochemistry Majors program is based on academic standing.

1. To be considered for admission to the program students must have at least 30 credit hours in courses and have successfully completed the following courses (or their equivalents) with a minimum overall average of 60%. In addition, students must be eligible for entry to Chemistry 2400.
 - a. Six credit hours in **Critical Reading and Writing (CRW)** courses, including at least 3 credit hours in English courses.
 - b. Chemistry 1050 and 1051 (or 1200 and 1001)
 - c. Mathematics 1006 (or 1000), 1001 (or Mathematics 1090, 1006 (or 1000), or Mathematics 109A/B, 1006 (or 1000))
- 11.1.1.3 Admission to the Major in Nutrition**

Entry to the Nutrition majors program is based on academic standing.

1. To be considered for admission to the program students must have at least 30 credit hours in courses and have successfully completed the following courses (or their equivalents) with a minimum overall average of 60%.
 - a. Six credit hours in **Critical Reading and Writing (CRW)** courses, including at least 3 credit hours in English courses.
 - b. Chemistry 1050, 1051 (or Chemistry 1010, 1050 or Chemistry 1200, 1001)
 - c. Mathematics 1090, 1006 (or 1000) (or Mathematics 109A/B, 1006 (or 1000)), or Mathematics 1006 (or 1000) and one elective)
 - d. Biology 1001, 1002 or Physics 1020, 1021 (or 1050 1051)

11.1.2.1 Major in Biochemistry

Entry to the Biochemistry majors program is based on academic standing.

1. Required courses to complete the major:
 - a. Six credit hours in **Critical Reading and Writing (CRW)** courses, including at least 3 credit hours in English courses.
 - b. Biology 1001 and 1002; Mathematics 1006 (or 1000), 1001; Physics 1050 (or 1020), 1051 (or 1021); Chemistry 1050, 1051 (or Chemistry 1200 and 1001).

11.1.2.4 Major in Nutrition

1. Required courses:
 1. Six credit hours in **Critical Reading and Writing (CRW)** courses, including at least 3 credit hours in English courses.
 2. Biology 1001 and 1002; Mathematics 1006 (or 1000), Physics 1020 and 1021 (or Physics 1050 and 1051); Chemistry 1050, 1051 (or Chemistry 1200 and 1001).

11.1.2.5 Honours Degree in Nutrition

1. Required courses:
 1. Six credit hours in **Critical Reading and Writing (CRW)** courses, including at least 3 credit hours in English courses.
 2. Biology 1001 and 1002; Mathematics 1006 (or 1000), Physics 1020 (or 1050) and 1021 (or 1051); Chemistry 1050, 1051 (or Chemistry 1200 and 1001).

Changes to the new Human Biosciences Majors:

11.X.1.1 Admission to the Major in Human Biosciences

Entry to the Human Biosciences Major program is based on academic standing.

1. To be considered for admission to the program students must have at least 24 credit hours in courses and have successfully completed the following courses (or their equivalents) with a minimum overall average of 60%. In addition, students must be eligible for entry to Chemistry 2400.

- a. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses.
- b. Chemistry 1050 and 1051 (or 1200 and 1001).
- c. Mathematics ~~1000~~ 1006 (or equivalent).
- d. Biology 1001.
- e. Biology 1002 or Human Biosciences 1001 (or Biochemistry 1600).

Note: Students who have appropriate high school equivalent courses may be admitted directly into the Human Biosciences major.

11.X.2.1 Major in Human Biosciences

1. Required courses to complete the major:
 - a. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses.
 - b. Biology 1001; Biology 1002 or Human Biosciences 1001 (or Biochemistry 1600); Mathematics 1006 (or equivalent), Statistics 2550 (or equivalent); Chemistry 1050, 1051 (or Chemistry 1200 and 1001).

- c. Human Biosciences 2001 (or Biochemistry 2101 or 2201), 2002 (or Biochemistry 2600), 2003 (or Biochemistry 3206 or 3106), 2004 (or Biochemistry 2100 or 2200), 2901 (or Biochemistry 2901), 3001, 3002, 3003, 3004, 3005, 3906 (or Biochemistry 3906), 3907 (or Biochemistry 3907).
- d. Human Biosciences 4800.
- e. At least six further credit hours from Human Biosciences courses at the 4000-level.
- f. Medicine 310A/B.
- g. Chemistry 2400.
- h. A sufficient number of elective courses to bring the total Science courses up to at least 78 credit hours and the degree total up to 120 credit hours.

11.X.2.2 Honours Degree in Human Biosciences

1. Required courses:

- a. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses.
- b. Biology 1001; Biology 1002 or Human Biosciences 1001 (or Biochemistry 1600); Mathematics 10006 (or equivalent), Statistics 2550 (or equivalent); Chemistry 1050, 1051(or Chemistry 1200 and 1001).
- c. Human Biosciences 2001 (or Biochemistry 2101 or 2201), 2002 (or Biochemistry 2600), 2003 (or Biochemistry 3206 or 3106), 2004 (or Biochemistry 2100 or 2200), 2901 (or Biochemistry 2901), 3001, 3002, 3003, 3004, 3005, 3906 (or Biochemistry 3906), 3907 (or Biochemistry 3907), 499A/B.
- d. Human Biosciences 4800.
- e. At least 15 credit hours from Human Biosciences courses at the 3000 or 4000-level, at least 9 credit hours of which are from the 4000-level.
- f. Medicine 310A/B.
- g. Chemistry 2400.
- h. A sufficient number of elective courses to bring the total for the degree up to 120 credit hours.

10.2.3 Cell Biology and Human Biosciences Joint Honours

The following courses are required:

- 1. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses.
- 2. Biology 1001, 1002, Chemistry 1050, 1051 (or 1200 and 1001), Mathematics 10006 (or equivalent), Statistics 2550;
- 3. Human Biosciences 2001 (or the former Biochemistry 2101 or 2201), 2002 (or the former Biochemistry 2600), 2003 (or Biochemistry 3206), 2004 (or the former Biochemistry 2100 or 2200),2901, Chemistry 2400;
- 4. Human Biosciences 3004 and Medicine 310A/B;

5. Human Biosciences 4800 (Capstone);
6. An additional 15 credit hours to be selected from Human Biosciences 3001, 3002, 3003, 3101, 3906 or 3907, 4002, 4101, 4102, 4104, 4200, 4201, 4230, 4231, 4232;
7. Biology 2060, 2250, 2600, 2900, 3530, 4241, plus one of Biology 3401, 3402, 4245 or 4404;
8. 12 credit hours from the following: Biology 3050, 3052 (or Biochemistry 3052), 3401, 3402, 3500, the former 3620, 3950, 3951, 4010, the former 4040, 4050, 4200 (or Human Biosciences 3101), 4245, 4250, 4251, the former 4255, 4404, 4550, 4605, 4607;
9. Human Biosciences 499A/B or Biology 499A/B; and
10. Electives to make up 120 credit hours.

Seventy-five credit hours in Biology, Human Biosciences, Chemistry and Medicine courses beyond the first-year level from those listed in the program shall contribute to those in which a grade of "B" or an average of 75 or higher is required.

10.2.4 Chemistry and Human Biosciences Joint Honours

The following courses are required:

1. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses;
2. Chemistry 1050 and 1051 (or Chemistry 1200 and 1001), Mathematics 10006 (or equivalent) and 1001, Physics 1050 (or 1020) and 1051 (or 1021), Biology 1001 and 1002 are highly recommended;
3. Mathematics 2000;
4. Chemistry 2100, 2210, 2301, 2302, 2400, 2401, 3110, 3211, 4410;
5. Nine further credit hours in Chemistry courses numbered 3000 or higher, at least 6 credit hours of which must be in courses numbered 4000 or higher;
6. Human Biosciences 2001 (or the former Biochemistry 2101 or 2201), 2002 (or the former Biochemistry 2600), 2003 (or the former Biochemistry 3206), 2004 (or the former Biochemistry 2100 or 2200), 2901;
7. Two of Human Biosciences 3001, 3002, 3003, 3004, 3005;
8. An additional 12 credit hours to be selected from Human Biosciences 3001, 3002, 3003, 3101, 3906 or 3907, 4002, 4101, 4102, 4104, 4200, 4201, 4210 or 4211, 4230, 4231, 4232;
9. Human Biosciences 4800 (Capstone);
10. Human Biosciences 499A/B or Chemistry 490A/B; and
11. A sufficient number of elective courses to bring the degree to a total of 120 credit hours.

10.2.5 Human Biosciences and Physics Joint Honours

The following courses are required:

1. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses;
2. Chemistry 1050 and 1051 (or 1200 and 1001), Mathematics 10006 (or equivalent) and 1001, Physics 1050 (or 1020) and 1051;
3. Chemistry 2400;
4. Chemistry 2301 or Physics 2053;
5. Mathematics 2000, 2050, 2260, either Mathematics 3202 or Physics 3810;
6. Human Biosciences 2001 (or the former Biochemistry 2101 or 2201), 2002 (or the former Biochemistry 2600) 2003 (or the former Biochemistry 3206), 2004 (or the former Biochemistry 2100 or 2200), 2901 (or Biochemistry 2901);
7. Two of Human Biosciences 3001, 3002, 3003, 3004, 3005;
8. An additional 9 credit hours to be selected from Human Biosciences 3001, 3002, 3003, 3101 (or Biochemistry 4105), 3105, 3906 or 3907, 4002, 4101, 4102, 4104, 4200, 4201, 4230, 4231, 4232;
9. Human Biosciences 4800 (Capstone);
10. Physics 2055, 2750 or 2056, 2820, 3220, 3400, 3500, 3750, 3820, 3900, plus one 4000 level Physics course;
11. Human Biosciences 499A/B or Physics 490A/B; and
12. Other courses to complete the prescribed minimum of 120 credit hours in courses for the Joint Honours degree.

10.2.6 Human Biosciences and Psychology

(Behavioural Neuroscience) Joint Honours

Note: Students completing this program cannot receive credit for Psychology 2920. The following courses (or equivalent) are required:

1. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses;
2. Chemistry 1050 and 1051 (or 1200 and 1001), Biology 1001 and 1002, Mathematics 10006 (or equivalent);
3. Human Biosciences 2001 (or the former Biochemistry 2101 or 2201), 2002 (or the former Biochemistry 2600), 2003 (or the former Biochemistry 3206), 2004 (or the former

Biochemistry

2100 or 2200), 2901, 3004 and Medicine 310A/B;

4. An additional 15 credit hours to be selected from Human Biosciences 3001, 3002, 3003, 3101,

3906 or 3907, 4002, 4101, 4102, 4104, 4200, 4201, 4230, 4231, 4232;

5. Human Biosciences 4800 (Capstone);

6. Psychology 1000, 1001, 2521, 2910, 2911, 2930, 3800, 3820, 3900;

7. Three credit hours in Psychology chosen from the following: the former PSYC 3250, 3810, 3830, 3840, or 3860;

8. Three credit hours in Psychology chosen from the following: 3050, 3100, 3251, 3350, 3450, 3620, 3650, 3750;

9. Any Psychology research experience course and one of Psychology 4850, 4851, 4852, 4853,

or 4854; or, any Psychology selected topics course and Psychology 4870;

10. Human Biosciences 499A/B 499A/B or Psychology 499A/B; and

11. Chemistry 2400.

SECTION OF CALENDAR

Indicate the section of the Calendar impacted by the proposed change(s):

Department of: BIOLOGY

RATIONALE

The following course pre-requisite changes are proposed due to the addition of a new course: MATH 1006.

11.2.1 Entrance Requirements (Biology)

Entry to the Biology Majors Program is competitive and based on academic standing.

To be considered for admission to the program students must have successfully completed Biology 1001/1002 with an average of at least 65%. In addition, applicants will normally have successfully completed the following courses (or their equivalents) and must have a minimum overall average of 60% in these courses.

1. Six credit hours in **Critical Reading and Writing (CRW)** courses, including at least 3 credit hours in English courses.
2. Mathematics 1090 and Mathematics 1006 (or 1000) (or Mathematics 109A/B and Mathematics 1006 (or 1000), or Mathematics 1006 (or 1000) only)
3. Chemistry 1050 and 1051 (or 1200 and 1001, or 1010 and the former 1011) (or Physics 1020/1021 (or equivalent))
4. If Mathematics 1006 (or 1000) taken, any one other first year course.

11.2.3.1 Major in Biology

All students majoring in Biology are required to complete a minimum of 45 credit hours in courses from the Department of Biology offering. Those 45 credit hours must include: Biology 1001 and 1002 or their equivalents; the 15 credit hours in core courses listed below; and 24 credit hours in Biology electives at the 2000, 3000 or 4000 level except Biology 2040, 2041, 2120, 3053, and 3820.

Biology Core (15 credit hours): Biology 2060, 2250, 2600, 2900, plus one of Biology 3401, 3402, 4245 or 4404.

A maximum of 9 credit hours can be in Biology courses with no associated laboratory/seminar.

All majors must also successfully complete the following courses or their equivalents:

1. Six credit hours in **Critical Reading and Writing (CRW)** courses, including at least 3 credit hours in English courses
2. Physics 1020 and 1021 (or equivalent)
3. Mathematics 1006 (or 1000)

11.2.4.1 Honours in Biology

An Honours degree in Biology may comprise a broadly based selection of courses according to the student's interests, or it may be more narrowly focussed. An Honours student may focus on any area of Biology where an appropriate supervisor can be found. All Honours students should choose courses in consultation with their supervisors, but it is particularly important that students wishing to focus within the Honours degree should discuss course selection with an Honours supervisor within their area of interest.

1. Biology Course Requirements:

Students seeking an honours degree in Biology are required to successfully complete a minimum of 69 credit hours in courses from the Department of Biology offering. Those 69 credit hours must include:

1. Biology 1001 and 1002 or their equivalents;
2. 15 credit hours in the following core courses: Biology 2060, 2250, 2600, 2900, plus one of Biology 3401, 3402, 4245 or 4404; and
3. 42 credit hours from Biology electives at the 2000, 3000 or 4000 level (except Biology 2040, 2041, 2120, 3053, and 3820) and Biology 499A and 499B.
4. A maximum of 9 credit hours can be in Biology courses with no associated laboratory/seminar.

2. Core Course Requirements:

All honours students must also successfully complete the following courses or their equivalents:

1. Six credit hours in **Critical Reading and Writing (CRW)** courses, including at least 3 credit hours in English courses.
2. Physics 1020 and 1021 (or equivalent)
3. Mathematics 1006 (or 1000)

11.8.1 Regulations (Mathematics and Statistics)

1. At most 9 credit hours in Mathematics will be given for courses successfully completed from the following list subject to normal credit restrictions: Mathematics 1000, 1005, 1006, 1031, 1050, 1051, 1052, 1053, the former 1080, the former 1081, 1090, 109A/B, the former 1150 and 1151.
2. Students who have already obtained 6 or more credit hours in Mathematics or Statistics courses numbered 2000 or above should not register for Mathematics 1050 or Mathematics 1051 and cannot receive credit for either course.

