PHYSICS (PHYS)

Updated April 26, 2021

Chair: B. Jamieson; Professors: J. Martin, M. Martin; Associate Professors: D. Vincent, C. Bidinosti; A. Frey, B. Jamieson; Assistant Professors: R. Mammei; Instructors: I. Burley, D. Campbell, E. Elhami, V. Milosevic-Zdjelar.

DEGREES/PROGRAMS OFFERED

3-Year BSc
3-Year BSc (Applied Physics Stream)
3-Year BSc (Radiation Health and Safety Stream)
4-Year BSc
4-Year BSc (Radiation Therapy) – *See Radiation Therapy section of Calendar.*
Honours BSc
Honours BSc (Chemical Physics Stream)
Honours BSc (Computational Physics Stream)
Honours BSc (Mathematical Physics Stream)
Honours BSc (Medical Physics Stream)
Minor

INTRODUCTION

Physics is the study of nature at its most fundamental level. Its purpose is to formulate theories that accurately account for the behaviour of observed phenomena at all levels, from the microscopic world of the atom, to the vast reaches of the universe as a whole. In the process of trying to understand nature, physics often makes surprising discoveries that revolutionize the world. Such discoveries include lasers, the electronic processes underlying today's compact, high-speed computers, and the nuclear processes behind medical imaging systems such as MRI's. Even the World Wide Web was developed by particle physicists as a graphics-based communications system to enable them to share information.

A degree in Physics can lead to careers in teaching at the school or university level and research in universities, government labs, and high-tech industry. Physicists acquire skills that are also useful in a wide variety of other fields, such as engineering, health sciences, and finance. Specialized streams in chemical, mathematical, and computational physics are available for those wanting to pursue studies in one of these cross-disciplinary fields. Students pursuing any 3-year or 4-year BSc in Physics also have the opportunity to take a Business Stream (see the "Science with a Business Stream" section of this Course Calendar).

GENERAL INFORMATION

Prerequisites
Note that prerequisites may be waived in some circumstances; please consult the Department Chair.

Notes on Specific Courses and their Applicability
PHYS-1301(6) Introduction to Physics does not involve Calculus and is offered for pre-medical, pre-dental, and arts students.
PHYS-1701(6) Astronomy, **PHYS-2705(6)** Cosmology, and **PHYS-2812(3)** The Physics of Music meet the Science Requirement and are intended for liberal arts students who desire a non-mathematical approach to the understanding of science.
PHYS-2102(3) and **PHYS-2103(3)** - Scientific Computing and Numeric and Symbolic Computing - provide an introduction to the use of computers in science, and should be useful to anyone interested in gaining practical experience with a variety of programming languages.

GENERAL 3-YEAR BSc DEGREE REQUIREMENTS

ADMISSION REQUIREMENT Students must consult with a Department advisor in planning their course of study.

GRADUATION REQUIREMENT 90 credit hours

RESIDENCE REQUIREMENT

Degree:	Minimum 30 credit hours.
Major:	Minimum 18 credit hours.

GENERAL DEGREE REQUIREMENT

Humanities:	Minimum 12 credit hours in Humanities.
Writing:	Minimum 3 credit hours of Academic Writing.
Indigenous:	3 credit hours in designated indigenous requirement courses
Maximum Introductory Courses:	Students may use a maximum of 42 credit hours at the 1000 level. Of these, a maximum of 6 credit hours may be below the 1000 level. As a result, students must take a minimum of 48 credit hours at the 2000-level or above in order to not exceed the maximum number of introductory courses.
Distribution:	Minimum three (3) credit hours from each of five (5) different subjects.

MAJOR REQUIREMENT

Single Major:	Minimum 33 credit hours/Maximum 48 credit hours in Major subject.

Double major:	33 credit hours in Physics and the specified number of credit hours in the other Department/ program.

GENERAL 4-YEAR BSc DEGREE REQUIREMENTS

ADMISSION REQUIREMENT Students must consult with a Department advisor in planning their studies.

GRADUATION REQUIREMENT 120 credit hours; that is, 90 credit hours meeting the requirements for the 3-Year BSc plus 30 additional credit hours.

