# 11.11 Physics and Physical Oceanography

[www.mun.ca/physics](http://www.mun.ca/physics)

The following undergraduate programs are available in the Department:

1. [Applied Mathematics and Physics Joint Honours](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/2/#d.en.303995)
2. [Applied Mathematics and Physics Joint Major](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/1/#d.en.303980)
3. [Chemistry and Physics Joint Honours](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/2/#d.en.303985)
4. [Computer Science and Physics Joint Honours](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/2/#d.en.304005)
5. [Computer Science and Physics Joint Major](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/1/#d.en.303979)
6. [Earth Sciences and Physics Joint Honours](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/2/#d.en.303989)
7. [Earth Sciences and Physics Joint Major](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/1/#d.en.303977)
8. [Geophysics and Physical Oceanography Joint Honours](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/2/#d.en.303986)
9. [Human Biosciences and Physics Joint Honours](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/2/#d.en.324428)
10. [Honours in Environmental Physics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/#d.en.304110)
11. [Honours in Ocean Physics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/#d.en.304107)
12. [Honours in Physics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/#d.en.304109)
13. [Major in Environmental Physics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/#d.en.304111)
14. [Major in Ocean Physics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/#d.en.304112)
15. [Major in Physics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/#d.en.304113)
16. [Minor in Applied Science - Electrical Engineering for Majors and Honours (see Faculty of Engineering and Applied Science)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-engineering-and-applied-science/6/3/#d.en.303594)
17. [Minor in Physics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/#d.en.304108)

Details of Joint Major and Joint Honours programs are given under [Joint Program Regulations](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/). Other joint programs may be arranged in consultation with the departments concerned.

Physics and Physical Oceanography course descriptions are found at the end of the Faculty of Science section under [Course Descriptions, Physics and Physical Oceanography](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/).

##### Notes:

1. The attention of students intending to follow any one of the programs listed above is drawn to the [University Regulations (Undergraduate), General Academic Regulations (Undergraduate)](https://www.mun.ca/university-calendar/university-regulations-undergraduate/6/), governing the appropriate degree. Additional Departmental requirements are given below.
2. Faculty advisors are available to provide advice to students who are registered in, or who are considering registering in, any of the programs. Students are urged to consult with these advisors at their earliest opportunity in order to ensure that they select appropriate courses and programs. Students with credits in Physics courses which are not listed in this calendar should consult with the Department.
3. The six course stream consisting of Physics [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2055](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), and [2820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) or alternatively the seven course stream of Physics [1020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [1021](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2055](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), and [2820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) is intended to provide a cohesive overview of Physics for potential Physics majors. Students who receive a grade of greater than 70% in Physics [1020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) may proceed directly into Physics [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) without taking Physics [1021](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
4. Physics [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) is recommended for students who have completed Level II Physics, Level III Physics and Level III Advanced Mathematics. Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) must be taken at the same time as, or be successfully completed prior to, taking Physics [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/). Students who have successfully completed Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and Physics [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) are required to register for or successfully complete Mathematics [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) before registering for Physics [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
5. Physics [1020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) is intended for students who have no background in Physics or who are pursuing degree programs which do not require Physics [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/). Students who successfully complete Physics [1020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) (with a grade of at least 70%) and Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) are eligible for admission to Physics [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/). Students may receive credit for only one of Physics [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [1020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
6. Students who have successfully completed Advanced Placement courses in both Physics and Mathematics will normally be eligible for direct entry into Physics [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), which can be taken concurrently with Physics [2053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [2750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/). Eligible students are advised to consult the Department.
7. Where circumstances warrant, any prerequisites listed below may be waived by the Head of the Department.

#### [11.11.1 Minor in Physics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/#11.11.1)

A minor in Physics will consist of 24 credit hours in Physics courses which must include Physics [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) (or [1020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)), [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2055](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/). Only 6 credit hours at the 1000 level can be used to fulfill the 24 credit hours. For those students whose major is Chemistry or Human Biosciences, the 24 credit hours in Physics will not include [2053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).

For Computer Engineering and Electrical Engineering students, 24 credit hours in Physics which must include Physics [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) (or [1020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)), [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), and [3000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), with an additional 12 credit hours selected from Physics [2820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3600](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3751](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3800](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [4000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [4220](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [4600](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) or other 3000 or 4000 level courses subject to approval by the Head of the Department of Physics and Physical Oceanography and the Head of the Department of Electrical and Computer Engineering.