3. Students with credits in Mathematics or Statistics not listed in this Calendar must consult the Department for equivalency before taking any course listed under **Course Descriptions, Mathematics and Statistics**.
4. Placement in Mathematics 1000, 1005, 1006, 1050, 1051, 1090, and 109A/B, shall be determined by the Department of Mathematics and Statistics on the basis of the student's score on the Mathematics Placement Test (MPT), SAT Subject Test in Mathematics Level 1, or other acceptable criteria-based test.

SECTION OF CALENDAR

Indicate the section of the Calendar impacted by the proposed change(s):

Department of: CHEMISTRY

RATIONALE

The following course pre-requisite changes are proposed due to the addition of a new course: MATH 1006.

CALENDAR CHANGES**10.2 Joint Honours****10.2.1 Applied Mathematics and Chemistry Joint Honours**

The following courses are required:

1. Six credit hours in [Critical Reading and Writing \(CRW\)](#) courses, including at least 3 credit hours in English courses.
2. A computing course. Computer Science 1510 is recommended.
3. Biochemistry 2201 or the former 2101, or 2901.
4. Physics 1050 (or 1020) and 1051 (or 1021).
5. Mathematics 1000 (or 1006) 1001, 2000, 2050, 2051, 2260, 2320, 3000, 3001, 3132, 3161, 3202, 3210, 4160.
6. Chemistry 1050 and 1051 (or 1200 and 1001), 2100, 2210, 2301, 2302, 2400, 2401, 3110, 3210 or 3211, 3303.
7. Six additional credit hours chosen from courses numbered 3000 or higher that are offered by the Department of Chemistry.
8. An Honours Dissertation (Mathematics 419A/B or Chemistry 490A/B). The topic of the Honours Dissertation must have the prior approval of the Heads of the two Departments. A faculty member of either Department may act as supervisor.
9. A sufficient number of elective courses to bring the degree up to a total of 120 credit hours.
10. Mathematics 2130 is recommended.

10.2.4 Biochemistry and Chemistry Joint Honours

The following courses are required:

1. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses;
2. Chemistry 1050 and 1051 (or Chemistry 1200 and 1001), Mathematics 1000 (or 1006) and 1001, Physics 1050 (or 1020) and 1051 (or 1021), Biology 1001 and 1002 are highly recommended;
3. Mathematics 2000;
4. Chemistry 2100, 2210, 2301, 2302, 2400, 2401, 3110, 3211, 4410;

5. Nine further credit hours in Chemistry courses numbered 3000 or higher, at least 6 credit hours of which must be in courses numbered 4000 or higher;
6. Biochemistry 2200 or 2100, Biochemistry 2201 or the former 2101, 2901, 3105, 3206;
7. Either Biochemistry 3108 and 3207, or Medicine 310A/B
8. 9 credit hours chosen from Biochemistry 3906 or 3907, 4002, 4101, 4102, 4103, 4104, 4105, 4200, 4201, 4210 or 4211, 4230, 4231, 4232-4239;
9. Either Chemistry 490A/B or Biochemistry 499A/B; and
10. A sufficient number of elective courses to bring the degree to a total of 120 credit hours.

10.2.12 Chemistry and Earth Sciences Joint Honours

The following courses, including prerequisites, where applicable, will be required:

1. Six credit hours in [Critical Reading and Writing \(CRW\)](#) courses, including at least 3 credit hours in English courses.
2. Mathematics 1000 (or 1006) and 1001, Earth Sciences 1000 and 1002, Chemistry 1050 and 1051 (or 1010, the former 1011 and the former 1031) (or 1200 and 1001) or their equivalents, Physics 1050 (or 1020) and 1051 (or 1021).
3. Earth Sciences 2030, 2031, 2401, 2502, 2702, 2905, 3420, 3600; plus 6 additional credit hours in 3000-level Earth Sciences courses, and 9 additional credit hours in 4000-level Earth Sciences courses.
4. Chemistry 2100, 2210, 2301, 2302, 2400, 2401 and 3110; and at least 6 additional credit hours in 3000-level and 6 credit hours in 4000-level Chemistry courses.
5. Mathematics 2000 and 2050.
6. Biology 2120 and Biochemistry 2201 or the former 2101.
7. An Honours Dissertation (Earth Sciences 499A/B or Chemistry 490A/B). The topic of the Honours Dissertation must have the prior approval of the Heads of the two Departments. A faculty member of either Department may act as supervisor.
8. Other courses to complete the prescribed minimum of 120 credit hours.

Any change in the program of study must have the prior approval of the Heads of the two Departments concerned.

10.2.13 Chemistry and Physics Joint Honours

The following courses are prescribed:

1. Six credit hours in [Critical Reading and Writing \(CRW\)](#) courses, including at least 3 credit hours in English courses.

2. Mathematics 1000 (or 1006), 1001, 2000, 2050, 3202, and 2260.
3. Physics 1050 (or 1020) and 1051, 2055, 2750 or 2056, 2820, 3220, 3500, 3750, 3820, 3900, 4820, 3 additional credit hours in a Physics course numbered 3000 or higher and 6 additional credit hours in Physics courses numbered 4000 or higher.
4. Chemistry 1050 and 1051 (or Chemistry 1200 and 1001), 2100, 2210, 2301, 2302, 2400, 2401, 3210 or 3211, 3303, and 6 additional credit hours in Chemistry courses numbered 3000 or higher.
5. Biochemistry 2201 or the former 2101, or 2901.
6. An Honours Dissertation (Chemistry 490A/B or Physics 490A/B). The topic of the Honours Dissertation must have the prior approval of the Heads of the two Departments. A faculty member of either Department may act as supervisor.
7. A sufficient number of elective courses to bring the degree total to 120 credit hours.

11.3. Chemistry

11.3.4 General Degree - Major in Chemistry

Students wishing to take a Major in Chemistry should consult those regulations of the Calendar dealing with [Degree Regulations](#) for the General Degree of Bachelor of Science. The courses required for a Major in Chemistry are:

1. Chemistry 1050 and 1051 (or 1200 and 1001), 2100, 2210, 2301, 2302, 2400, 2401, 3110, 3210, 3211, 3303, and 3411.
2. Physics 1050 (or 1020) and 1051 (or 1021).
3. Mathematics 1000 (or 1006), 1001, 2000, and 2050.
4. Biochemistry 2201 or the former 2101, and 2901.

Recommended courses: Mathematics 2051 and Mathematics 2260, Physics 2820 and/or 2750.

Students considering declaring Chemistry as their Major are encouraged to contact either the Head of the Department or the Deputy Head (Undergraduate Studies). Chemistry Majors may complete a minor in [Applied Science - Process Engineering](#). The requirements for this minor are detailed under [Faculty of Engineering and Applied Science, Minor in Applied Science - Process Engineering](#).

11.3.5 Honours Degree in Chemistry

Students wishing to take Honours should consult those regulations of the Calendar dealing with [Degree Regulations](#) for the Honours Degree of Bachelor of Science.

11.3.5.1 Required Courses

1. CHEM 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. 12 credit hours selected from the 4000 level Chemistry courses chosen in consultation with the 490A/B supervisor for chemistry.
3. Physics 1050 (or 1020) and 1051 (or 1021).
4. Mathematics 1000 (or 1006), 1001, 2000, and 2050.
5. Biochemistry 2201 or the former 2101, and 2901.

Chemistry Honours students may complete a minor in [Applied Science - Process Engineering](#). The requirements for this minor are detailed under [Faculty of Engineering and Applied Science, Minor in Applied Science - Process Engineering](#).

11.3.5.2 Other Information

1. Those courses in which a grade of B or an average of 75% or higher are required, as specified under [Academic Standing](#) in the [Degree Regulations](#) for the Honours Degree of Bachelor of Science, are the courses beyond first year used to satisfy clause 1. under [Required Courses](#) above.
2. Recommended courses: Mathematics 2051 and Mathematics 2260, Physics 2820 and/or 2750.
3. A thesis based on a selected research topic carried out under the supervision of a member of the Department is to be submitted in the final year.
4. Chemistry 490A/B will normally require the equivalent of nine hours per week for two semesters. Registration in Chemistry 490A/B is normally restricted to those students who have honours standing. The Honours dissertation will be assessed by a committee comprising the supervisor and one other faculty member.
5. With approval of the Heads of the Chemistry and Biochemistry Departments prior to registration, a number of courses in Biochemistry may be substituted for a like number of Chemistry courses.
6. Prospective Honours students in Chemistry in their first year should take
 - a. Six credit hours in [Critical Reading and Writing \(CRW\)](#) courses, including at least 3 credit hours in English courses.
 - b. Chemistry 1050 and 1051 (or 1200 and 1001).
 - c. Physics 1050 and 1051 or 1020 and 1021.
 - d. Mathematics 1000 (or 1006) and 1001.
 - e. Six credit hours in other courses.
7. Students should consult the [Undergraduate Student Handbook](#) for timetabling details.
8. Students completing first year requirements for either Chemistry or Mathematics via the three course options (i.e. Chemistry 1010, 1050, 1051, Mathematics 1090, 1000 (or 1006), 1001 (or 109A/B, 1000 (or 1006), 1001) instead of the two course options (Chemistry 1050, 1051, Mathematics 1000 (or 1006), 1001) will require the corresponding number of extra credits to obtain an Honours degree.

9. Arrangements for subsequent years will depend on the other science subjects being studied and should be made in consultation with the Faculty Advisor.
10. Certain advanced courses may only be offered in alternate years. Students therefore should consult the Head of the Department before registration.
11. Certain Graduate courses may be taken in the final year of the Honours Program with the permission of the Head of the Department.
12. Details of Joint Honours programs with Biochemistry, Earth Sciences, Mathematics and Physics are outlined under [Joint Programs](#).
13. Details of the Environmental Science (Chemistry Stream) Major or Honours are outlined under the [Grenfell Campus](#) section of the Calendar.

11.3.6 General Degree - Major in Computational Chemistry

Students wishing to take a Major in Computational Chemistry should consult those regulations of the Calendar dealing with [Degree Regulations](#) for the General Degree of Bachelor of Science.

11.3.6.1 Required Courses

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 (or 1006), 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 \(CRW\)](#) courses, including at least 3 credit hours in English courses.

11.3.6.2 Suggested Program of Study

Given appropriate circumstances the Major in Computational Chemistry program can be completed in four years. While students should consult the Undergraduate Handbook for further timetabling details, to complete the program in four years generally will require that students take the following courses in their first year:

1. Six credit hours in [Critical Reading and Writing \(CRW\)](#) courses, including at least 3 credit hours in English courses.
2. Chemistry 1050 and 1051 (or 1200 and 1001).
3. Physics 1050 (or 1020) and 1051.
4. Mathematics 1000 (or 1006) and 1001.
5. Computer Science 1001 and 1510.

11.3.7 Honours Degree in Computational Chemistry

Students wishing to take Honours in Computational Chemistry should consult those sections of the Calendar dealing with [Degree Regulations](#) for the Honours Degree of Bachelor of Science.

11.3.7.1 Required Courses

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 (or 1006), 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 3731 or Mathematics 3132.
8. Chemistry 490A/B.
9. Six credit hours in [Critical Reading and Writing \(CRW\)](#) courses, including at least 3 credit hours in English courses.

11.3.7.2 Suggested Program of Study

Given appropriate circumstances the Honours in Computational Chemistry program can be completed in four years. While students should consult the Undergraduate Handbook for further timetabling details, to complete the program in four years generally will require that students take the following courses in their first year:

1. Six credit hours in [Critical Reading and Writing \(CRW\)](#) courses, including at least 3 credit hours in English courses.
2. Chemistry 1050 and 1051 (or 1200 and 1001).
3. Physics 1050 (or 1020) and 1051.
4. Mathematics 1000 (or 1006) and 1001.
5. Computer Science 1001 and 1510.

11.3.7.3 Other Information

1. A thesis based on a selected research topic carried out under the supervision of a member of the Department is to be submitted in the final year.
2. Chemistry 490A/B will normally require the equivalent of nine hours per week for two semesters. Registration in Chemistry 490A/B is restricted to those students who have honours standing. The Honours dissertation will be assessed by a committee comprising the supervisor and one other faculty member.
3. Students completing first year requirements for any of Chemistry, Mathematics or Physics via the three course options (i.e. Chemistry 1010, 1050, 1051,

Mathematics 1090, 1000 (or 1006), 1001 or 109A/B, 1000 (or 1006), 1001, Physics 1020, 1021, 1051) instead of the two course options (Chemistry 1050, 1051, Chemistry 1200, 1001, Mathematics 1000 (or 1006), 1001, Physics 1050, 1051) will require the corresponding number of extra credits to obtain an Honours degree.

4. Arrangements for subsequent years will depend on the other science subjects being studied and should be made in consultation with a Faculty Advisor.
5. Certain advanced courses may only be offered in alternate years. Students therefore should consult the Head of the Department before registration.

11.3.8 General Degree in Chemistry (Biological)

Students wishing to pursue a General Degree in Chemistry (Biological) are encouraged to contact the Department Head or the Deputy Head (Undergraduate Studies) as early as possible and should consult those regulations of the Calendar dealing with [Degree Regulations](#) for the General Degree of Bachelor of Science.

11.3.8.1 Required Courses

1. Chemistry 1050 and 1051, 2100, 2210, 2301, 2302, 2400, 2401, 3110, 3211, and 4410.
2. At least 6 credit hours from Chemistry 3210, 3303, 3411 or any 4000-level Chemistry course.
3. 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.
4. Biochemistry 2201 or the former 2101, 2901 and at least 6 credit hours from Biochemistry 3105, 3206 or 3106, 3207 or 3107, 4101, and 4201.
5. Mathematics 1000 (or 1006) and 1001. Statistics 2550 is strongly recommended.
6. Physics 1050 (or 1020) and Physics 1051 (or 1021).
7. Six credit hours in [Critical Reading and Writing \(CRW\)](#) courses, including at least 3 credit hours in English courses.

11.3.8.2 Other Information

In first year, prospective students for the General Degree in Chemistry (Biological) should complete:

1. Six credit hours in [Critical Reading and Writing \(CRW\)](#) courses, including at least 3 credit hours in English courses.
2. Chemistry 1050 and 1051, Biology 1001 and 1002, Physics 1050 (or 1020) and Physics 1051 (or 1021), and Mathematics 1000 (or 1006) and 1001.
3. This program fulfills the first and second teachable requirements for admission into the [Bachelor of Education \(Intermediate/Secondary\)](#) at this University with Chemistry and Biology as the first and second teachable subjects, respectively.

4. Students in the Chemistry (Biological) program are not able to also qualify for a minor in Biology.
5. Some courses listed under [Required Courses](#) above require one or more prerequisites that are not defined as part of the program.

11.3.9 Honours Degree in Chemistry (Biological)

Students wishing to take Honours should consult those sections of the Calendar dealing with [Degree Regulations](#) for the Honours Degree of Bachelor of Science. Students wishing to pursue an Honours Degree in Chemistry (Biological) are encouraged to contact the Department Head or the Deputy Head (Undergraduate Studies) as early as possible.

11.3.9.1 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. Biochemistry 2201 or the former 2101, 2901 and at least 6 credit hours from Biochemistry 3105, 3206 or 3106, 3207 or 3107, 4101, and 4201.
6. Mathematics 1000 (or 1006) 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.