RESIDENCE REQUIREMENT

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

GENERAL DEGREE REQUIREMENT

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

GENERAL HONOURS BSc DEGREE REQUIREMENTS

ADMISSION REQUIREMENT Students must have completed 30 credit hours.
Students must consult and have the approval of the Department Chair or the Chair's designate when planning their studies.

GRADUATION REQUIREMENT 120 credit hours

Graduation GPA Requirement:	To graduate with a BSc (Honours), students must have a minimum GPA of 3.0 on all major (Physics) courses which will be calculated on all course attempts in the major, and a minimum GPA of 2.75 on all non-major courses which will be calculated as for the general degree.

RESIDENCE REQUIREMENT

Degree:	Minimum 60 credit hours.
Major:	Minimum 30 credit hours, including minimum 18 credit hours at upper level (3000/4000) of which a minimum of 12 credit hours are at the 4000 level.

GENERAL DEGREE REQUIREMENT

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

HONOURS REQUIREMENT

Single Honours:	Minimum 60 credit hours in the Major subject. Minimum 30 credit hours in upper-level (3000 and 4000) Honours subject courses of which a minimum of 12 credit hours must be at the 4000 level.

REQUIREMENTS FOR A 3-YEAR BSc IN PHYSICS

MAJOR REQUIREMENT

Single Major: Minimum of 45 credit hours as per the courses listed below.

Required Courses (36 credit hours):

MATH-1101(6) Introduction to Calculus
OR MATH-1103(3) Introduction to Calculus I
AND MATH-1104(3) Introduction to Calculus II
PHYS-1101(6) Foundations of Physics
PHYS-2105(3) Mathematical Physics I
PHYS-2106(3) Mathematical Physics II
PHYS-2200(3) Electricity and Magnetism

PHYS-2302(6) Modern and Thermal Physics
PHYS-3301(6) Quantum Mechanics
PHYS-3901(3) Intermediate Physics Laboratory

Plus a minimum of 6 credit hours from:

PHYS-2202(3) Optics and Waves
PHYS-3202(3) Intermediate Mechanics
PHYS-3403(3) Thermal and Statistical Physics

Plus a minimum of 3 credit hours from:

Any other PHYS course excluding **PHYS-1005(6)** Concepts in Science and **PHYS-1301(6)** Introduction to Physics.

Recommended: Students are advised to include courses in the areas of Calculus and Differential Equations as part of their degree program. Students are advised to consult with the Department Chair before entering Year 2 of their studies.

Combined Major: Minimum of 48 credit hours from two (2) different majors with not less than 18 credit hours from each major subject.

Prescribed courses: Required courses depend on the second major area and will be determined in consultation with the department.

REQUIREMENTS FOR A 3-YEAR BSc (APPLIED PHYSICS STREAM)

MAJOR REQUIREMENT

Single major: Minimum of 45 credit hours as per the courses listed below.

Required Courses (33 credit hours):

MATH-1101(6) Introduction to Calculus
OR MATH-1103(3) Introduction to Calculus I
AND MATH-1104(3) Introduction to Calculus II
PHYS-1101(6) Foundations of Physics
PHYS-2105(3) Mathematical Physics I
PHYS-2106(3) Mathematical Physics II
PHYS-2200(3) Electricity and Magnetism
PHYS-2202(3) Optics and Waves
PHYS-2302(6) Modern and Thermal Physics
PHYS-3901(3) Intermediate Physics Laboratory

Plus a minimum of 6 credit hours from:

PHYS-2102(3) Scientific Computing
PHYS-2103(3) Numeric and Symbolic Computing
PHYS-2110(3) Statics
PHYS-2803(3) Fundamentals of Digital Electronics

Plus a minimum of 6 credit hours from:

PHYS-3202(3) Intermediate Mechanics
PHYS-3301(6) Quantum Mechanics
PHYS-3403(3) Thermal and Statistical Physics

REQUIREMENTS FOR A 3-YEAR BSc (RADIATION HEALTH AND SAFETY)

MAJOR REQUIREMENT

Single Major: Minimum of 60 credit hours as per the courses listed below.