#### [11.11.2 Major in Physics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/#11.11.2)

As a component of the [Degree Regulations](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/4/) for the General Degree of Bachelor of Science, a student shall successfully complete the following requirements:

1. Six credit hours in [Critical Reading and Writing (CRW)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-humanities-and-social-sciences/6/1/#d.en.307242) courses, including at least 3 credit hours in English courses.
2. Chemistry [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) or ([1200](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)).
3. Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
4. Computer Science [1510](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) or [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
5. Mathematics [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), and [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
6. Physics [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) (or [1020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)) and [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
7. Physics [2053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2055](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3220](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3400](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3500](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [3900](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
8. An additional 9 credit hours in physics courses numbered 3000 or higher which shall include at least 6 credit hours selected from the courses numbered 4000 or higher (excluding [490A/B](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)).
9. Forty-two credit hours in applicable elective courses to form a total of 120 credit hours.

Mathematics [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) are prerequisites to many Physics courses and should be successfully completed by the end of second year. Mathematics [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) is co-requisite to Physics [3220](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and is recommended to be successfully completed before the Winter semester of the third year. Those who intend to make a career in Physics should note that additional Physics courses are strongly recommended and interested students should consult the academic program officer.

#### [11.11.3 Honours in Physics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/#11.11.3)

As a component of the [Degree Regulations](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/4/) for the Honours Degree of Bachelor of Science, students shall successfully complete the following requirements:

1. Six credit hours in [Critical Reading and Writing (CRW)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-humanities-and-social-sciences/6/1/#d.en.307242) courses, including at least 3 credit hours in English courses.
2. Chemistry [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) (or [1200](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)).
3. Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
4. Computer Science [1510](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) or [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
5. Mathematics [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
6. Physics [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) (or [1020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)) and [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
7. Physics [2053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2055](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3220](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3230](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3400](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3500](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3900](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [4500](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [4820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [4850](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [490A/B](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
8. Physics [3800](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) or [4900](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
9. An additional 12 credit hours in physics courses numbered 3000 or higher which shall include at least 6 credit hours selected from physics courses numbered 4000 or higher. Students are encouraged to consider Physics [3800](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [4400](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [4900](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), and other courses depending on the focus of their thesis research.
10. Eighteen credit hours in applicable elective courses to form a total of 120 credit hours.

##### Notes:

Certain graduate courses may be taken in the final year of the Honours Program with the permission of the Head of the Department.

Only 6 credit hours at the 1000 level in each of Physics, Chemistry and Mathematics can be used to fulfil the 120 credit hours required for the Honours program. The inclusion of Mathematics [1090](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) (or [109A/B](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)) or the sequence of Physics [1020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [1021](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), and [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) will each increase the number of credit hours required for the Honours Physics program by three.

An Honours thesis is to be presented on work undertaken by the candidate under the guidance of a Department of Physics and Physical Oceanography faculty member. The thesis comprises the 6 credit hour course Physics [490A/B](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/). Students should seek departmental advice regarding a thesis project no later than the winter preceding the semester in which the project will be started.

For specific courses and recommendations about electives, consultation with a faculty advisor in the Department is suggested.

#### [11.11.4 Major in Environmental Physics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/#11.11.4)

As a component of the [Degree Regulations](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/4/) for the General Degree of Bachelor of Science, students shall successfully complete the following requirements:

1. Six credit hours in [Critical Reading and Writing (CRW)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-humanities-and-social-sciences/6/1/#d.en.307242) courses, including at least 3 credit hours in English courses.
2. Chemistry [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) (or Chemistry [1010](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), the former 1011, and the former 1031)
3. Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)
4. Mathematics [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)
5. Physics [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) (or [1020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)) and [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)
6. Physics [2053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2055](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2300](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3220](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3300](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3340](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) (or Earth Sciences [3179](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)), [3900](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)
7. Earth Sciences [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [1002](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2502](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3600](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)
8. Geography [2102](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2195](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3120](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)
9. Biology [2120](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2600](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)
10. Plus 30 additional credit hours from elective courses for a total of 120 credit hours.

The Major degree offers students a fair degree of latitude in choosing electives, students are encouraged to take Physics [2750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) as well as electives from Geography and Earth Sciences: of particular merit would be any of Earth Sciences [3611](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3170](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3172](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) or [4105](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).