11.3.9.2 Other Information

In first year, prospective students for the Honours Degree in Chemistry (Biological) should complete:

1. Six credit hours in [Critical Reading and Writing \(CRW\)](#) courses, including at least 3 credit hours in English courses.
2. Chemistry 1050 and 1051, Biology 1001 and 1002, Physics 1050 (or 1020) and Physics 1051 (or 1021), and Mathematics 1000 (or 1006) and 1001.
3. Chemistry 490A/B will normally require the equivalent of nine hours per week for two semesters. Registration in Chemistry 490A/B is restricted to those students who have honours standing. The Honours dissertation will be assessed by a committee comprising the supervisor and one other faculty member. Chemistry 490A/B Projects are to be approved by the Head of the Department or delegate.

4. The Honours in Chemistry (Biological) program can be completed in four years. Students should consult the [Undergraduate Student Handbook](#) for timetabling details.
5. Students completing first year requirements for any of Chemistry, Mathematics, or Physics via the three course options (i.e. Chemistry 1010, 1050, 1051 (or 1010, the former 1011, and the former 1031), Mathematics 1090, 1000 (or 1006), 1001, Physics 1020, 1021, 1051) instead of the two course options (Chemistry 1050, 1051, Mathematics 1000 (or 1006), 1001, Physics 1050, 1051) will require the corresponding number of extra credits to obtain an Honours degree.
6. With the permission of the Head of the Department, 6000-level courses may be taken in the final year of the Honours Program.
7. This program fulfills the first and second teachable requirements for admission into the [Bachelor of Education \(Intermediate/Secondary\)](#) at this University with Chemistry and Biology as the first and second teachables, respectively.
8. Students in the Chemistry (Biological) program are not able to also qualify for a minor in Biology.
9. Some courses listed under [Required Courses](#) above require one or more prerequisites that are not defined as part of the program.

CALENDAR ENTRY AFTER CHANGES

10.2 Joint Honours

10.2.1 Applied Mathematics and Chemistry Joint Honours

The following courses are required:

11. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses.
12. A computing course. Computer Science 1510 is recommended.
13. Biochemistry 2201 or the former 2101, or 2901.
14. Physics 1050 (or 1020) and 1051 (or 1021).
15. Mathematics 1000 (or 1006) 1001, 2000, 2050, 2051, 2260, 2320, 3000, 3001, 3132, 3161, 3202, 3210, 4160.
16. Chemistry 1050 and 1051 (or 1200 and 1001), 2100, 2210, 2301, 2302, 2400, 2401, 3110, 3210 or 3211, 3303.
17. Six additional credit hours chosen from courses numbered 3000 or higher that are offered by the Department of Chemistry.
18. An Honours Dissertation (Mathematics 419A/B or Chemistry 490A/B). The topic of the Honours Dissertation must have the prior approval of the Heads of the two Departments. A faculty member of either Department may act as supervisor.
19. A sufficient number of elective courses to bring the degree up to a total of 120 credit hours.

20. Mathematics 2130 is recommended.

10.2.4 Biochemistry and Chemistry Joint Honours

The following courses are required:

11. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses;
12. Chemistry 1050 and 1051 (or Chemistry 1200 and 1001), Mathematics 1000 (or 1006) and 1001, Physics 1050 (or 1020) and 1051 (or 1021), Biology 1001 and 1002 are highly recommended;
13. Mathematics 2000;
14. Chemistry 2100, 2210, 2301, 2302, 2400, 2401, 3110, 3211, 4410;
15. Nine further credit hours in Chemistry courses numbered 3000 or higher, at least 6 credit hours of which must be in courses numbered 4000 or higher;
16. Biochemistry 2200 or 2100, Biochemistry 2201 or the former 2101, 2901, 3105, 3206;
17. Either Biochemistry 3108 and 3207, or Medicine 310A/B
18. 9 credit hours chosen from Biochemistry 3906 or 3907, 4002, 4101, 4102, 4103, 4104, 4105, 4200, 4201, 4210 or 4211, 4230, 4231, 4232-4239;
19. Either Chemistry 490A/B or Biochemistry 499A/B; and
20. A sufficient number of elective courses to bring the degree to a total of 120 credit hours.

10.2.12 Chemistry and Earth Sciences Joint Honours

The following courses, including prerequisites, where applicable, will be required:

9. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses.
10. Mathematics 1000 (or 1006) and 1001, Earth Sciences 1000 and 1002, Chemistry 1050 and 1051 (or 1010, the former 1011 and the former 1031) (or 1200 and 1001) or their equivalents, Physics 1050 (or 1020) and 1051 (or 1021).
11. Earth Sciences 2030, 2031, 2401, 2502, 2702, 2905, 3420, 3600; plus 6 additional credit hours in 3000-level Earth Sciences courses, and 9 additional credit hours in 4000-level Earth Sciences courses.
12. Chemistry 2100, 2210, 2301, 2302, 2400, 2401 and 3110; and at least 6 additional credit hours in 3000-level and 6 credit hours in 4000-level Chemistry courses.
13. Mathematics 2000 and 2050.
14. Biology 2120 and Biochemistry 2201 or the former 2101.
15. An Honours Dissertation (Earth Sciences 499A/B or Chemistry 490A/B). The topic of the Honours Dissertation must have the prior approval of the Heads of

the two Departments. A faculty member of either Department may act as supervisor.

16. Other courses to complete the prescribed minimum of 120 credit hours.

Any change in the program of study must have the prior approval of the Heads of the two Departments concerned.

10.2.13 Chemistry and Physics Joint Honours

The following courses are prescribed:

8. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses.
9. Mathematics 1000 (or 1006), 1001, 2000, 2050, 3202, and 2260.
10. Physics 1050 (or 1020) and 1051, 2055, 2750 or 2056, 2820, 3220, 3500, 3750, 3820, 3900, 4820, 3 additional credit hours in a Physics course numbered 3000 or higher and 6 additional credit hours in Physics courses numbered 4000 or higher.
11. Chemistry 1050 and 1051 (or Chemistry 1200 and 1001), 2100, 2210, 2301, 2302, 2400, 2401, 3210 or 3211, 3303, and 6 additional credit hours in Chemistry courses numbered 3000 or higher.
12. Biochemistry 2201 or the former 2101, or 2901.
13. An Honours Dissertation (Chemistry 490A/B or Physics 490A/B). The topic of the Honours Dissertation must have the prior approval of the Heads of the two Departments. A faculty member of either Department may act as supervisor.
14. A sufficient number of elective courses to bring the degree total to 120 credit hours.

11.3. Chemistry

11.3.4 General Degree - Major in Chemistry

Students wishing to take a Major in Chemistry should consult those regulations of the Calendar dealing with Degree Regulations for the General Degree of Bachelor of Science. The courses required for a Major in Chemistry are:

5. Chemistry 1050 and 1051 (or 1200 and 1001), 2100, 2210, 2301, 2302, 2400, 2401, 3110, 3210, 3211, 3303, and 3411.
6. Physics 1050 (or 1020) and 1051 (or 1021).
7. Mathematics 1000 (or 1006), 1001, 2000, and 2050.
8. Biochemistry 2201 or the former 2101, and 2901.

Recommended courses: Mathematics 2051 and Mathematics 2260, Physics 2820 and/or 2750.

Students considering declaring Chemistry as their Major are encouraged to contact either the Head of the Department or the Deputy Head (Undergraduate Studies). Chemistry Majors may complete a minor in Applied Science - Process Engineering. The requirements for this minor are detailed under Faculty of Engineering and Applied Science, Minor in Applied Science - Process Engineering.

11.3.5 Honours Degree in Chemistry

Students wishing to take Honours should consult those regulations of the Calendar dealing with Degree Regulations for the Honours Degree of Bachelor of Science.

11.3.5.1 Required Courses

6. CHEM 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.
7. 12 credit hours selected from the 4000 level Chemistry courses chosen in consultation with the 490A/B supervisor for chemistry.
8. Physics 1050 (or 1020) and 1051 (or 1021).
9. Mathematics 1000 (or 1006), 1001, 2000, and 2050.
10. Biochemistry 2201 or the former 2101, and 2901.

Chemistry Honours students may complete a minor in Applied Science - Process Engineering. The requirements for this minor are detailed under Faculty of Engineering and Applied Science, Minor in Applied Science - Process Engineering.

11.3.5.2 Other Information

14. Those courses in which a grade of B or an average of 75% or higher are required, as specified under Academic Standing in the Degree Regulations for the Honours Degree of Bachelor of Science, are the courses beyond first year used to satisfy clause 1. under Required Courses above.
15. Recommended courses: Mathematics 2051 and Mathematics 2260, Physics 2820 and/or 2750.
16. A thesis based on a selected research topic carried out under the supervision of a member of the Department is to be submitted in the final year.
17. Chemistry 490A/B will normally require the equivalent of nine hours per week for two semesters. Registration in Chemistry 490A/B is normally restricted to those students who have honours standing. The Honours dissertation will be assessed by a committee comprising the supervisor and one other faculty member.
18. With approval of the Heads of the Chemistry and Biochemistry Departments prior to registration, a number of courses in Biochemistry may be substituted for a like number of Chemistry courses.
19. Prospective Honours students in Chemistry in their first year should take
 - a. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses.

- b. Chemistry 1050 and 1051 (or 1200 and 1001).
 - c. Physics 1050 and 1051 or 1020 and 1021.
 - d. Mathematics 1000 (or 1006) and 1001.
 - e. Six credit hours in other courses.
20. Students should consult the Undergraduate Student Handbook for timetabling details.
 21. Students completing first year requirements for either Chemistry or Mathematics via the three course options (i.e. Chemistry 1010, 1050, 1051, Mathematics 1090, 1000 (or 1006), 1001 (or 109A/B, 1000 (or 1006), 1001) instead of the two course options (Chemistry 1050, 1051, Mathematics 1000 (or 1006), 1001) will require the corresponding number of extra credits to obtain an Honours degree.
 22. Arrangements for subsequent years will depend on the other science subjects being studied and should be made in consultation with the Faculty Advisor.
 23. Certain advanced courses may only be offered in alternate years. Students therefore should consult the Head of the Department before registration.
 24. Certain Graduate courses may be taken in the final year of the Honours Program with the permission of the Head of the Department.
 25. Details of Joint Honours programs with Biochemistry, Earth Sciences, Mathematics and Physics are outlined under Joint Programs.
 26. Details of the Environmental Science (Chemistry Stream) Major or Honours are outlined under the Grenfell Campus section of the Calendar.

11.3.6 General Degree - Major in Computational Chemistry

Students wishing to take a Major in Computational Chemistry should consult those regulations of the Calendar dealing with Degree Regulations for the General Degree of Bachelor of Science.

11.3.6.1 Required Courses

9. Chemistry 1050 and 1051 (or 1200 and 1001), 2100, 2210, 2301, 2302, 2400, 2401, 3210 or 3211, 3303, 4304, 4305.
10. Physics 1050 (or 1020) and 1051, and 2820.
11. Mathematics 1000 (or 1006), 1001, 2000, 2050, 2051, 2260 (or the former Mathematics 3260), and 3202.
12. Computer Science 1001, 1002, 1003, and 1510.
13. Computer Science 2500 or 2002.
14. Computer Science 2001.
15. Computer Science 3731 or Mathematics 3132.
16. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses.

11.3.6.2 Suggested Program of Study

Given appropriate circumstances the Major in Computational Chemistry program can be completed in four years. While students should consult the Undergraduate Handbook for further timetabling details, to complete the program in four years generally will require that students take the following courses in their first year:

6. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses.
7. Chemistry 1050 and 1051 (or 1200 and 1001).
8. Physics 1050 (or 1020) and 1051.
9. Mathematics 1000 (or 1006) and 1001.
10. Computer Science 1001 and 1510.

11.3.7 Honours Degree in Computational Chemistry

Students wishing to take Honours in Computational Chemistry should consult those sections of the Calendar dealing with Degree Regulations for the Honours Degree of Bachelor of Science.

11.3.7.1 Required Courses

10. Chemistry 1050 and 1051 (or 1200 and 1001), 2100, 2210, 2301, 2302, 2400, 2401, 3210 or 3211, 3303, 4304, and 4305.
11. Physics 1050 (or 1020), 1051, and 2820.
12. Mathematics 1000 (or 1006), 1001, 2000, 2050, 2051, 2260 (or the former Mathematics 3260), and 3202.
13. Computer Science 1001, 1002, 1003, and 1510.
14. Computer Science 2500 and 2002.
15. Computer Science 2001
16. Computer Science 3731 or Mathematics 3132.
17. Chemistry 490A/B.
18. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses.

11.3.7.2 Suggested Program of Study

Given appropriate circumstances the Honours in Computational Chemistry program can be completed in four years. While students should consult the Undergraduate Handbook for further timetabling details, to complete the program in four years generally will require that students take the following courses in their first year:

6. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses.
7. Chemistry 1050 and 1051 (or 1200 and 1001).
8. Physics 1050 (or 1020) and 1051.
9. Mathematics 1000 (or 1006) and 1001.

10. Computer Science 1001 and 1510.

11.3.7.3 Other Information

6. A thesis based on a selected research topic carried out under the supervision of a member of the Department is to be submitted in the final year.
7. Chemistry 490A/B will normally require the equivalent of nine hours per week for two semesters. Registration in Chemistry 490A/B is restricted to those students who have honours standing. The Honours dissertation will be assessed by a committee comprising the supervisor and one other faculty member.
8. Students completing first year requirements for any of Chemistry, Mathematics or Physics via the three course options (i.e. Chemistry 1010, 1050, 1051, Mathematics 1090, 1000 (or 1006), 1001 or 109A/B, 1000 (or 1006), 1001, Physics 1020, 1021, 1051) instead of the two course options (Chemistry 1050, 1051, Chemistry 1200, 1001, Mathematics 1000 (or 1006), 1001, Physics 1050, 1051) will require the corresponding number of extra credits to obtain an Honours degree.
9. Arrangements for subsequent years will depend on the other science subjects being studied and should be made in consultation with a Faculty Advisor.
10. Certain advanced courses may only be offered in alternate years. Students therefore should consult the Head of the Department before registration.

11.3.8 General Degree in Chemistry (Biological)

Students wishing to pursue a General Degree in Chemistry (Biological) are encouraged to contact the Department Head or the Deputy Head (Undergraduate Studies) as early as possible and should consult those regulations of the Calendar dealing with Degree Regulations for the General Degree of Bachelor of Science.

11.3.8.1 Required Courses

8. Chemistry 1050 and 1051, 2100, 2210, 2301, 2302, 2400, 2401, 3110, 3211, and 4410.
9. At least 6 credit hours from Chemistry 3210, 3303, 3411 or any 4000-level Chemistry course.
10. 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.
11. Biochemistry 2201 or the former 2101, 2901 and at least 6 credit hours from Biochemistry 3105, 3206 or 3106, 3207 or 3107, 4101, and 4201.
12. Mathematics 1000 (or 1006) and 1001. Statistics 2550 is strongly recommended.
13. Physics 1050 (or 1020) and Physics 1051 (or 1021).
14. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses.