Required Courses (48 credit hours):

BIOL-1112(6) Human Anatomy and Physiology
STAT-1501(3) Elementary Biological Statistics I

MATH-1101(6) Introduction to Calculus
OR MATH-1103(3) Introduction to Calculus I
AND MATH-1104(3) Introduction to Calculus II
PHYS-1101(6) Foundations of Physics
PHYS-2102(3) Scientific Computing
PHYS-2105(3) Mathematical Physics I
PHYS-2106(3) Mathematical Physics II
PHYS-2200(3) Electricity and Magnetism
PHYS-2302(6) Modern and Thermal Physics
CCMB-2510(3)* Radiation Biology
CCMB-2540(3)* Radiation Protection and Health Phys
PHYS-3901(3) Intermediate Physics Laboratory

Plus a minimum of 12 credit hours from:

PHYS-2103(3) Numeric and Symbolic Computing
PHYS-2202(3) Optics and Waves

PHYS-2502(3) Radiation and the Environment
PHYS-2503(3) Medical Imaging
PHYS-3220(3)** Medical Physics and Physiological Measurement
PHYS-3301(6) Quantum Mechanics
PHYS-3403(3) Thermal and Statistical Physics
CCMB-2520(3)* Physics of Radiation Therapy
CCMB-2530(3)* Industrial, Therapy, and Imaging Apparatus
STAT-2001(3) Elementary Biological Statistics II

*These courses are taught through CancerCare Manitoba (CCMB).
**This course is taught through the University of Manitoba.

REQUIREMENTS FOR A 4-YEAR BSc IN PHYSICS

MAJOR REQUIREMENT

Single Major: Minimum of 66 credit hours as per the courses listed below.

Required Courses (48 credit hours):

MATH-1101(6) Introduction to Calculus
OR MATH-1103(3) Introduction to Calculus I
AND MATH-1104(3) Introduction to Calculus II
PHYS-1101(6) Foundations of Physics
PHYS-2105(3) Mathematical Physics I
PHYS-2106(3) Mathematical Physics II
PHYS-2200(3) Electricity and Magnetism
PHYS-2202(3) Optics and Waves
PHYS-2302(6) Modern and Thermal Physics
PHYS-3202(3) Intermediate Mechanics
PHYS-3301(6) Quantum Mechanics
PHYS-3403(3) Thermal and Statistical Physics
PHYS-3901(3) Intermediate Physics Laboratory
PHYS-4901(3) Advanced Physics Laboratory

Plus a minimum of 6 credit hours from:

PHYS-3203(3) Advanced Mechanics
PHYS-4201(6) Electrodynamics
PHYS-4602(3) Advanced Quantum Mechanics

Plus a minimum of 12 credit hours from:

PHYS-2102(3) Scientific Computing
PHYS-2103(3) Numeric and Symbolic Computing
PHYS-2803(3) Fundamentals of Digital Electronics
OR any 3000 or 4000 level PHYS course

If necessary, alternate Mathematics or Physics courses can be substituted with written permission from the Department of Physics.

Students must complete a special registration form available from the Department Chair before registering for the 66th credit hour.

Combined Major: Minimum of 60 credit hours from two (2) different majors with not less than 24 credit hours from each major subject.

Prescribed courses: Required courses depend on the second major area and will be determined in consultation with the department.

REQUIREMENTS FOR A 4-YEAR BSc (RADIATION THERAPY)

Radiation Therapy is a new program. Please see the “Radiation Therapy” section of the Course Calendar.

REQUIREMENTS FOR AN HONOURS BSc IN PHYSICS

HONOURS REQUIREMENT

Single Honours: Minimum of 90 credit hours as per the courses listed below.