#### [11.11.5 Honours in Environmental Physics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/#11.11.5)

As a component of the [Degree Regulations](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/4/) for the Honours Degree of Bachelor of Science, students shall successfully complete the following requirements:

1. Six credit hours in [Critical Reading and Writing (CRW)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-humanities-and-social-sciences/6/1/#d.en.307242) courses, including at least 3 credit hours in English courses
2. Chemistry [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) (or Chemistry [1010](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), the former 1011, and the former 1031)
3. Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)
4. Mathematics [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)
5. Physics [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) (or [1020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)) and [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)
6. Physics [2053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2055](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2300](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3220](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3300](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3340](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) (or Earth Sciences [3179](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)), [3900](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [4205](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [4300](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [4340](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [490A/B](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)
7. Earth Sciences [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [1002](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2502](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3600](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)
8. Geography [2102](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2195](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3120](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)
9. Biology [2120](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2600](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)
10. Plus 15 additional credit hours from elective courses for a total of 120 credit hours.

Students are encouraged to take Physics [2750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) as well as electives from Geography and Earth Sciences: of particular merit would be any of Earth Sciences [3611](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3170](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3172](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) or [4105](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).

#### [11.11.6 Major in Ocean Physics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/#11.11.6)

As a component of the [Degree Regulations](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/4/) for the General Degree of Bachelor of Science, students shall successfully complete the following requirements:

1. Six credit hours in [Critical Reading and Writing (CRW)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-humanities-and-social-sciences/6/1/#d.en.307242) courses, including at least 3 credit hours in English courses.
2. Chemistry [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) (or Chemistry [1200](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)).
3. Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
4. Computer Science [1510](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) or [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
5. Mathematics [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), and [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
6. Physics [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) (or [1020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)) and [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
7. One of Ocean Sciences [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2100](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), or [2200](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
8. Ocean Sciences [2300](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) or Physics [2300](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
9. Physics [2053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2055](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3220](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3400](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3500](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), and [3900](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
10. Physics [3300](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3340](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), and [4300](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
11. An additional 3 credit hours in physics courses numbered 3000 or higher. Students are encouraged to consider Physics [3150](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3800](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [4205](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), or [4340](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
12. Thirty-six credit hours in applicable elective courses.

Mathematics [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) are prerequisites to many Physics courses and should be successfully completed by the end of second year. Note that Mathematics [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) is co-requisite to Physics [3220](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and is recommended to be successfully completed before the Winter term of the third year. Statistics [2550](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) is a recommended elective. Note that Ocean Sciences [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) is a prerequisite for Ocean Sciences [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and Earth Sciences [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) is a prerequisite for Ocean Sciences [2200](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) so that interested students need to consider this if they choose either of these options for clause 7 above.

#### [11.11.7 Honours in Ocean Physics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/#11.11.7)

As a component of the [Degree Regulations](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/4/) for the Honours Degree of Bachelor of Science, students shall successfully complete the following requirements:

1. Six credit hours in [Critical Reading and Writing (CRW)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-humanities-and-social-sciences/6/1/#d.en.307242) courses, including at least 3 credit hours in English courses.
2. Chemistry [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) (or Chemistry [1200](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)).
3. Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
4. Computer Science [1510](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) or [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
5. Mathematics [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), and [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
6. One of Ocean Sciences [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2100](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), or [2200](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
7. Physics [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) (or [1020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/)) and [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
8. Physics [2053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2055](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [2820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3220](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3230](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3400](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3500](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3800](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3900](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [4820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), and [490A/B](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
9. Ocean Sciences [2300](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) or Physics [2300](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
10. Physics [3300](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [3340](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [4205](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [4300](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), and [4340](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
11. Statistics [2550](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).
12. Twelve credit hours in applicable elective courses.

Certain of the graduate courses may be taken in the final year of the Honours Program with the permission of the Head of the Department.

Only 6 credit hours at the 1000 level in each of Physics, Chemistry and Mathematics can be used to fulfill the 120 credit hours required for the Honours program. The inclusion of Mathematics [1090](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), or the sequence of Physics [1020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), [1021](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), and [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/), will each increase the number of credit hours required for the Honours Physics program by three.

Ocean Sciences [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) is a prerequisite for Ocean Sciences [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) and Earth Sciences [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) is a prerequisite for Ocean Sciences [2200](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/) so that interested students need to consider this if they choose either of these options for clause 6 above.