11.3.8.2 Other Information

In first year, prospective students for the General Degree in Chemistry (Biological) should complete:

6. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses.
7. Chemistry 1050 and 1051, Biology 1001 and 1002, Physics 1050 (or 1020) and Physics 1051 (or 1021), and Mathematics 1000 (or 1006) and 1001.
8. This program fulfills the first and second teachable requirements for admission into the Bachelor of Education (Intermediate/Secondary) at this University with Chemistry and Biology as the first and second teachable subjects, respectively.
9. Students in the Chemistry (Biological) program are not able to also qualify for a minor in Biology.
10. Some courses listed under Required Courses above require one or more prerequisites that are not defined as part of the program.

11.3.9 Honours Degree in Chemistry (Biological)

Students wishing to take Honours should consult those sections of the Calendar dealing with Degree Regulations for the Honours Degree of Bachelor of Science. Students wishing to pursue an Honours Degree in Chemistry (Biological) are encouraged to contact the Department Head or the Deputy Head (Undergraduate Studies) as early as possible.

11.3.9.1 Required Courses

9. Chemistry 1050 and 1051, 2100, 2210, 2301, 2302, 2400, 2401, 3110, 3211, 4410 and 490A/B.
10. At least 3 credit hours from Chemistry 3210, 3303, 3411 or any 4000-level Chemistry course not used to fulfill clause 3. below.
11. At least 3 credit hours from Chemistry 4151, 4201, 4206, 4305, or 4701.
12. 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.
13. Biochemistry 2201 or the former 2101, 2901 and at least 6 credit hours from Biochemistry 3105, 3206 or 3106, 3207 or 3107, 4101, and 4201.
14. Mathematics 1000 (or 1006) and 1001. Statistics 2550 is strongly recommended.
15. Physics 1050 (or 1020) and Physics 1051 (or 1021).
16. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses.

11.3.9.2 Other Information

In first year, prospective students for the Honours Degree in Chemistry (Biological) should complete:

10. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses.
11. Chemistry 1050 and 1051, Biology 1001 and 1002, Physics 1050 (or 1020) and Physics 1051 (or 1021), and Mathematics 1000 (or 1006) and 1001.
12. Chemistry 490A/B will normally require the equivalent of nine hours per week for two semesters. Registration in Chemistry 490A/B is restricted to those students who have honours standing. The Honours dissertation will be assessed by a committee comprising the supervisor and one other faculty member. Chemistry 490A/B Projects are to be approved by the Head of the Department or delegate.
13. The Honours in Chemistry (Biological) program can be completed in four years. Students should consult the Undergraduate Student Handbook for timetabling details.
14. Students completing first year requirements for any of Chemistry, Mathematics, or Physics via the three course options (i.e. Chemistry 1010, 1050, 1051 (or 1010, the former 1011, and the former 1031), Mathematics 1090, 1000 (or 1006), 1001, Physics 1020, 1021, 1051) instead of the two course options (Chemistry 1050, 1051, Mathematics 1000 (or 1006), 1001, Physics 1050, 1051) will require the corresponding number of extra credits to obtain an Honours degree.
15. With the permission of the Head of the Department, 6000-level courses may be taken in the final year of the Honours Program.
16. This program fulfills the first and second teachable requirements for admission into the Bachelor of Education (Intermediate/Secondary) at this University with Chemistry and Biology as the first and second teachables, respectively.
17. Students in the Chemistry (Biological) program are not able to also qualify for a minor in Biology.
18. Some courses listed under Required Courses above require one or more prerequisites that are not defined as part of the program.

SECTION OF CALENDAR

Indicate the section of the Calendar impacted by the proposed change(s):

Department of: OCEAN SCIENCES

11.9.3.1 Admission Requirements for the Major in Ocean Sciences or the Major in Ocean Sciences (Environmental Systems)

Admission to the Ocean Sciences Major Programs is based on academic standing. To be considered for admission, students must normally have completed 30 credit hours with a minimum of 24 credit hours in Science, and an overall average of at least 65%. It is recommended that the following courses be successfully completed before admission:

1. Biology 1001 and 1002;
2. Chemistry 1050 and 1051 (or 1200 and 1001);
3. Earth Sciences 1000;
4. Six credit hours in [Critical Reading and Writing \(CRW\)](#) courses, including at least 3 credit hours in English courses;
5. Mathematics 1006 (or 1000) ~~1000 (or equivalent)~~;
6. Ocean Sciences 1000 with a minimum grade of 65%; and
7. Physics 1020 or (1050) or 3 credit hours in Ocean Sciences courses at the 2000 level.

Students are advised to consult with the Department at the earliest opportunity to prepare adequately for program admission. Each student majoring in Ocean Sciences will be assigned an advisor who should be consulted on academic issues, including course selection.

SECTION OF CALENDAR

Indicate the section of the Calendar impacted by the proposed change(s):

Department of: PSYCHOLOGY

RATIONALE

The following course pre-requisite changes are proposed due to the addition of a new course: MATH 1006.

11.11.2 Admission to Major Programs (Department of Psychology)

Admission to the Major programs in the Department of Psychology is competitive and selective. Students who wish to enter these programs must submit a completed application form, available on the Department of Psychology website in the Winter semester, to the Department of Psychology by June 1 for Fall semester registration. To be eligible for admission, students must have completed the 24 credit hours as listed below with an average of at least 65% in Psychology 1000/1001 and an overall average of at least 60% in Psychology, Critical Reading and Writing (CRW), and Mathematics:

1. Psychology 1000, 1001.
2. Six credit hours in **Critical Reading and Writing (CRW)** courses, including at least 3 credit hours in English courses.
3. Mathematics 1006 (or 1000), or two of 1090, 1050, 1051 (or equivalent).
4. Six credit hours of electives (9 if only Mathematics 1006 (or 1000) is successfully completed).

SECTION OF CALENDAR

Indicate the section of the Calendar impacted by the proposed change(s):

School of: HUMAN KINESIOLOGY AND RECREATION

RATIONALE

The following course pre-requisite changes are proposed due to the addition of a new course: MATH 1006.

6.2 Bachelor of Kinesiology

<ul style="list-style-type: none"> • Required Non-HKR Courses • (30 Credit Hours) 	<ul style="list-style-type: none"> • Required HKR Courses • (57 Credit Hours) 	<ul style="list-style-type: none"> • Elective Courses • (33 Credit Hours)
<ul style="list-style-type: none"> • Biology 2040 • Chemistry 1050, 1051, or 1200, 1001 • 3 credit hours in a <u>Critical Reading and Writing (CRW)</u> designated course • English 1090 or 1000 • Mathematics 1006 (or 1000) • Physics 1020 or 1050 • Psychology 1000, 1001 • Statistics 2550 or equivalent 	<ul style="list-style-type: none"> • HKR 2000 • HKR 2300 • HKR 2310 • HKR 2320 • HKR 2340 • HKR 2500 • HKR 2600 • HKR 2703 • HKR 3300 • HKR 3310 • HKR 3320 • HKR 3340 • HKR 3400 • HKR 3410 • HKR 4330 • HKR 4410 • HKR 4600 • HKR 4702 • HKR 4703 	<ul style="list-style-type: none"> • 33 credit hours of elective courses of which 27 credit hours must be at the 2000 level or above: • 12-15 credit hours in HKR elective courses other than those identified as required HKR courses. • 18-21 credit hours in non-HKR elective courses other than those identified as required non-HKR courses.

6.3 Bachelor of Physical Education

<ul style="list-style-type: none"> • Required Non-HKR Courses • (27 Credit Hours) 	<ul style="list-style-type: none"> • Required HKR Courses • (63 Credit Hours) 	<ul style="list-style-type: none"> • Elective Courses • (30 credit hours)
<ul style="list-style-type: none"> • Required Non-HKR Courses • (27 Credit Hours) 	<ul style="list-style-type: none"> • Required HKR Courses • (63 Credit Hours) 	<ul style="list-style-type: none"> • Elective Courses • (30 credit hours)

<ul style="list-style-type: none"> • 3 credit hours in a <u>Critical Reading and Writing (CRW)</u> designated course • English 1090 or 1000 • Mathematics 1006 (or 1000 and 3 credit hours in an elective course, or 6 credit hours chosen from Mathematics 1050, 1051, 1052, 1053, 1090, 109A/B. • Psychology 1000, 1001 • 6 credit hours in a laboratory science (Biology, Chemistry or Physics is recommended) • Statistics 2550 or equivalent 	<ul style="list-style-type: none"> • HKR 2000 • HKR 2004 • HKR 2100 • HKR 2210 • HKR 2220 • HKR 2300 • HKR 2310 • HKR 2320 • HKR 2500 • HKR 3110 (Students following the Bachelor of Physical Education (General) degree must replace HKR 3110 with 6 credit hours in HKR elective courses at the 2000 level or above.) • HKR 3220 • HKR 3300 • HKR 3310 • HKR 3320 • HKR 3340 • HKR 3400 • HKR 4210 • HKR 4220 • HKR 4420 • HKR 4600 	<p>6 credit hours in HKR elective courses at the 2000 level or above.</p> <p>A minimum of 24 credit hours in a Minor or an acceptable <u>Academic Discipline</u>. In choosing the minor students must follow the minor regulations of the appropriate Faculty or School. Students must select from and follow the <u>Academic Discipline</u> requirements of the <u>Faculty of Education Bachelor of Education (Intermediate/Secondary), Admission Regulations</u>.</p> <p>No more than 6 credit hours at the 1000 level may be included in the 24 credit-hour <u>Academic Discipline</u>.</p> <p>At least 3 credit hours at the 3000 level or higher must be included in the 24 credit-hour <u>Academic Discipline</u>.</p>
<ul style="list-style-type: none"> • Additional Requirement • At the time of graduation, students require proof of current certification in first aid and CPR. These certifications must be submitted to the School's Academic Program Officer. 		

Appendix for Changes to MATH 1006

APPENDIX A

Feedback from Consultations

Consultations were done in two rounds: 1) we started with a pre-consultation with units that were most likely to be affected and then 2) we passed the proposal through the Department and did the regular full consultation. In the chart below responses from both rounds are recorded. The two rounds of consultation are included separately below. All of the substantive suggestions were from the first round.

Academic Unit	Response Received
Humanities and Social Sciences	
Business Administration	Yes
Education	
Engineering and Applied Science	Yes
Human Kinetics and Recreation	Yes
Marine Institute	
Medicine	Yes
Music	
Nursing	
Pharmacy	Yes

Academic Unit	Response Received
Science	
Biochemistry	Yes
Biology	Yes
Computer Science	
Earth Sciences	
Mathematics and Statistics	Yes
Ocean Sciences	Yes
Physics and Physical Oceanography	Yes
Psychology	Yes
Social Work	
Library	
Grenfell - Arts and Social Science	
Grenfell - Science and the Environment	Yes
Grenfell - Fine Arts	
Labrador Institute	

Round 1 – Pre-consultation

For the first round we consulted the units most likely to be affected by the changes: Grenfell, Human Kinetics and Recreation, Medicine, Pharmacy and Science. That feedback (and our responses to that feedback) is listed below.

These changes were incorporated and then the proposal was passed through the Department of Mathematics and Statistics. At that point we initiated the second (official) round of consultations. These are included page 45 onwards.

Physics

From: Ivan Saika Voivoid <saika@mun.ca>

Date: Wednesday, October 26, 2022 at 14:01

To: Ivan Booth <ibooth@mun.ca>

Subject: Re: Pre-Consultation on Calculus for the Life Sciences

Dear Ivan B,

We've discussed the proposal for M1006 within our Undergraduate Studies Committee and we think it's very nice.

It looks like a good option for students who end up going on to our joint honours program with Biochemistry.

In the proposed calendar entry it says "Students who intend to take further Calculus courses should complete MATH 1000 instead of MATH 1006." We assume that's because M1006 won't have so many sections, essentially a scheduling issue. However, is it for a substantive reason?

Are we correct in our interpretation that M1006 and M1000 are fully equivalent in terms of providing prerequisite knowledge for further calculus courses?

I'm glad to see that M1006 will introduce Taylor series/polynomials. Is this currently the case with M1000?

Cheers,

Ivan SV

AH: I have removed the phrase: "Students who intend to take further Calculus courses should complete MATH 1000 instead of MATH 1006."



Mathematics and Statistics

On 2022-10-17, 15:33, "John W Craighead" <jwcraighead@mun.ca> wrote:

Ivan Booth, Chair, Math U/G Studies Committee,

Having taught/tutored similar courses at Bishop`s/Queen`s, I strongly support this initiative. It`s focus on calculus with life science applications brings the discipline alive for life science students. The applications are interesting and also well suited to teaching intro calculus. Bishop`s offered both differential & integral calculus for the life sciences. Respectfully submitted, John

AH: John Craighead is a potential instructor. Also Shannon Sullivan.

Hi Folks,

Was this line intended to be there in the description for Math 1006: "Students who intend to take further Calculus courses should complete MATH 1000 instead of MATH 1006."

I thought part of the point was that this course could easily serve as a prerequisite for math 1001? It also seems in contradiction to the line : “The offering would strengthen data science education amongst undergraduate students as students in disciplines that are traditionally data collection-oriented (i.e., the life science-related programs) are more motivated and capable of engaging with students in traditionally data analysis-oriented disciplines (i.e., Applied Mathematics, Statistics, and Computer Science).” (Since the three examples at the end all require further calculus.)

Tara

AH: Same comment from Ivan SV. Line deleted.



Psychology

Hi Ivan (and Amy)-

The Psychology Department discussed the proposals for your Math 1006 course & the STAT 1500 course. We feel they are both great ideas. We would recommend that our prospective majors students take Math 1006 should they wish to take Calculus, as Psychology and Behavioural Neuroscience are Life Sciences.

As the pre-reqs for STAT 1500 are similar to those for Math 1000, we would also like to recommend to students that should they not require a Calculus course as a pre-requisite for other courses that they might wish to take in the future (e.g., as would be the case for most of our students following a BA route), we would also accept STAT 1500 as meeting the entrance eligibility requirements.

Currently, we admit students on a competitive entry basis, and we would revise 11.11.2.3 of our admission criteria (see current wording below) to read:

3. Mathematics 1000 (or equivalent) or Statistics 1500, or two of Mathematics 1090, 1050, 1051 (or equivalent).

I am not 100% sure on how we would handle the Calendar change for 11.11.2.3- i.e., if it would be a change initiated by Psychology or just added as a Secondary calendar change to the Stat 1500 calendar change form... maybe that's a question for Shannon or Tracey.

Happy to discuss any of this further.

Best,
Carolyn

Current Calendar wording for 11.11.2.:

11.11.2 Admission to Major Programs

Admission to the Major programs in the Department of Psychology is competitive and selective. Students who wish to enter these programs must submit a completed application form, available on the Department of Psychology website in the Winter semester, to the Department of Psychology by June 1 for Fall semester registration. To be eligible for admission, students must have completed the 24 credit hours as listed below with an average of at least 65% in Psychology 1000/1001 and an overall average of at least 60% in Psychology, Critical Reading and Writing (CRW), and Mathematics:

1. Psychology 1000, 1001.
2. Six credit hours in Critical Reading and Writing (CRW) courses, including at least 3 credit hours in English courses.
3. Mathematics 1000, or two of 1090, 1050, 1051 (or equivalent).
4. Six credit hours of electives (9 if only Mathematics 1000 is successfully completed).