Required Courses (72 credit hours):

MATH-1101(6) Introduction to Calculus
OR MATH-1103(3) Introduction to Calculus I
AND MATH-1104(3) Introduction to Calculus II
MATH-1201(3) Linear Algebra I
MATH-2102(3) Differential Equations I

PHYS-1101(6) Foundations of Physics
PHYS-2105(3) Mathematical Physics I
PHYS-2106(3) Mathematical Physics II
PHYS-2200(3) Electricity and Magnetism
PHYS-2202(3) Optics and Waves
PHYS-2302(6) Modern and Thermal Physics
PHYS-3202(3) Intermediate Mechanics
PHYS-3203(3) Advanced Mechanics
PHYS-3301(6) Quantum Mechanics
PHYS-3403(3) Thermal and Statistical Physics
PHYS-3901(3) Intermediate Physics Laboratory
PHYS-4001(6) Honours Thesis
PHYS-4201(6) Electrodynamics
PHYS-4602(3) Advanced Quantum Mechanics
PHYS-4901(3) Advanced Physics Laboratory

Plus a minimum of 6 credit hours from:

PHYS-2102(3) Scientific Computing
PHYS-2103(3) Numeric and Symbolic Computing
PHYS-2803(3) Fundamentals of Digital Electronics
OR any 3000 or 4000 level PHYS course

In addition to the above, students must select a further 6 credit hours in Mathematics and 6 credit hours from Biology and/or Chemistry excluding **BIOL-1102(6)** Biology and Human Concerns and **CHEM-2801(6)** Chemistry and Society.
If necessary, alternate Mathematics or Physics courses can be substituted with written permission from the Department of Physics.

REQUIREMENTS FOR AN HONOURS BSc (CHEMICAL PHYSICS STREAM)

HONOURS REQUIREMENT

Single Honours: Minimum of 96 credit hours as per the courses listed below.

Required Courses (84 credit hours):

CHEM-1111(3) Introduction to the Chemical Properties of Matter
CHEM-1112(3) Basic Principles of Chemical Reactivity
CHEM-2102(3) Thermodynamics and Kinetics
CHEM-2103(3) Atoms, Molecules and Spectroscopy
CHEM-2401(3) Inorganic Chemistry I
CHEM-3101(3) Physical Chemistry of Condensed Phases
CHEM-3102(3) Quantum Chemistry and Spectroscopy
CHEM-4101(3) Quantum Chemistry

MATH-1101(6) Introduction to Calculus
OR MATH-1103(3) Introduction to Calculus I
AND MATH-1104(3) Introduction to Calculus II
MATH-1201(3) Linear Algebra I
MATH-2102(3) Differential Equations I
PHYS-1101(6) Foundations of Physics
PHYS-2105(3) Mathematical Physics I
PHYS-2106(3) Mathematical Physics II
PHYS-2200(3) Electricity and Magnetism
PHYS-2302(6) Modern and Thermal Physics
PHYS-3301(6) Quantum Mechanics
PHYS-3403(3) Thermal and Statistical Physics
PHYS-3901(3) Intermediate Physics Laboratory
PHYS-4001(6) Honours Thesis
PHYS-4201(6) Electrodynamics
PHYS-4602(3) Advanced Quantum Mechanics

Plus a minimum of 3 credit hours from:

CHEM-2202(3) Organic Chemistry I
CHEM-2302(3) Quantitative Chemical Analysis

Plus a minimum of 9 credit hours from:

PHYS-2102(3) Scientific Computing
PHYS-2103(3) Numeric and Symbolic Computing
PHYS-2202(3) Optics and Waves
PHYS-2803(3) Fundamentals of Digital Electronics
OR any 3000 or 4000 level PHYS course

If necessary, alternate Mathematics or Physics courses can be substituted with written permission from the Department of Physics.

REQUIREMENTS FOR AN HONOURS BSc (COMPUTATIONAL PHYSICS STREAM)

HONOURS REQUIREMENT

Single Honours: Minimum of 90 credit hours as per the courses listed below.