An Honours thesis is to be presented on work undertaken by the student under the guidance of a Department of Physics and Physical Oceanography faculty member. The thesis comprises the 6 credit hour course Physics [490A/B](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/). Students should see departmental advice regarding a thesis project no later than the winter preceding the semester in which the project will be started.

For specific courses and recommendations about electives, consultation with a faculty advisor in the Department is suggested.

Not all courses are offered every year. Students should check with the Department prior to registration to plan programs.

**COURSES-**

Physics courses are designated by PHYS.

##### [PHYS 1020 Introductory Physics I](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304695)

is an algebra-based introduction to Newtonian mechanics. Topics covered include motion in one and two dimensions, Newton’s laws, momentum, energy and work, and rotational motion. Previous exposure to physics would be an asset but is not essential.

CO: Mathematics [1090](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) or [109A](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

CR: PHYS [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

LH: 3; six laboratory sessions per semester

OR: tutorial sessions may be held on weeks when no laboratory is scheduled

PR: Level III Advanced Mathematics or Mathematics [1090](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) or [109A](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), Science [1807](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and Science [1808](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/). It is recommended that students have completed at least one of level II and level III high school physics courses

##### [PHYS 1021 Introductory Physics II](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304710)

is an algebra-based introduction to oscillations, fluids, wave motion, electricity and magnetism, and circuits.

LH: 3; normally there will be six laboratory sessions per semester

OR: tutorial sessions may be held on weeks when no laboratory is scheduled

PR: PHYS [1020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) or [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), Science [1807](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and Science [1808](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 1050 General Physics I: Mechanics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304672)

is a calculus-based introduction to mechanics. The course emphasizes problem solving, beginning with a review of vectors and one-dimensional kinematics. The main part of the course covers motion in two dimensions, forces and Newton’s Laws, energy, momentum, rotational motion and torque, and finally oscillations. For details regarding recommendations for students taking PHYS 1050, see [Note 4 under Physics and Physical Oceanography](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/11/).

CO: Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

CR: PHYS [1020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

LH: 3

PR: Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), Science [1807](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and Science [1808](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 1051 General Physics II: Oscillations, Waves, Electromagnetism](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304677)

is a calculus-based introduction to oscillations, wave motion, and electromagnetism. Topics include: simple harmonic motion; travelling waves, sound waves, and standing waves; electric fields and potentials; magnetic forces and fields; electric current and resistance; and electromagnetic waves.

CO: Mathematics [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

LH: 3

PR: PHYS [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), or [1021](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), or 1020 (with a minimum grade of 70%), Mathematics [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), Science [1807](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and Science [1808](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 2053 Fluids and Thermodynamics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304683)

introduces the student to basic concepts in fluid statics and dynamics as well as the fundamental concepts in thermal physics: kinetic theory, the laws of thermodynamics, thermodynamic processes, entropy, and heat engines and refrigerators.

CO: Mathematics [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and PHYS [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) (or PHYS [1021](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) with a minimum grade of 70%)

LH: 3

PR: Mathematics [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and PHYS [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) (or PHYS [1021](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) with a minimum grade of 70%), Science [1807](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and Science [1808](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 2055 Electricity and Magnetism](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304679)

builds upon the concepts of electric and magnetic forces and fields, Gauss's Law, electric potential and electromagnetic induction introduced in PHYS 1051, expanding them to introduce capacitance, their application in DC and AC circuits, electromagnetic waves, wave optics, and geometric optics.

CO: Mathematics [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

LH: 3

PR: Mathematics [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), PHYS [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), Science [1807](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and Science [1808](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 2151 Stellar Astronomy and Astrophysics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304698)

introduces concepts in modern astronomy including: the celestial sphere, eclipses, parallax, and Kepler's laws; radiation; the Sun; spectroscopy; telescopes, resolution, and detectors; magnitudes, spectral classifications, and the Hertzsprung-Russell diagram; the interstellar medium, star formation, stellar evolution, nucleosynthesis, white dwarfs, neutron stars, pulsars, nebulae, supernovae, black holes, and gamma-ray bursts; galaxies, dark matter, and active galactic nuclei; cosmology, the cosmic microwave background, inflation and dark energy; and the search for extraterrestrial intelligence.