Students who fulfil the eligibility requirements compete for a limited number of available spaces. Selection is based on academic performance, normally cumulative average and performance in recent courses.

AH: Mostly not relevant to MATH 1006 if I understand correctly this pertains to STAT 1550.

Ocean Sciences

Dear Ivan – this sounds like a fantastic course that I wish had been offered when I was an undergraduate. I would certainly recommend that my honours students take it and would even nudge some of my graduate students to audit it. I imagine this might be a pathway to ease “math phobia” that we see in so many biology majors. Hope that is helpful – Paul

Dr. Paul Snelgrove
Associate Scientific Director, Ocean Frontier Institute

Departmental Science Advisor, Fisheries and Oceans Canada

University Research Professor, Department of Ocean Sciences and Biology Department
Memorial University of Newfoundland
St. John's NL A1C 5S7 Canada

709-864-3440

Pharmacy

Hi Amy,

I'm sorry to be slow getting back to you but our UGS committee met recently to discuss the proposed new math course and how it might be incorporated into pharmacy requirements.

We would not be able to require students to take math 1006 since calculus is not in our program as such but is a pre-requisite for our program. We would continue to accept Math 1000 or other equivalent courses for admission. That being said, we are currently working on a calendar change to add math 1006 as an acceptable calc I pre-requisite course for our applications and we would encourage applicants to take advantage of math 1006 when possible.

We did want to ask, how accessible does the department plan to make math 1006? Will there be multiple sections offered or will it be offered in multiple semesters? Normally our students would take this course in the fall but sometimes students do take a different approach to pre-requisite completion.

Thanks!
Erin

--

Erin Davis, PharmD

Associate Dean Undergraduate Studies

Associate Professor

Memorial University School of Pharmacy

T 709 864 8815

E emdavis@mun.ca

AH: My understanding is that PharmD will handle their own calendar changes

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Grenfell

Good afternoon,

The SSE Committee on Academic Programming has reviewed the materials for the following calendar change proposal:

- Calculus for the Life Sciences, MATH 1006

Grenfell's Mathematics has a number of comments and concerns on how this will align with our courses. You should receive (or perhaps have already received, as I am writing this a couple of days late) a note from the Chair shortly.

Thank you,

Dmitry Sveshnikov (Chair of SSE-CAP)

IB: We followed up with Grenfell Mathematics and were told that there are no concerns

(Followed-up with Grenfell)

Subject: Feedback on proposal for Math 1006

Date: Wednesday, November 16, 2022 at 13:58:57 Newfoundland Standard Time **From:** Milley, Rebecca

To: Booth, Ivan

CC: Sveshnikov, Dmitry

The math unit in the School of Science and the Environment at Grenfell Campus has no concerns with the proposal for Math 1006.

Secondary calendar changes will have to include changes to math degree programs on both campuses to indicate "Math 1000 or 1006". There may be other programs besides

math at Grenfell (both within our school and in the School of Arts & Social Science) that also will need this change, and we can provide a list of those when this proposal is out for official consultation.

Rebecca Milley, PhD

Chair, Computational Mathematics

Grenfell Campus, Memorial University of Newfoundland

Corner Brook, NL, Canada (709) 639-2596 AS 3011

Biochemistry

Hi Amy,

Thank you for the opportunity to review the proposal for the new Math 1006. We discussed the proposal at a recent Biochemistry Undergrad Committee meeting and the overall feeling about the course was highly positive. We are very happy to have a calculus course available to our undergrads that they will find more relevant to life science. This is particularly true as we recently sent out a proposal for consultation for a new undergraduate program (Human Biosciences) that will ultimately replace our current programs (Biochemistry and Nutrition).

With respect to Math 1006, will it be a suitable prerequisite for Stats 2550? It was not included in the calendar changes with the new course proposal, but our students need 2550 as part of their program requirements.

Thanks,
Janet

AH: This is corrected.

Chemistry

From: "Katz, Michael" <mkatz@mun.ca>

Date: Wednesday, November 9, 2022 at 13:33

To: Ivan Booth <ibooth@mun.ca>

Subject: RE: Pre-Consultation on Calculus for the Life Sciences

Hi Ivan,

I finally got our Academic Program Officer to put together all of the information for making Math 1006 equivalent to Math 1000 in the chemistry program. I have attached the document.

If it's not too late to add it to your request as a secondary change, then that would be great. If it is, then let me know and we will forward it along to go with the Math 1006 changes.

Let me know either way. Chemistry really liked this proposal and we are excited to see how it helps the students learn calculus.

Mike

--

Dr. Michael J. Katz

Associate Professor of Chemistry

Deputy Head (Undergraduate)

Memorial University of Newfoundland

Room: CSF3338

Phone: 709-864-8745

<https://www.mun.ca/faculty/mkatz/>

<http://www.KatzResearchGroup.com>

This communication is intended for the use of the recipient to whom it is addressed, and may contain confidential, personal, and/or privileged information. Please contact me immediately if you are not the intended recipient of this communication, and do not copy, distribute, or take action relying on it. Any communication received in error should be deleted or destroyed.

AH: Chemistry calendar changes are included
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.....

Round 2 – Official Consultation

This was the official round of consultation. For completeness, the consultation letter is included as well as the letter we sent to the units that had already responded to the pre-consultation. Most units that responded to the first round simply let that response stand for the second round.

Consultation Letter

Subject: Calendar Change Consultation: New Course, M1006 Calculus for the Life Sciences

Date: Friday December 9, 2022 at 10:52:37 Newfoundland Standard Time

From: Booth, Ivan

To: Faculty of Humanities and Social Sciences, Oldford, Erin, Furey, Edith, engrconsult@mun.ca, HKR Dean, deanofmedicine@med.mun.ca, Karen Bulmer, DeanNurse, pharminfo@mun.ca, Dean of Science, adeanugradswk, Library Correspondence, kjacobse@grenfell.mun.ca, ssedean@grenfell.mun.ca, thennessey@grenfell.mun.ca, miugconsulta/ons@mi.mun.ca, Ashlee Cunsolo

Cc: Amy Hurford

Attachments: MATH_1006_Course_Proposal.docx, MATH_1006_Course_Proposal.pdf

Hello Everyone,

Mathematics and Statistics seeks consultation on a new course M1006: Calculus for the Life Sciences. The full proposed calendar change is attached but, for convenience, it is also briefly summarized below.

Executive Summary: M1000 (Differential Calculus) is a standard calculus course taken by a large fraction of first year students at MUN. Many of those students have a strong interest in the life sciences. These students include Bachelor of Science majors in Biology, Biochemistry, Ocean Sciences, and Psychology; and Bachelor of Kinesiology; and Bachelor of Physical Education.

The content of MATH 1000 is important for students with an interest in the life sciences, but without examples that consistently reinforce relationships between foundational concepts in MATH 1000 (i.e., the Mean Value Theorem), and life sciences applications, students lose motivation in pursuing further mathematics and statistics learning, which can discourage them from entering life science-related quantitative careers, for example, interdisciplinary careers involving data science, statistics, and modelling.

MATH 1006 (Calculus for the Life Sciences) aims to remedy this problem by being a course that covers essentially the same material as the traditional MATH 1000 but with a focus on applications in the life sciences. It aims to connect students interested in the life sciences with the power of mathematics and statistics to make compelling quantitative arguments, and to highlight the value of collaboration with experts in data analysis-related disciplines. It will be credit restricted with MATH 1000 and equivalent as a pre-requisite for any future courses.

If you have a comment or feedback on the attached proposal, we would appreciate receiving it by January 6, 2023.

Best,
Ivan Booth (he/him)
Deputy Head (Undergraduate) Department of Math and Stats Memorial University

Letter to those units with whom we had already pre-consulted

From: Ivan Booth <ibooth@mun.ca>
Date: Friday, December 9, 2022 at 10:52
To: Dean of Science <deansci@mun.ca>, "pharminfo@mun.ca" <pharminfo@mun.ca>, DeanNurse <DeanNurse@mun.ca>, HKR Dean <hkrdean@mun.ca>, "ssedean@grenfell.mun.ca" <ssedean@grenfell.mun.ca>
Cc: Amy Hurford <ahurford@mun.ca>
Subject: Re: Pre-Consultation on Calculus for the Life Sciences

Hello Everyone,

MATH 1006 (Calculus for the Life Sciences) has been approved by the Math/Stats Dept and is headed for the Faculty of Science Undergrad Studies committee. So now we are doing our formal consultation. Most of you already responded to the pre-consultation. The proposal hasn't changed significantly since that stage. If you would like to respond to the new consultation that'd be great but we can also just use your earlier response if that works better for you.

This email is really to make sure that there is no confusion by that fact that we are now consulting a second time on something that everyone from this original group already strongly supported!

Best,
Ivan Booth (he/him)
Deputy Head (Undergraduate)
Department of Math and Stats
Memorial University

Responses

Business

From: "Oldford, Erin" <eoldford@mun.ca>
Date: Friday, December 9, 2022 at 12:50
To: Ivan Booth <ibooth@mun.ca>
Subject: RE: Calendar Change Consultation: New Course, M1006 Calculus for the Life Sciences

Hi Ivan,

We have reviewed the proposal, and we are in support.

Erin

ERIN OLDFORD, PhD
Associate Dean of Undergraduate Programs,
Associate Professor of Finance, and
Faculty Advisor to The Fund
Faculty of Business Administration
Memorial University of Newfoundland
St. John's, Newfoundland & Labrador
www.business.mun.ca

Medicine

From: medvicedean <medvicedean@mun.ca>
Date: Monday, December 12, 2022 at 22:42
To: Ivan Booth <i Booth@mun.ca>
Cc: "DeanofMedicine@med.mun.ca" <DeanofMedicine@med.mun.ca>
Subject: Re: Calendar Change Consultation: New Course, M1006 Calculus for the Life Sciences

Dr. Booth, Thank you for the attached summary. I have no edits nor concerns from the FoM regarding this consultation for the proposed calendar change / new course. Thanks Dolores

Dolores M McKeen MD FRCPC MSc CCPE
Vice Dean | Education & Faculty Affairs
Professor | Memorial University of Newfoundland
Past President | Canadian Anesthesiologists' Society
@dolores_mckeen

Faculty of Medicine
Memorial University of Newfoundland
Faculty of Medicine Building | Rm 2M315
300 Prince Philip Drive
St. John's NL CA A1B 3V6
T: 709 864 6417 | F: 709 864 6336

Biology

From: "Wiersma, Yolanda" <ywiersma@mun.ca>
Date: Monday, December 19, 2022 at 12:54

To: Ivan Booth <ibooth@mun.ca>

Subject: FW: Calendar Change Consultation: New Course, M1006 Calculus for the Life Sciences

Hi Ivan,

The Biology Undergraduate Committee reviewed this proposal and is highly supportive and enthusiastic about the development of the MATH 1006 course as an alternative course for students.

Thanks for the opportunity to provide feedback,

Yolanda

--

Dr. Yolanda F. Wiersma, PhD (she/her)
Professor and Deputy Head (Undergraduate)

Engineering

On 2023-01-05, 08:35, "Engineering Consult" <engrconsult@mun.ca <mailto:engrconsult@mun.ca>> wrote:

Hi,

Thank you for the opportunity to provide feedback on the calendar change proposal. The Faculty of Engineering Committee on Undergraduate Studies does not anticipate any effect of this change on engineering programs.

Best,

Dr. Salim Ahmed, Chair
Committee on Undergraduate Studies
Faculty of Engineering and Applied Science
Memorial University of Newfoundland
St. John's NL A1B 3X5

APPENDIX B

Sample Day 1 Handout

MATH 1006 – Calculus for the Life Sciences

Course description MATH 1006. Calculus for Life Sciences is an introduction to differential calculus, including algebraic, trigonometric, exponential, logarithmic and inverse trigonometric functions. Applications include biomechanics, ecology, infectious diseases, physiology, and modelling.

Course format The course is delivered as 4 x 1 hour lectures per week.

Course expectations: Students are expected to attend all classes. Any students that are disruptive, violating university policies, or acting in a potentially unsafe way will be warned and asked to leave.

Learning goals

- Can solve problems relevant to the course material
- Understands the relevance of course concepts to the life sciences
- Appreciates the relevance of mathematics to modelling in the life sciences
- Some knowledge of how to use software to support understanding and verify calculations

Required Text and Readings

The course will cover Chapters 2-4 of Biocalculus: Calculus for the Life Sciences by James Stewart and Troy Day. Some concepts will be illustrated with freely available software (also available in the Henrietta Harvey computer lab). Course announcements and materials will be made of BrightSpace.

Method of evaluation

Weekly assignments: 15%

Midterm 1 (mid-Oct): 15%

Midterm 2 (mid-Nov): 15%

Final Exam: 55%

The Department of Mathematics and Statistics offers supplementary examinations for first and second year courses to students who are in clear academic standing, who have a passing term mark, and whose final grade is between 45 and 49 (inclusive). Application for supplementary examinations must be made within 5 working days of the release of marks in any semester. Regulations governing supplementary exams are in section 8 of the Faculty of Science Calendar.

Late assignments and missed midterms, and final exams will be accommodated as described by University Regulation 6.7.3 and 6.7.5 (see

<https://www.mun.ca/regoff/calendar/sectionNo=REGS-0474> for Regulations). The Final exam will cover all Lecture material. Specific regulations governing final examinations are described by University Regulation 6.8.

Course outline

UNIT 1: LIMITS, Chapter 2 of Stewart and Day 2015

1.1 Limits of Sequences

- *Logistic sequence, dynamics of viral infections*

1.2 Limits of functions at infinity

- *Monod growth function*

1.3 Limits of functions at finite numbers

1.4 Limits: Algebraic methods

1.5 Continuity

Host, parasites and time-travel

UNIT 2: DERIVATIVES, Chapter 3 of Stewart and Day, 2015

2.1 Derivatives and rates of change

- *Measuring the rate of increase in blood alcohol concentrations*

2.2 The derivative as a function

2.3 Basic differentiation formulas

2.4 Product and Quotient rules

2.5 The Chain rule

2.6 Exponential Growth and Decay

- *Population growth, Radioactive decay, Newton's law of cooling, controlling Red Blood Cell Loss during surgery*

2.7 Derivatives of the logarithmic and inverse tangent functions

2.8 Linear approximations and Taylor polynomials

- *Harvesting renewable resources*

Kill curves and antibiotic effectiveness

UNIT 3: APPLICATIONS OF DERIVATIVES, Chapter 4 of Stewart and Day, 2015

3.1 Maximum and minimum values

- *The calculus of rainbows*

3.2 How derivatives affect the shape of a graph

3.3 L'Hospital's rule: comparing rates of growth

- *Mutation-selection balance in Genetic Diseases*

3.4 Optimizing problems

- *Flapping and Gliding*
- *The tragedy of the commons: an introduction to game theory*

3.5 Recursions: equilibria and stability

3.6 Antiderivates

Additional Policies

Accommodation of students with disabilities

Memorial University of Newfoundland is committed to supporting inclusive education

based on the principles of equity, accessibility and collaboration. Accommodations are provided within the scope of the University Policies for the Accommodations for Students with Disabilities (www.mun.ca/policy/site/policy.php?id=239). Students who may need an academic accommodation are asked to initiate the request with the Glenn Roy Blundon Centre at the earliest opportunity (www.mun.ca/blundon).