PR: 6 credit hours in Mathematics courses at the first year level

##### [PHYS 2300 Introductory Physical Oceanography](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304688)

provides an introduction to general oceanography with a primary focus on physical oceanography. Topics include how oceans form and evolve on a planetary scale. Ocean characteristics studied include: the properties of seawater; elementary dynamics of fluids on the rotating Earth; ocean circulation; wind-forcing in the ocean; tides and waves. Contemporary methods used in oceanographic study are covered including satellite oceanography. Interactions that occur between physical and chemical processes and biological activity are reviewed.

CR: Environmental Science [2371](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

EQ: Ocean Sciences [2300](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

PR: 6 credit hours in any first-year courses in Physics

##### [PHYS 2750 Modern Physics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304712)

explores the fundamental ideas that are still driving technological developments. Einstein's theory of special relativity, and the microscopic world described by quantum physics are introduced through crucial historical observations. The course covers the dual nature of light and particles, quantum well and quantum tunneling phenomena, which play a key role in modern electronics. Atomic and nuclear structure, and elementary particles are also described.

CO: Mathematics [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/); PHYS [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

CR: PHYS [2056](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

LH: 3

PR: Mathematics [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/); PHYS [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) (or PHYS [1021](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) with a minimum grade of 70%)

##### [PHYS 2820 Computational Mechanics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304691)

introduces computational methods in the context of Newtonian mechanics. Numerical differentiation and integration, numerical solutions to differential equations and data analysis are applied to projectile motion, N-body systems, oscillations and problems from astrophysics and geophysics. Implementation of numerical methods using computer programming is emphasized.

CO: Mathematics [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

LH: 2

PR: Mathematics [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and PHYS [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 3000 Physics of Device Materials](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304703)

is an introduction to the physics of materials, particularly group IV and III-V semiconductors, used in common technological devices. It covers fundamental concepts including structures of crystalline solids, quantum mechanics and statistical mechanics of charge carriers, equilibrium charge carrier concentrations, carrier transport and excess carrier phenomena. These concepts are applied to multi-material devices including pn and metal-semiconductor junctions, metal-oxide-semiconductor field-effect transistors, photovoltaic devices, light-emitting diodes, and solid-state lasers.

PR: PHYS [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 3050 Introduction to Biophysics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304665)

focuses on theoretical and computational modeling of biological processes using tools and concepts from physics, including the statistical physics of polymers, electrostatics of aqueous solutions, free energy minimization, energy-entropy competition, random walks, diffusion, the Einstein relation and depletion forces. With these tools the course examines the physics of biological processes such as osmotic pressure in cells, folding and cooperativity of macromolecules, ligand-receptor binding, energy balance of the cell, cell membrane shapes, ion channels, and molecular motors.

PR: one of Computer Science [1510](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) or [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) or PHYS [2820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), and one of PHYS [2053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) or Chemistry [2301](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 3150 Astrophysics I](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304705)

covers macroscopic and microscopic physics related to stellar structure, energy production, and evolution. This includes stellar observables, gravity and other forces, the Virial Theorem, light and matter in stars, stellar spectra and classification, Hertzsprung-Russell diagrams and properties of main sequence dwarf stars, radiation in the stellar atmosphere, structural relationships and stellar models, energy sources and energy transport in stars, star formation and stellar evolution, nucleosynthesis, variable stars, Chandrasekhar’s limit, and degenerate remnants.

CR: PHYS [3160](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

PR: PHYS [2053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), [2750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) (or [2056](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)), and [2820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 3151 Astrophysics II](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304697)

deals with galactic and cosmological scale astrophysics. Topics include: galaxies including Hubble classification, dark matter, and structure of the Milky Way Galaxy; globular and open star clusters; compact objects including compact binary systems, novas and supernovas, pulsars and magnetars, X-ray binaries; black holes, active galactic nuclei, quasars, the Lyman forest, and the Gunn-Peterson trough; and cosmology including the cosmic microwave background, the FLRW metric, the Friedmann equations, cosmological expansion, and dark energy.

CR: PHYS [3160](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

PR: PHYS [3150](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and [3220](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 3220 Classical Mechanics I](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304686)

covers vector operations, coordinate transformations, derivative of vectors, Newton’s laws, differential equations, kinematics and dynamics of a particle, linear and quadratic air resistance, terminal velocity, momentum of a time varying mass, center of mass systems, angular momentum, moment of inertia, energy, work-energy theorem, forces as the gradient of potential energy, time dependent potential energy, curvilinear one-dimensional systems, energy of a multiparticle system, calculus of variations, and Lagrangian Dynamics.

CO: PHYS [2820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), Mathematics [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

PR: PHYS [2820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), Mathematics [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 3230 Classical Mechanics II](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304706)

covers noninertial frames of reference, Newton's second law in a rotating frame, centrifugal force, Coriolis force, motion of rigid bodies, center of mass, rotation about a fixed axis, rotation about any axis, inertia tensor, Euler's equations with zero torque, coupled oscillators, chaos theory, bifurcation diagrams, state-space orbits, Poincare sections, Hamiltonian dynamics, ignorable coordinate, phase-space orbits, Liouville's theorem, scattering angle, impact parameter, differential scattering cross section, and Rutherford scattering.

CO: Mathematics [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

PR: PHYS [3220](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), Mathematics [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 3300 Intermediate Physical Oceanography](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304681)

provides a physics-based introduction to both dynamical and descriptive physical oceanography. Topics include properties of seawater, geostrophy, conservation equations, wind-forced dynamics, large-scale ocean circulation and waves and tides. A survey of analytical, observational, numerical, and laboratory approaches is presented.

PR: PHYS [2053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and Mathematics [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) or registration in [Academic Term 5 of the Ocean and Naval Architectural Engineering program](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-engineering-and-applied-science/6/6/)

##### [PHYS 3340 Principles of Environmental Physics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304694)

applies basic physical principles to the environment of the Earth with a focus on problem solving and developing physical understanding. Key topics to be covered include the climate system and climate change, energy production and use, and the role of science in guiding public decision-making.

PR: Mathematics [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and PHYS [2053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 3400 Thermal Physics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304700)

covers central concepts in thermodynamics and statistical mechanics, including temperature, entropy, the laws of thermodynamics, the Einstein model of solids, paramagnetism, Helmholtz and Gibbs free energies, chemical potential, thermodynamic identities, Boltzmann statistics, the partition function, and quantum statistics.

PR: Mathematics [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), PHYS [2053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and PHYS [2750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) or ([2056](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/))

##### [PHYS 3500 Electromagnetic Fields I](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304669)

examines the laws of electrostatic and magnetostatic fields based on vector calculus and a local formulation. Topics covered include Gauss's law, potentials, energy and work, the multipole expansion, Laplace's equation and boundary conditions, linear dielectrics, electric polarization, electric displacement, capacitance, magnetic fields B and H, vector potentials, Lorentz force, magnetization and Maxwell's equations.

CR: Electrical and Computer Engineering 5700, the former Engineering 5812

PR: PHYS [2055](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and Mathematics [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 3550 Electric Circuits](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304684)

covers circuit elements. Simple resistive circuits. Techniques of circuit analysis. Topology in circuit analysis. Operational amplifiers. Reactive circuit elements. Natural response and step response of RL, RC and RLC circuits. Circuits driven by sinusoidal sources. Mutual inductance. Series and parallel resonance. Laplace transforms in the analysis of frequency response.

CO: Mathematics [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

CR: Electrical and Computer Engineering 3300, the former Engineering 3821

LC: 6

LH: 6

PR: Mathematics [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), Mathematics [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) or (the former Mathematics 3260), PHYS [2055](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 3600 Optics and Photonics I](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304707)

covers topics in geometrical and physical optics and applications of associated phenomena, principles, and concepts to photonics. Topics include geometrical optics (thin lenses, mirrors, and optical instruments), physical optics (two-beam and multiple-beam interference, Fraunhofer diffraction, reflection, transmission, and polarization), and applications (fibre-optic light guides, modulation of light waves, and optical communication systems).

PR: Mathematics [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and PHYS [2055](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 3750 Quantum Physics I](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304668)

introduces the foundational techniques that are required to understand the physics of atoms and molecules. Beginning with the wave-particle duality of nature, the wave function and the time-independent Schrodinger equation, techniques to calculate wave functions and macroscopic observables in simple one-dimensional models are covered. The three-dimensional hydrogen atom, the simplest real-life system that allows for a quantitative quantum description, is then examined in detail.

CO: Mathematics [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/). PHYS [3220](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) is recommended.

PR: PHYS [2750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) (or [2056](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) or CHEM [2302](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)). PHYS [3220](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) is recommended.