Academic misconduct

Students are expected to adhere to those principles, which constitute proper academic conduct. A student has the responsibility to know which actions, as described under Academic Offences in the University Regulations, could be construed as dishonest or improper. Students found guilty of an academic offence may be subject to a number of penalties commensurate with the offence including reprimand, reduction of grade, probation, suspension or expulsion from the University. For more information regarding this policy, students should refer to University Regulation 6.12.

Equity and Diversity

A safe learning environment will be provided for all students regardless of race, colour, nationality, ethnic origin, social origin, religious creed, religion, age, disability, disfigurement, sex (including pregnancy), sexual orientation, gender identity, gender expression, marital status, family status, source of income or political opinion.

You should not photograph or record myself, teaching assistants, or other students in the class without first obtaining permission. Accommodation will be made for students with special needs.

The sound should be turned off on phones and computers during class.

Additional Supports

Resources for additional support can be found at:

- www.mun.ca/currentstudents/student/
- <https://munsu.ca/resource-centres/>

APPENDIX C

Table 1. Comparison of MATH 1000 and 1006 Course outlines. Within unit ordering is different. Content differences are underlined

<p>MATH 1006</p> <p>UNIT 1: LIMITS</p> <p>1.1 <u>Limits of Sequences</u></p> <p>1.2 Limits of functions at infinity (includes limits of the exponential function-vertical, monod growth function -horizontal)</p> <p>1.3 Limits of functions at finite numbers</p> <p>1.4 Limits: Algebraic methods (incl. limit laws)</p> <p>1.5 Continuity</p> <p>UNIT 2: DERIVATIVES</p> <p>2.1 Derivatives and rates of change (incl. tangents)</p> <p>2.2 The derivative as a function (incl. higher order derivatives)</p> <p>2.3 Basic differentiation formulas (incl. power, exponential, sine and cosine)</p> <p>2.4 Product and Quotient rules (incl. trigonometric functions)</p> <p>2.5 The Chain rule (incl. implicit differentiation)</p> <p>2.6 Exponential Growth and Decay</p> <p>2.7 Derivatives of the logarithmic and inverse tangent functions</p> <p>2.8 <u>Linear approximations and Taylor polynomials</u></p> <p>UNIT 3: APPLICATIONS OF DERIVATIVES</p> <p>3.1 Maximum and minimum values</p> <p>3.2 How derivatives affect the shape of a graph (incl. mean value theorem)</p> <p>3.3 L'Hospital's rule: comparing rates of growth</p> <p>3.4 Optimizing problems</p> <p>3.5 <u>Recursions: equilibria and stability</u></p> <p>3.6 <u>Antiderivates</u></p>	<p>MATH 1000 (Fall 2016/Fall 2022 Instructor Dr. Danny Dyer)</p> <p>UNIT 1: LIMITS</p> <p>1.1 The limit of a function</p> <p>1.2 Calculating limits using the limit laws</p> <p>1.3 Evaluating limits; vertical asymptotes</p> <p>1.4 Continuity</p> <p>1.5 Limits at infinity horizontal asymptotes</p> <p>UNIT 2: DIFFERENTIATION</p> <p>2.1 Tangent and <u>velocity problems</u></p> <p>2.2 Derivatives</p> <p>2.3 Derivates of polynomial and exponential functions</p> <p>2.4 The product and quotient rules</p> <p>2.5 Derivatives of trigonometric functions</p> <p>2.6 The chain rule</p> <p>2.7 Implicit differentiation</p> <p>2.8 Derivatives of logarithmic functions</p> <p>2.9 Inverse trigonometric functions and their derivatives</p> <p>2.10 <u>Hyperbolic functions and their derivatives</u></p> <p>2.11 Higher order derivatives</p> <p>UNIT 3: APPLICATIONS OF DERIVATIVES</p> <p>3.1 <u>Rectilinear motion and related rates</u></p> <p>3.2 Maximum and minimum values</p> <p>3.3 The mean value theorem</p> <p>3.4 How derivatives affect the shape of the graph</p> <p>3.5 <u>Summary of curve sketching</u></p> <p>3.6 Optimization problems</p> <p>3.7 L'Hopital's rule</p>
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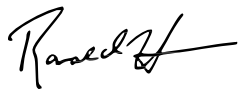
March 28, 2023

Dear Faculty of Science Graduate Studies Committee members,

Attached you will find two word documents (an amended calendar entry indicating all changes and a clean copy) which details proposed changes to the MSc in Scientific Computing. In addition to cleaning up some calendar language and adding new co-op language, the proposal is to change the existing "course and project" based MSc route to a course only MSc with an existing team-taught project course, CMSC 6920, now a required course for students who choose this option.

The Scientific Computing program currently has one of the worst conversion rates based on the number of applications to the number of offers of admission. This is due in large part to the need to have a project supervisor arranged for course-based students before an offer of admission is made. The proposed change will remove this barrier while ensuring students still receive the project experience through a regularly offered course.

Sincerely,



Dr. Ronald D. Haynes
Professor, Department of Mathematics and Statistics
Chair, MSc and Phd Scientific Computing Programs
Memorial University of Newfoundland

31.20 Scientific Computing

- www.mun.ca/sgs/contacts/sgscontacts.php
- www.mun.ca/science
- www.mun.ca/become/graduate/apply/app_deadlines.php

31.20.1 Administrative Committee

The Administrative Committee, appointed by the Dean of the School of Graduate Studies on the recommendation of the Dean of the Faculty of Science, consists of at least one representative of each participating academic unit, and one member external to the University.

31.20.2 Participating Departments and Organizations

This interdisciplinary program offers the Master of Science Degree in both Scientific Computing and Scientific Computing (Co-operative). The departments of Biochemistry, Chemistry, Computer Science, Earth Sciences, Mathematics and Statistics, Physics and Physical Oceanography and the Faculty of Engineering and Applied Science are participants in this program. Other departments and faculties may be involved, depending on the nature of the thesis. External organizations may provide placements for co-op students, jointly supervise students, share computing resources and participate in teaching courses.

31.20.3 Admission Criteria and Procedures

1. The criteria for acceptance of an applicant are: the applicants' anticipated successful and timely completion of the program, and, for the thesis program, the willingness of a faculty member to supervise the applicant and provide research funding.
2. Students will be expected to hold a B.Sc. (Honours) or B.Eng. Degree with honours standing, or equivalent, with a strong computational orientation. At the time of application, the student is expected to provide evidence (for example, transcripts of completed courses) of knowledge of a programming language. Evidence of knowledge of numerical_analysis, differential equations, and linear algebra is an asset. Students with an inadequate background may be encouraged to take certain undergraduate courses.
3. Admission decisions will be made by the School of Graduate Studies on the recommendation of the Chair of the Administrative Committee.

31.20.4 Program of Study

1. The goal of Scientific Computing is to solve technical problems, in science and engineering, using computers and computational methods. Our program is designed to educate students to apply computational, numerical and programming concepts and tools to solve and model complex problems in science and engineering.
2. The Program is offered in thesis and course-only versions, each with the option of a co-operative education program. The normal length of time to complete each option is 24 months, however, students who choose a co-operative education option may take longer.
3. Students enrolled in the thesis program will complete the work for the thesis under the guidance of a supervisor (or joint supervisors). The home department of students in the thesis program will be the same as that of the supervisor. Upon completion of the work for the thesis, students are required to present a seminar suitable for the interdisciplinary audience of Scientific Computing program students.
4. All students are required to complete a minimum of 3 core courses (9 credit hours) selected from the list of [Core Courses](#) below. All students are also recommended to complete CMSC 6950. Additional courses are required in accordance with the program options as outlined below and will normally be selected from the student's discipline of specialization. The course requirements for each thesis based student are approved by the Program Chair on the recommendation of the student's supervisor(s), and should reflect the interdisciplinary nature of the program. The course requirements for course-based students are approved by the Program Chair. Students are expected to attend research seminars in their home department and/or those relevant to Scientific Computing, when advertised.

- a. The thesis option requires the completion of a minimum of four graduate courses (12 credit hours) numbered 6000 or higher, which must include three courses (9 credit hours) from the [Core Courses](#) below. Equivalent courses may be considered for substitution with approval of the Program Chair. The additional course(s) will normally be chosen from the [Additional Courses](#) below in the same discipline as the thesis work. The submission of an acceptable thesis is required. The thesis is to contain an original scholarly contribution which must be submitted to the School of Graduate Studies for final examination. The thesis must be written in a format according to procedures outlined in Guidelines for Theses and Reports by the School of Graduate Studies at www.mun.ca/sqs/qo/quid_policies/theses.php.
- b. The course-based option requires the completion of a minimum of seven graduate courses (21 credit hours) numbered 6000 or higher, which must include CMSC 6920 plus at least three other courses (9 credit hours) from the [Core Courses](#) below. Equivalent courses may be considered for substitution with approval of the Program Chair. The additional courses will normally be chosen from the [Additional Courses](#) below.

31.20.5 Co-operative Education Option

1. A Co-operative Education Option is available to students who are accepted into the M.Sc. program. Students in this option may follow the thesis or course-based version of the program. The co-op option will add 4 or 8 months to the anticipated program length mentioned above.
2. Students will normally declare their intention to complete the co-operative education option at least six months prior to the intended work term start.
3. Students will complete one or two consecutive work terms (CMSC 601W) with the same employer, normally following the successful completion of a minimum of four courses (12 credit hours).
4. Students must have at least one course remaining following completion of the work terms.
5. General management of the Co-operative Education Option is the responsibility of the designated Academic Staff Member in Co-operative Education (ASM-CE). ASMs-CE are responsible for providing professional development to students, facilitating the engagement of potential employers in the program, developing employment opportunities, organizing competitions for work term employment, arranging job interviews, monitoring students during the work term and evaluating the work term.
6. Work terms are not guaranteed; students are ultimately responsible for securing their work term placements.
7. Students in the Co-operative Education Option give permission to the university to provide a copy of their resume and university transcript to potential employers.
8. Students in the Co-operative Education Option may independently obtain a work term placement in consultation with the ASM-CE. Such employment positions must satisfy the criteria for work terms, be confirmed in writing by the employer and be approved by the ASM-CE before the first day of the work term shown at www.mun.ca/coop.
9. Work terms are normally at least 12 weeks in duration, full-time and paid. Remuneration for work placements is determined by employers based on their internal wage structures.
10. Students are not permitted to drop their work term without prior approval from an ASM-CE. Students who drop a work term without permission, who fail to honour an agreement to work with an employer, or who conduct themselves in such a manner as to cause their discharge from the work term, will normally be awarded a fail grade for the work term and will not be permitted to continue in the Co-operative Education Option.
11. In the event that a student fails to obtain one or two semesters of placements, but successfully completes all other requirements of the Degree, the student will still be eligible for graduation.

31.20.6 Courses

31.20.6.1 Core Courses

- Computer Science 6731 Topics in Numerical Methods
- Mathematics 6201 Numerical Methods for Partial Differential Equations
- Mathematics 6210 Numerical Solutions of Differential Equations
- Mathematics 6202 Numerical Optimization
- Scientific Computing 6910 Matrix Computations and Applications or Computer Science 6931 Matrix Computations and Applications (*credit may be obtained for only one of the CMSC 6910, COMP 6732, and COMP 6931*)
- Scientific Computing 6920 Applied Scientific Programming
- Scientific Computing 6950 Computer Based Tools and Applications (*credit may be obtained for only one of CMSC 6950 and the former CMSC 6940*)

31.20.6.2 Additional Courses

Additional courses may be selected from courses offered by Biochemistry, Chemistry, Computer Science, Earth Sciences, Engineering and Applied Sciences, Mathematics and Statistics, Physics and Physical Oceanography, and Scientific Computing, upon approval of the chair of the program.

Annotated Copy – RH Wed Apr 5, 2023

31.20 Scientific Computing

- www.mun.ca/sgs/contacts/sgscontacts.php
- www.mun.ca/science
- www.mun.ca/become/graduate/apply/app_deadlines.php

31.20.1 Administrative Committee

The Administrative Committee, appointed by the Dean of the School of Graduate Studies on the recommendation of the Dean of the Faculty of Science, consists of at least one representative of each participating academic unit, and one member external to the University.

31.20.2 Participating Departments and Organizations

This interdisciplinary program offers the Master of Science Degree in both Scientific Computing and Scientific Computing (Co-operative). The departments of Biochemistry, Chemistry, Computer Science, Earth Sciences, Mathematics and Statistics, Physics and Physical Oceanography and the Faculty of Engineering and Applied Science are participants in this program. Other departments and faculties may be involved, depending on the nature of the thesis or project. External organizations may provide placements for co-op students, jointly supervise students, share computing resources and participate in teaching courses.

31.20.3 Admission Criteria and Procedures

1. The criteria for acceptance of an applicant are: the applicants' anticipated successful and timely completion of the program, and, for the thesis program, the willingness of a participating faculty member to supervise the applicant and provide research funding.
2. Students will be expected to hold a B.Sc. (Honours) or B.Eng. Degree with honours standing, or equivalent, with a strong computational orientation. At the time of application, the student is expected to provide evidence (for example, transcripts of completed courses) of ~~the student's knowledge of a modern computer programming language, such as Fortran, and/or C and/or C++, and/or Matlab, and/or Python.~~ Evidence of knowledge of numerical analysis, differential equations, and/or and linear algebra is an asset. ~~and/or computer graphics would be an asset.~~ Students with an inadequate background may be encouraged to take certain undergraduate courses.
3. Admission decisions will be made by the School of Graduate Studies on the recommendation of the Chair of the Administrative Committee.

31.20.4 Program of Study

1. The goal of Scientific Computing is to solve technical problems, in science and engineering, using computers and computational methods. Our program is designed to educate students to apply computational, numerical and programming concepts and tools to solve and model complex problems in science and engineering.
2. The Program is offered in thesis and ~~project (non-thesis) course-only~~ course-only versions, each with the option of a co-operative education program. ~~It is intended that the overall level of student effort and performance required in each version will be comparable.~~ The normal length of time to complete each option is 24 months, however, students who choose a co-operative education option may take longer.
3. Students enrolled in the thesis program will complete ~~The the~~ work for the thesis ~~or project will be carried out~~ under the guidance of a supervisor (or joint supervisors). The home department of ~~the students in the thesis program~~ will be the same as that of the Supervisor. Upon completion of the work for the thesis ~~or project, each student~~ is are required to present a seminar suitable for the interdisciplinary audience of Scientific Computing program students.
4. All students are required to complete a minimum of 3 core courses (9 credit hours) selected from the list of Core Courses ~~listing~~ below. All students are also recommended to complete CMSC 6950. Additional courses are required in accordance with the program options as outlined below and will normally be selected from the student's discipline of specialization. The course requirements for each thesis based student are approved by the Program Chair on the recommendation of the student's supervisor(s), and should reflect the interdisciplinary nature of the program. The course requirements for course-based

students are approved by the Program Chair. Students are expected to attend research seminars in their home department as well as and/or those relevant to Scientific Computing, when advertised.