##### [PHYS 3751 Quantum Physics II](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304702)

is an introduction to the physics of elementary particles. After a brief overview of special relativity and non-relativistic quantum mechanics, this course covers relativistic quantum mechanics (Klein-Gordon and Dirac equations, antiparticles, spin, transition probability, and Feynman diagrams) and particle physics (leptons and quarks, strong and weak interaction, conservation laws, and the standard model of elementary particles).

PR: PHYS [3750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 3800 Computational Physics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304699)

is a project-based course that trains students to become functional in computational methods by writing and compiling computer code (C/Fortran) in a Unix environment to solve problems from different areas of physics. Students complete one or more projects that introduce students to a particular class of numerical methods. Lectures and tutorials cover the theory that underlies the computational methods and background for code development and the application of the required numerical methods.

LH: 2

PR: Computer Science [1510](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), or [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), or Engineering 1020 (or other computer programming course as approved by the instructor). PHYS [2820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), Mathematics [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) (or the former Mathematics 3260), and Mathematics [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 3820 Mathematical Physics I](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304673)

focuses on applications of mathematical techniques to solve problems in physics. Vectors, vector calculus, matrices and tensors, coordinate systems and transformations, and summation notation are reviewed. Topics in complex numbers, functions and calculus are introduced, including branch cuts, differentiation, integration, Cauchy formula, series, residue theorem, and the gamma function. Other topics include differential equations using series solutions and separation of variables, and Fourier series of real and complex functions.

PR: Mathematics [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) (or the former Mathematics 3260), and Mathematics [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 3900 Experimental Physics I](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304671)

develops experimental, analytical, and communications skills through extended experiments in fields of physics including optics, magnetism, fluids, spectroscopy, materials characterization, and modern physics. Students select from a range of experiments that illustrate concepts encountered in previous courses to apply existing knowledge and problem solving skills, while other experiments introduce more advanced techniques and phenomena.

CR: PHYS [4880](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

LC: 0

LH: 6

PR: at least two of PHYS [2053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), [2820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), [2055](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), PHYS [2750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) (or [2056](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)); Science [1807](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and Science [1808](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 4000 Solid State Physics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304709)

focuses on the relation between structure and physical properties in crystalline materials. An introduction to crystal structure addresses symmetry and reciprocal space. Phonons and lattice vibrations are linked with thermal properties of solids. Electrons in solids, including energy bands and semiconductors, lead to discussions of transport in solids.

PR: PHYS [3400](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and [3750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 4205 Introduction to Fluid Dynamics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304680)

covers basic observations, mass conservation, vorticity, stress, hydrostatics, rate of strain, momentum conservation (Navier-Stokes equation), simple viscous and inviscid flows, Reynolds number, boundary layers, Bernoulli's and Kelvin's theorems, potential flows, water waves, thermodynamics.

CR: ONAE [4020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

EQ: Mathematics [4180](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

PR: Mathematics [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) (or the former Mathematics 3260) and Mathematics [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 4210 Continuum Mechanics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304704)

- inactive course.

##### [PHYS 4220 Introduction to General Relativity](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304696)

studies both the mathematical structure and physical content of Einstein’s theory of gravity. Topics include the geometric formulation of special relativity, curved spacetimes, metrics, geodesics, causal structure, gravity as spacetime curvature, the weak-field limit, geometry outside a spherical star, Schwarzschild and Kerr black holes, Robertson-Walker cosmologies, gravitational waves, an introduction to tensor calculus, Einstein’s equations, and the stress-energy tensor.

CO: Mathematics [4230](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

EQ: Mathematics [4130](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

PR: Mathematics [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and one of PHYS [3220](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), Mathematics [4230](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) or waiver approved by the instructor

##### [PHYS 4300 Advanced Physical Oceanography](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304685)

covers dynamical physical oceanography. The equations of motion in oceanography are derived and analysed. Topics include geostrophy, conservation equations, linear and non-linear wave theory, and open ocean and shelf circulation dynamics.

PR: PHYS [3300](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and [3820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 4340 Modelling in Environmental Physics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304678)

covers the basic principles underlying environmental modelling. Techniques for numerical modelling are introduced with applications to simulation of terrestrial, atmospheric and oceanic environments. Concepts and principles of free and forced dynamical systems are introduced and applied to the analysis and interpretation of simplified climate and environment model simulations. Includes some discussion of dynamics and transition to chaos in environmental systems, uncertainty in their simulations and predictability of future environmental and climate changes.