- a. The thesis option requires the completion of a minimum of four graduate courses (12 credit hours) numbered 6000 or higher, which must include three courses (9 credit hours) from the [Core Courses](#) listing below. Equivalent courses may be considered for substitution with approval of the Program Chair. The additional course(s) will normally be chosen from the [Additional Courses](#) listing below in the same discipline as the thesis work. The submission of an acceptable thesis is required. The thesis is to contain an original scholarly contribution which must be submitted to the School of Graduate Studies for final examination. The thesis must be written in a format according to procedures outlined in Guidelines for Theses and Reports by the School of Graduate Studies at www.mun.ca/sqs/go/quid_policies/theses.php.
- b. The ~~project~~ course-based option requires the completion of a minimum of ~~eight~~ seven graduate courses (~~24~~ 21 credit hours) numbered 6000 or higher, ~~which must include CMSC 6009 and which must include~~ CMSC 6920 plus at least three other courses (9 credit hours) from the [Core Courses](#) listing below. Equivalent courses may be considered for substitution with approval of the Program Chair. The additional courses will normally be chosen from the [Additional Courses](#) listing below. ~~in the same discipline as the project work. An acceptable project report is also required that is based on research performed with the guidance of the student's supervisor. The project, which will include an in-depth written report, shall require the equivalent of at least one and no more than two semesters of full time work. The project report must be written in a format according to procedures outlined in Guidelines for Theses and Reports by the School of Graduate Studies at www.mun.ca/sqs/go/quid_policies/theses.php. The report will be evaluated by the student's supervisor, by the Chair of the Board of Study (or delegate), as well as by one other faculty member. Acceptance of a final version of the report (and a passing grade for CMSC 6009) requires the agreement of the three examiners.~~

31.20.5 Co-operative Education Option

- 1- ~~A co-operative education option will be~~ Co-operative Education Option is available to students who are accepted into the M.Sc. program. Students in this option may follow the thesis or ~~non-thesis~~ course-based version of the program. ~~The co-op option will add 4 or 8 months to the anticipated program length mentioned above. It is expected to take up to 24 months to complete.~~
2. ~~Students will normally declare their intention to complete the co-operative education option at the start of the second semester of their academic program at least six months prior to the intended work term start.~~
3. ~~Students will complete two work terms (CMSC 601W and CMSC 602W) consecutively, complete one or two consecutive work terms (CMSC 601W) with the same employer normally following the successful completion of a minimum of four courses (12 credit hours).~~
4. ~~Students must have at least one course remaining following completion of the work terms.~~
5. ~~The dates for starting and finishing each work term are shown at www.mun.ca/coop.~~
6. ~~A competition for work term employment is organized by Co-operative Education in cooperation with a designated faculty member from Scientific Computing. Students may also obtain their own work term jobs outside the competition. Such jobs must be confirmed by letter from the employer and approved by the Chair of Scientific Computing and by Co-operative Education on or before the first day of the work term. Work term jobs may be outside St. John's and possibly outside Newfoundland and Labrador. Students who do not wish to accept a work term job arranged by Co-operative Education shall be responsible for finding an acceptable alternative. By entering the competition, students give permission for Co-operative Education to supply their Memorial University of Newfoundland transcripts and resumes to potential employers. General management of the Co-operative Education Option is the responsibility of the designated Academic Staff Member in Co-operative Education (ASM-CE). ASMs-CE are responsible for providing professional development to students, facilitating the engagement of potential employers in the program, developing employment opportunities, organizing competitions for work term employment, arranging job interviews, monitoring students during the work term and evaluating the work term.~~
7. ~~Work terms are not guaranteed;~~ students are ultimately responsible for securing their work term placements.

8. Students in the Co-operative Education Option give permission to the university to provide a copy of their resume and university transcript to potential employers.
9. Students in the Co-operative Education Option may independently obtain a work term placement in consultation with the ASM-CE. Such employment positions must satisfy the criteria for work terms, be confirmed in writing by the employer and be approved by the ASM-CE before the first day of the work term shown at www.mun.ca/coop.
10. Work terms are normally at least 12 weeks in duration, full-time and paid. Remuneration for work placements is determined by employers based on their internal wage structures.
11. Each work term placement will be supervised by the student's program supervisor, the on-site supervisor assigned by the employer and Co-operative Education. The overall evaluation of the work term is the responsibility of the program Supervisor, on-site Supervisor, and Co-operative Education. The work term shall consist of two components:
 - o On the job Student Performance as evaluated by the on-site supervisor and Co-operative Education, in consultation with the program supervisor.
 - o A Work Report graded by Co-operative Education and the program supervisor in consultation with the on-site supervisor.
12. Evaluation of the work term will result in the assignment of one of the following final grades:
 - a. Pass with Distinction: Indicates OUTSTANDING PERFORMANCE in both the work report and work performance.
 - b. Pass: Indicates that PERFORMANCE MEETS EXPECTATIONS in both the work report and work performance.
 - c. Fail: Indicates FAILING PERFORMANCE in the work report and/or the work performance. If a student fails to achieve a final grade of Pass or Pass with Distinction, and provided the student has not failed to achieve a grade of 'B' or better in any program course, the student may request to repeat the work term component. The request will be considered by the Chair of Scientific Computing in consultation with the program supervisor and Co-operative Education. Only one repetition of a work term will be permitted in the student's program.
13. Following the completion of the two work terms, each student must complete any remaining course requirements and project report or thesis. Assuming that prior written authorization of the employer and the supervisory committee was obtained and submitted to the School of Graduate Studies, students may include material from the work terms in their reports or theses. For students following the non-thesis version of the program, the two work term reports may be combined into a single, integrated report for this purpose. All other students must write a thesis on a research project which may be based on research completed during the work terms.
14. Students are not permitted to drop their work term without prior approval from an ASM-CE. Students who drop a work term without permission, who fail to honour an agreement to work with an employer, or who conduct themselves in such a manner as to cause their discharge from the work term, will normally be awarded a fail grade for the work term and will not be permitted to continue in the Co-operative Education Option.
15. Students who are accepted into the co-op option are not guaranteed placements. In the event that a student fails to obtain one or two semesters of placements, but successfully completes all other requirements of the Degree, the student will still be eligible for graduation, but without the designation of a co-op degree.

31.20.6 Courses

31.20.6.1 Core Courses

- Computer Science 6731 Topics in Numerical Methods
- Mathematics 6201 Numerical Methods for Partial Differential Equations
- Mathematics 6210 Numerical Solutions of Differential Equations
- Mathematics 6202 Numerical Optimization
- ~~Scientific Computing 6009 Master's Project~~
- Scientific Computing 6910 Matrix Computations and Applications or Computer Science 6931 Matrix Computations and Applications (*credit may be obtained for only one of the CMSC 6910, COMP 6732, and COMP 6931*)
- Scientific Computing 6920 Applied Scientific Programming
- ~~Scientific Computing 6930 Algorithms for Distributed and Shared Memory Computers~~

- Scientific Computing 6950 Computer Based Tools and Applications (*credit may be obtained for only one of CMSC 6950 and the former CMSC 6940*)

31.20.6.2 Additional Courses

The following courses are identified as suitable for students in this program. Other courses may be permitted with the approval of the Program Chair.

Additional courses may be selected from courses offered by Biochemistry, Chemistry, Computer Science, Earth Sciences, Engineering and Applied Sciences, Mathematics and Statistics, Physics and Physical Oceanography, and Scientific Computing, upon approval of the chair of the program.

Biochemistry

- 6000-6009 Special Topics in Biochemistry
- 6010-6019 Special Topics in Nutrition and Metabolism
- 6020-6029 Special Topics in Food Science
- 6400 Control of Intermediary Metabolism
- 6460 Structural Biochemistry
- 6520 Nutritional Biochemistry
- 6530 Food Biochemistry
- 6590 Cellular, Molecular and Developmental Biology (*credit restricted with Biology 6590 and Medicine 6590*)
- 6630 Marine Biochemistry
- 6680 Processing and Quality of Foods

Chemistry

- 6201 Bioinorganic Chemistry
- 6204 Mechanisms in Catalysis
- 6205 Photochemistry of Transition Metal Complexes
- 6210 Organometallic Chemistry
- 6300 Quantum Chemistry I
- 6301 Quantum Chemistry II
- 6302 Molecular Spectroscopy
- 6304 Computational Chemistry I
- 6310 Electronic Structure Theory
- 6323 Chemical Thermodynamics I
- 6324 Chemical Thermodynamics II
- 6340 Biophysical Chemistry
- 6350 Electrochemical Kinetics
- 6360 Solid State Chemistry
- 6380 Adsorption on Surfaces
- 6381 Surface and Interface Science
- 6382-6389 Selected Topics in Physical Chemistry
- 6390-6398 Selected Topics in Physical Chemistry
- 6399 Chemical Kinetics and Dynamics
- 6401 Organic Spectroscopic Analysis I
- 6402 Organic Spectroscopic Analysis II
- 6470 Physical Organic Chemistry
- 6590-6599 Selected Topics in Theoretical and Computational Chemistry
- 6600 Applications of Inorganic and Organometallic Chemistry to Toxicology

Computer Science

- 6904 Advanced Computer Architectures (*credit may be obtained for only one of 6904 and the former 6722*)
- 6905 Software Engineering (*credit may be obtained for only one of 6905 and the former 6713*)
- 6906 Numerical Methods (*credit may be obtained for only one of 6906 and the former 6731*)
- 6909 Fundamentals of Computer Graphics (*credit may be obtained for only one of 6909 and the former 6752*)
- 6918 Digital Image Processing (*credit may be obtained for only one of 6918 and the former 6756*)
- 6931 Matrix Computations and Applications (*credit may be obtained for only one of 6931, the former 6732, and CMSC 6910*)

Earth Sciences

- 6141 Rotation of the Earth
- 6142 Theory of Global Geodynamics

- 6171 Advanced Exploration Seismology
- 6172 Borehole Seismic
- 6175 Gravity and Magnetic Methods
- 6177 Mathematical Formulations of Seismic Wave Phenomena
- 6918 Airborne and Borehole Electromagnetic Methods
- 6994 Special Topics in Earth Sciences—Geophysical Inversion and Applications
- 7110 Physics of the Solid Earth
- 7120 Crustal Geophysics
- **Engineering and Applied Science**
- 9015 Ocean Engineering Hydrodynamics
- 9052 Ice Properties and Mechanics
- 9501 Finite Element Analysis with Engineering Applications
- 9713 Stochastic Hydrology
- 9815 Electromagnetic Propagation
- 9821 Digital Signal Processing
- 9826 Advanced Control Systems
- 9861 High-Performance Computer Architecture
- 9865 Advanced Digital Systems
- 9869 Advanced Concurrent Programming
- 9871 Information Theory and Coding
- **Mathematics and Statistics**
- 6112-6119 Special Topics in Applied Mathematics
- 6201 Numerical Methods for Partial Differential Equations
- 6210 Numerical Solution of Differential Equations (required course for Scientific Computing)
- 6212 Numerical Methods for Initial Value Problems
- 6588 Selected Topics in Statistics and Probability—Generalized Additive Models with Applications in Scientific Visualization
- **Physics and Physical Oceanography**
- 6000 Condensed Matter Physics I
- 6200 Nonlinear Dynamics
- 6308 Ocean Dynamics I
- 6309 Ocean Dynamics II
- 6310 Physical Oceanography
- 6316 Ocean Measurements and Data Analysis
- 6317 Ocean Acoustics
- 6318 Numerical Modelling
- 6320 Turbulence
- 6321 Coastal Oceanography
- 6323 Stability Theory
- 6400 Statistical Mechanics
- 6402 Theory of Phase Transitions
- 6800 Group Theory
- 6850 Quantum Mechanics I
- **Scientific Computing**
- 601W Work Term 1
- 602W Work Term 2
- 6910 Matrix Computations and Applications (*credit may be obtained for only one of CMSC 6910, the former COMP 6732, and 6931*) (*cross-listed with COMP 6931*)
- 6920 Applied Scientific Programming
- 6925 Tools of the Trade for Programming High-Performance Computers (2 credit hours)
- 6930 Algorithms for Distributed and Shared Memory Computers
- 6950 Computer Based Tools and Applications (*credit may be obtained for only one of CMSC 6950 and the former CMSC 6940*)



Request for Approval of a Graduate Course

SCHOOL OF GRADUATE STUDIES

Adobe Reader, minimum version 8, is required to complete this form. Download the latest version: <http://get.adobe.com/reader>. (1) Save the form by clicking on the diskette icon on the upper left side of the screen; (2) Ensure that you are saving the file in PDF format; (3) Specify where you would like to save the file, e.g. Desktop; (4) Review the [How to create and insert a digital signature](#) webpage for step by step instructions; (5) Fill in the required data and save the file; (6) Send the completed form by email to: sgs@mun.ca.

To: Dean, School of Graduate Studies
From: Faculty/School/Department/Program
Subject: Regular Course Special/Selected Topics Course

Course No.: COMP 6984

Course Title: Future Networks and Applications of Machine Learning

I. To be completed for all requests:

A. Course Type: Lecture course Lecture course with laboratory
 Laboratory course Undergraduate course¹
 Directed readings Other (please specify)

B. Can this course be offered by existing faculty? Yes No

C. Will this course require new funding (including payment of instructor, labs, equipment, etc.)? Yes No

If yes, please specify: One extra teaching credit will be granted for the 1st time offering of this course.

D. Will additional library resources be required (if yes, please contact munul@mun.ca for a resource consultation)? Yes No

E. Credit hours for this course: 3

F. Course description (please attach course outline and reading list):

The course will encompass an introduction to fifth generation (5G) networks and future networks beyond 5G. The course will also cover applications of machine learning (ML) in network design & management.

G. Method of evaluation:	Percentage	
	Written	Oral
Class tests	20	
Assignments	15	
Other (specify):	25(Pr	
Final examination:	40	

Total 100

¹ Must specify the additional work at the graduate level

II. To be completed for special/selected topics course requests only

For special/selected topics courses, there is no evidence of:

Instructor's initials

- 1. duplication of thesis work _____
- 2. double credit _____
- 3. work that is a faculty research product _____
- 4. overlap with existing courses _____

Recommended for offering in the Fall **Winter** Spring 20 24

Length of session if less than a semester:

III. This course proposal has been prepared in accordance with General Regulations governing the School of Graduate Studies

Qiang Ge

04/14/2023

Course instructor

Date

Adrian Fiech

Digitally signed by Adrian Fiech
Date: 2023.04.16 21:24:17 -02'30'

Approval of the head of the academic unit

Date

IV. This course proposal was approved by the Faculty/School/Council

Secretary, Faculty/School/Council

Date

COMP 6984

Machine Learning Applications in Future Networks

Winter 2024



Department of Computer Science

Instructor: Dr. Qiang Ye
Email: qiangy@mun.ca
Office: EN-2033

Main course page: Login to [Brightspace](#) with your MUN login/password.