PR: PHYS [3340](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and PHYS [3820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) or waiver approved by the instructor

##### [PHYS 4400 Statistical Mechanics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304687)

covers ensembles. Classical and quantum statistical mechanics. Statistical mechanics of phase transitions. Advanced topics in statistical mechanics.

CO: PHYS [3750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

PR: PHYS [3400](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and [3750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 4500 Electromagnetic Fields II](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304689)

covers electrodynamics and the applications of Maxwell's equations. Topics covered include electrodynamics (Maxwell's equations and boundary conditions), conservation laws (continuity equation, Poynting's theorem, and momentum conservation), electromagnetic waves (wave properties, reflection and transmission, absorption and dispersion, guided waves), radiation (potential and fields, dipole radiation, and radiation from point charges), and relativistic electrodynamics. Selected topics in electrodynamics and applied electromagnetism may be introduced.

CR: Electrical and Computer Engineering 6700, the former Engineering 6813

PR: PHYS [3500](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and [3820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 4600 Optics and Photonics II](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304675)

covers principles of lasers, interactions of laser light and matter, and new developments in the fields of optics and photonics. Topics include wave optics, optical resonators, interaction of radiation and atomic systems, principles and techniques of lasers, nonlinear optics and devices, guided-wave optics, and fibre-optic communication. Recent development in the fields, such as photonic crystal optics, ultrafast optics, and nano-optics will be introduced.

PR: PHYS [3500](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and [3600](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 4820 Mathematical Physics II](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304662)

covers topics on the common partial differential equations of Mathematical Physics and boundary value problems; Sturm-Liouville theory, introduction to the theory of distributions, Dirac delta function, Laplace and Fourier transforms, Green’s functions, Bessel functions, Legendre functions, spherical harmonics, and other topics such as group theory.

PR: PHYS [3820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) or all of Mathematics [2051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), [3210](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 4850 Quantum Mechanics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304711)

is a mathematically-based course that covers: the postulates of quantum mechanics; Hermitian operators; x, p and matrix representations of quantum mechanics; the harmonic oscillator; spin and orbital angular momentum and addition of angular momentum; stationary perturbation theory; time dependent perturbation theory.

PR: PHYS [3750](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and [3820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 4851 Advanced Quantum Mechanics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304701)

is a continuation of PHYS [4850](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) that covers: density operators; unitary operators, including symmetry operations and the time-evolution operator; gauge transformations and Berry's phase; quantum mechanical entanglement; systems of identical particles.

PR: PHYS [4820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and [4850](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 4852 Quantum Information and Computing](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304708)

covers postulates of quantum mechanics, matrix theory, density matrices, qubits, qubit registers, entanglement, quantum gates, superdense coding, quantum teleportation, quantum algorithms, open systems, decoherence, physical realization of quantum computers.

EQ: Mathematics [4252](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

PR: Mathematics [2051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) or PHYS [3820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 4900 Experimental Physics II](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304682)

builds on the skills developed in Experimental Physics I through advanced and open-ended experiments in fields of physics including optics, magnetism, fluids, spectroscopy, materials characterization, and modern physics.

LC: 0

LH: 6

PR: PHYS [3900](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), Science [1807](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and Science [1808](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)

##### [PHYS 490A/B Honours Physics Thesis](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304676)

is required of the Honours program.

##### [PHYS 6317 Underwater Acoustics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304664)

covers basic theory of sound, sound in the ocean environment, wave equation, ray tracing, sonar system operation, transducers, applications.

PR: PHYS [3810](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) (or the former Mathematics 3220) and [3220](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/), or waiver approved by the instructor

##### [PHYS 6318 Ocean Climate Modelling](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/#d.en.304666)

covers numerical techniques, finite difference, finite element and spectral methods. Introduction to the climate system. Ocean climate models. Box models. Variability on interdecadal, centennial and geological scales. Zonally averaged models. 3-D ocean modelling. Thermohaline circulation. General circulation models. Climate modelling and global warming.

PR: PHYS [3810](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) (or Mathematics [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/)), PHYS [3300](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/11/) and the completion of any 15 credit hours in core courses at the 3000 or 4000 level in the Faculty of Science or waiver approved by the instructor