Course Credit Hours: 3

Course Description:

The course will encompass an introduction to fifth generation (5G) networks and future networks beyond 5G. The course will also cover applications of machine learning (ML) in network design & management. The first half of the course will focus on introducing new applications, new key performance indicators, new wireless/core networking architectures, and key networking and computing technologies for 5G including software-defined networks/network function virtualization (SDN/NFV), edge computing, network slicing, and autonomous vehicular networking. Advanced link-layer and network-layer protocol functionalities and algorithms will also be presented. The second half of the course will introduce typical ML modules/frameworks/algorithms used in future network management. Potential ML techniques include supervised/unsupervised learning, reinforcement learning, federated learning, tabular Q learning, deep Q learning, and policy-based learning (e.g., actor-critic). We will focus on introducing applications of ML for network deployment, network resource allocation, network protocol design, based on future networking scenarios, e.g., space-air-ground integrated networks, SDN/NFV-enabled network control, drone networks, and remote/industrial Internet-of-Things (IoT).

Course Topics:

- 5G wireless/core networks
- 5G networking and computing technologies
- Traffic modeling (voice/video/VR)
- Advanced routing
- Advanced medium access control
- ML-assisted network management
- Future network deployment
- Future network resource allocation
- Future network protocol design

Reference Books/Materials:

This course does not require a textbook but important reference books and state-of-the-art research articles:

- 1) Schwartz, M., Broadband Integrated Networks, Prentice Hall, 1996.
- 2) Bertsekas, D., and R. Gallager, Data Networks, Prentice Hall, 1992.

3) Recently published research articles in 5G and beyond networks.

Evaluation:

The evaluation is based on **class tests, assignments, projects, and final exam**. The final grade in the course will be determined as follows:

- Class Tests - **20 %**
- Assignments - **15%**
- Projects - **25%**
- Final Exam - **40%**

COMP 6984 - Machine Learning Applications in Future Networks

Rationale

With the increased growth of the Internet of Things (IoT) and the proliferation of networked technologies and devices, wireless communications and networking has become critical to support information technology (IT) infrastructure. Computer Science graduates should know about the state-of-the-art networking technology and current trends including the application of Artificial Intelligence in this field.

Computer Science's faculty member Dr. Qiang Ye is an expert in wireless communication networks and Artificial Intelligence (AI)-assisted wireless networking. As the development of wireless communication, networking, and computing technologies has become essential part of IT infrastructure, Dr. Qiang Ye has developed this graduate course to introduce graduate students to this important field.

COMP 6984 will be available for all the programs in CS (thesis and course-based): CS PhD, CS Masters (Thesis, Course-Based, Workterm), our jointly offered degrees: Master of Artificial Intelligence, MASSE, & Master of Data Science and, if seats are available, we could accommodate students from Engineering (MAScCE) and Scientific Computing.

By taking this course, students will be exposed to the state-of-the-art networking and computing technologies, the network evolution trends, and the role of AI in promoting networks development. The subjects to be covered in the course are not currently offered in the existing Computer Science programs. More importantly, students will keep up to date with the cutting-edge technologies in the field, which can be beneficial to their future career development.



Request for Approval of a Graduate Course

SCHOOL OF
GRADUATE STUDIES

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To: Dean, School of Graduate Studies
From: Faculty/School/Department/Program
Subject: Regular Course Special/Selected Topics Course

Course No.: M6114

Course Title: Mathematics of Numerical Relativity

I. To be completed for all requests:

A. Course Type: Lecture course Lecture course with laboratory
 Laboratory course Undergraduate course¹
 Directed readings Other (please specify)

B. Can this course be offered by existing faculty? Yes No

C. Will this course require new funding (including payment of instructor, labs, equipment, etc.)? Yes No
If yes, please specify:

D. Will additional library resources be required (if yes, please contact munul@mun.ca for a resource consultation)? Yes No

E. Credit hours for this course: 3

F. Course description (please attach course outline and reading list):
(see attached description for outline etc.)

In G. below: 25% for written assignments, 25% for oral presentations of material in regular meetings, and 50% for the final project (40 written, 10 presentation)

G. Method of evaluation:	Percentage	
	Written	Oral
Class tests		
Assignments	25	25
Other (specify):	40	10
Final examination:		

Total 100

¹ Must specify the additional work at the graduate level

II. To be completed for special/selected topics course requests only

For special/selected topics courses, there is no evidence of:

- 1. duplication of thesis work
- 2. double credit
- 3. work that is a faculty research product
- 4. overlap with existing courses

Instructor's initials

IB _____
 IB _____
 IB _____
 IB _____

Recommended for offering in the Fall Winter Spring 2023

Length of session if less than a semester: Full semester

III. This course proposal has been prepared in accordance with General Regulations governing the School of Graduate Studies

Ivan Booth
 Course instructor

April 3, 2023
 Date

Chunhua Chen
 Approval of the head of the academic unit

Apr 4, 2023
 Date

IV. This course proposal was approved by the Faculty/School/Council

Secretary, Faculty/School/Council

Date

Mathematics 6114: Mathematics of Numerical Relativity

Course Outline

This special topics course will briefly review the basics of general relativity in its classical, four-dimensional spacetime form. It will then examine how spacetime can be mathematically decomposed into space and time and the standard $(3 + 1)$ -form of Einstein's equations derived. This is the form of the equations used in numerical relativity (and much of mathematical relativity). The decomposition splits the full Einstein equations into constraint equations on initial data, along with evolution equations for that data. The course will examine the mathematical and numerical techniques used to solve those equations. It will finish with a review of what numerical relativity has taught us about gravitational waves and black hole mergers. Throughout, comparisons will be made and analogies drawn between Einstein's equations and corresponding ideas from Maxwell's equations.

Course Texts

This will be offered as a reading course. The primary text will be *Numerical Relativity: Starting from Scratch* (Cambridge University Press, 2021), by T. Baumgarte and S. Shapiro with some extra readings from *Numerical Relativity: Solving Einstein's Equations on the Computer* (Cambridge University Press, 2010) also by T. Baumgarte and S. Shapiro. This second text is one of the standard references in the field and a very nice book, but is quite lengthy. Hence, the authors recently wrote a shorter, more concise, version (the primary text) that is intended as an introductory text for students and researchers just entering the field. Both of these texts are available as e-books from the Library.

Possible Instructors

This course could be taught by Ivan Booth or Graham Cox (both Math and Stats).

Marking Scheme

Marks will be awarded on the basis of 25% for assignments, 25% for weekly presentations and 50% for a final project (which in turn will be split as 40% for the written report and 10% for a talk based on that project).

The regular presentations will be on the material that the students have read that week and will include questioning from the instructor to assess the student's understanding. Some assignment problems will be numerical and the students will have an option to do their final report on either an analytical or numerical topic.

Justification and Notes

The intended audience is students studying mathematical relativity who also need to understand the basics of numerical relativity so as to be able to solve numerically-motivated mathematical problems (much of my research!). However the suggested text aims to be accessible to students without much background in relativity or geometry and so well-motivated students from other areas of mathematics, physics or scientific computing would also be welcome to take this course.



Request for Approval of a Graduate Course

SCHOOL OF GRADUATE STUDIES

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To: Dean, School of Graduate Studies
From: Faculty/School/Department/Program
Subject: Regular Course Special/Selected Topics Course

Course No.: MATH 6115

Course Title: Mathematical Epidemiology

I. To be completed for all requests:

A. Course Type: Lecture course Lecture course with laboratory
 Laboratory course Undergraduate course¹
 Directed readings Other (please specify)

B. Can this course be offered by existing faculty? Yes No

C. Will this course require new funding (including payment of instructor, labs, equipment, etc.)? Yes No
If yes, please specify:

D. Will additional library resources be required (if yes, please contact munul@mun.ca for a resource consultation)? Yes No

E. Credit hours for this course: 3

F. Course description (please attach course outline and reading list):
This course will cover different formulations and analyses of epidemiological models. Topics include host heterogeneity, multiple pathogens, spatial spread, within-host dynamics, and zoonotic spillover.

G. Method of evaluation:	Percentage	
	Written	Oral
Class tests		
Assignments	40%	
Other (specify): Project	60%	
Final examination:		
Total		100%

¹ Must specify the additional work at the graduate level

II. To be completed for special/selected topics course requests only

For special/selected topics courses, there is no evidence of:

- | | |
|--|------------------------------|
| | Instructor's initials |
| 1. duplication of thesis work | AH
_____ |
| 2. double credit | AH
_____ |
| 3. work that is a faculty research product | AH
_____ |
| 4. overlap with existing courses | AH
_____ |

Recommended for offering in the Fall Winter Summer 20 23

Length of session if less than a semester: 10 days x 3.5 hours per day of instruction.

This is near the same instructional hours as a semester and meets the guidelines of the AARMS summer school to complete 30 hours of instruction.

III. This course proposal has been prepared in accordance with General Regulations governing the School of Graduate Studies

Amy Hurford

Course instructor

March 20, 2023

Date

Chunhua Ou

Approval of the head of the academic unit

May 5, 2023

Date

IV. This course proposal was approved by the Faculty/School/Council

Secretary, Faculty/School/Council

Date

MATH 6115 Mathematical Epidemiology

Course instructors

Dr. Amy Hurford, Biology Dept, and Dept of Mathematics & Statistics, Memorial University
 Dr. Julien Arino, Dept of Mathematics, University of Manitoba (AARMS summer school)
 Dr. Amy Greer, Ontario Veterinary College, University of Guelph (AARMS summer school)
 Dr. Jane Heffernan, Dept of Mathematics and Statistics, York University (AARMS summer school)
 Dr. Stéphanie Portet, Dept of Mathematics, University of Manitoba (AARMS summer school)
 Dr. James Watmough, Dept of Mathematics and Statistics, University of New Brunswick (AARMS summer school)

Course description This course will cover different formulations and analyses of epidemiological models. Topics include host heterogeneity, multiple pathogens, spatial spread, within-host dynamics, and zoonotic spillover.

Prerequisites. Students should have completed undergraduate courses in dynamical systems and modelling.

Textbook: [Modelling Infectious Diseases in Humans and Animals](#) by Matt Keeling and Pejman Rohani (K&R) (available as a .pdf from the MUN library).

Rationale: This course will cover the different types of epidemiological models so that students understand the scope of options when modelling infectious diseases. Students will learn the assumptions of the different model formulations (the models are autonomous and non-autonomous, delay, and integro- differential equations, partial differential equations, and branching processes) and mathematical approximations that simplify computationally complex specifications (i.e., Gillespie's Direct Algorithm, moment equations, master equations, separation of time scales, commuter approximations). Students will analyze the models to understand their temporal dynamics (i.e., disease-free equilibrium stability as determined by the net reproduction number, dynamic resonance, bifurcation diagrams, numerical solutions), how the temporal dynamics depend on the biological assumptions, and how to interpret models to answer public health questions.

Format: The course will be part of the Atlantic Association for Research in the Mathematical Sciences (AARMS) summer school in 2023. This summer school has run every summer (aside from during the COVID-19 pandemic) and offers graduate mathematics courses for credit.

The course will take place at Bonne Bay Marine Station, August 19-31. This is a compressed schedule (i.e., 3.5 hours of instruction x 10 days = 35 hours total) relative to typical length of the AARMS summer school, but the course format meets the requirement of at least 30 hours of instructions (specified by AARMS director Sanjeev Seahara). A regular semester is 50 mins x 13 weeks x 3 / week = 32.5 hours.

To help students focus given the instructional intensity, we will teach using combinations of 15 x 1 hr lectures, 8 x 1 hr math and/or computer analysis problem sets (similar to computer labs), guest lectures, and guided work on student projects (10 hrs). The decision to have students work on projects is to capitalize on the venue where students will reside on site in close proximity, having come from across Canada and sharing similar interests, such that students can complete projects that are novel and ground-breaking.

Grading: Assignments (40%), Project (60%)

Course outline

[1] Simple Epidemiological Models (Ch 2 K&R)

[2] Host Heterogeneity (Ch 3 K&R)

[3] Multipathogen/Multihost (Ch 4 K&R)

[4] Pathogen evolution

[5] Temporally-forced models (Ch 5 K&R)

[6] Within-host dynamics

[7] Stochastic dynamics (Ch 6 K&R)

[8] Spatial models (Ch 7 K&R)

[9] Modelling importations

[10] Zoonotic spillover

[11] Controlling Infectious Disease (Ch 8 K&R)



Faculty of Science

Office of the Dean
St. John's, NL Canada A1B 3X7
Tel: 709 864 8154 Fax: 709 864 3316
deansci@mun.ca www.mun.ca/science

May 11, 2023

To: Heads of Departments, Faculty of Science

From: Dr. Travis Fridgen, Interim Dean of Science

Re: Reminder of Memorial's Conflict of Interest Policy and Implementation with respect to Graduate and Undergraduate Student Examination and Supervisory Committees

Documents to be aware of.

Conflict of Interest Policy:

<https://www.mun.ca/policy/browse/policies/view.php?policy=322#:~:text=Conflict%20of%20Interest%20%E2%80%94%20A%20conflict,are%20in%20any%20way%20motivated>

The Procedure for Disclosing and Assessing Conflicts of Interest:

<https://www.mun.ca/policy/browse/procedures/view.php?procedure=388>

The Conflict-of-Interest Disclosure form:

[https://www.mun.ca/policy/media/production/memorial/administrative/university-policies/media-library/browse/policies/documents/COI_Disclosure_Form%20Fall%202022%20\(Oct%2024\).pdf](https://www.mun.ca/policy/media/production/memorial/administrative/university-policies/media-library/browse/policies/documents/COI_Disclosure_Form%20Fall%202022%20(Oct%2024).pdf)

The Memorial University's Conflict of Interest (COI) Policy defines a **perceived conflict** of interest:

A perceived conflict of interest exists when there is a reasonable apprehension, which reasonably well-informed persons could have, that a conflict of interest exists.

A **family associate** is defined in the Memorial COI policy as:

A person who is related to the Member by blood or adoption, or is or has been related to the Member by marriage or common-law marriage.

It is the responsibility of department heads or their delegates to ensure that the student supervisory or examination committees, both present and future, in their respective departments comply with Memorial's COI policy. All real, perceived, or potential conflicts of interest must be declared. As per the procedure for declaring a COI, the Head of the Department should recommend whether or not the

conflict of interest should be allowed and if so, what conditions should apply to manage the situation. The decision on whether the conflict of interest should be allowed rests solely with the university conflict-of-interest committee. Below are some examples of perceived or potential conflicts of interest with respect to student committees. Note that the University COI policy lists examples of COI situations which is “far from exhaustive”. The situations below are also not meant to be exhaustive. These scenarios have been identified to protect both supervisors and students from COI-related complaints.

Supervisory Committees (see also SGS guidelines for supervisory committees)

- A family associate of a student’s supervisor should not serve on the supervisory committee for that student unless it is an academic necessity.
- Family associates may act as co-supervisors, but a conflict of interest must be declared.
- Supervisory committee members for a student should not be under the employ (e.g. postdoctoral fellow or research associate) of the student’s supervisor.
- Possible conditions for recommending the allowance a conflict of interest are that:
 - Co-supervisors effectively share their vote in any decision-making on supervisory committees.
 - Other members of the committee are appointed to ensure that co-supervisors do not have a majority vote on committees.

Examination Committees (see also SGS guidelines for supervisory committees)

- A family associate of a student’s supervisor should not serve as examiner of a comprehensive exam or thesis for that student.
- Only one co-supervisor of a graduate student should act as an examiner on their student’s comprehensive examination committee.