Required Courses (69 credit hours):

MATH-1101(6) Introduction to Calculus
OR MATH-1103(3) Introduction to Calculus I
AND MATH-1104(3) Introduction to Calculus II
MATH-1201(3) Linear Algebra I
MATH-2102(3) Differential Equations I
PHYS-1101(6) Foundations of Physics
PHYS-2102(3) Scientific Computing
PHYS-2103(3) Numeric and Symbolic Computing
PHYS-2105(3) Mathematical Physics I
PHYS-2106(3) Mathematical Physics II
PHYS-2200(3) Electricity and Magnetism
PHYS-2302(6) Modern and Thermal Physics
PHYS-2803(3) Fundamentals of Digital Electronics
PHYS-3202(3) Intermediate Mechanics
PHYS-3301(6) Quantum Mechanics
PHYS-3403(3) Thermal and Statistical Physics
PHYS-3901(3) Intermediate Physics Laboratory
PHYS-4001(6) Honours Thesis
With either
ACS-1903(3) Programming Fundamentals I and
ACS-1904(3) Programming Fundamentals II
OR
ACS-1905(3) Programming Fundamentals and
ACS-2947(3) Data Structures and Algorithms

Plus a minimum of 9 credit hours from:

PHYS-2202(3) Optics and Waves
OR any 3000 or 4000 level PHYS course

Plus a minimum of 12 credit hours from:

MATH-3701(3) Numerical Methods
ACS-2906(3) Computer Architecture and System Software
ACS-2913(3) Software Requirements Analysis and Design
ACS-2947(3) Data Structures and Algorithms
ACS-3913(3) Software Design and Architecture
ACS-3931(3) Principles of Operating Systems
ACS-3941(3) Implementation Issues in Object Oriented Languages
ACS-3947(3) Algorithm Design
ACS-4306(3) Applied Parallel Programming
ACS-4953(3) Introduction to Machine Learning*

*This course requires the permission of the ACS department.

If necessary, alternate Mathematics or Physics courses can be substituted with written permission from the Department of Physics.

REQUIREMENTS FOR AN HONOURS BSc (MATHEMATICAL PHYSICS STREAM)

HONOURS REQUIREMENT

Single Honours: Minimum of 93 credit hours as per the courses listed below.

Required Courses (81 credit hours):

MATH-1101(6) Introduction to Calculus
OR MATH-1103(3) Introduction to Calculus I
AND MATH-1104(3) Introduction to Calculus II
MATH-1201(3) Linear Algebra I
MATH-2102(3) Differential Equations I
MATH-2103(3) Differential Equations II
MATH-2105(3) Intermediate Calculus I
MATH-2106(3) Intermediate Calculus II
MATH-2203(3) Linear Algebra II
PHYS-1101(6) Foundations of Physics
PHYS-2105(3) Mathematical Physics I
PHYS-2106(3) Mathematical Physics II
PHYS-2200(3) Electricity and Magnetism
PHYS-2202(3) Optics and Waves
PHYS-2302(6) Modern and Thermal Physics
PHYS-3202(3) Intermediate Mechanics

PHYS-3203(3) Advanced Mechanics
PHYS-3301(6) Quantum Mechanics
PHYS-3403(3) Thermal and Statistical Physics
PHYS-3901(3) Intermediate Physics Laboratory
PHYS-4001(6) Honours Thesis
PHYS-4201(6) Electrodynamics
PHYS-4602(3) Advanced Quantum Mechanics

Plus a minimum of 12 credit hours from:

MATH-3101(6) Introduction to MathematicalAnalysis
MATH-3103(3) Methods in Advanced Calculus
MATH-3104(3) Methods in Partial Differential Equations
MATH-3202(3) Group Theory
MATH-3402(3) Combinatorics
MATH-3701(3) Numerical Methods
MATH-4101(3) Complex Analysis
MATH-4403(3) Set Theory
MATH-4601(3) Introduction to Topology and Analysis
OR any 3000 or 4000 level PHYS course

If necessary, alternate Mathematics or Physics courses can be substituted with written permission from the Department of Physics.

REQUIREMENTS FOR AN HONOURS BSc (MEDICAL PHYSICS STREAM)

HONOURS REQUIREMENT

Single Honours: Minimum of 90 credit hours as per the courses listed below.

Required Courses (78 credit hours):

BIOL-1112(6) Human Anatomy and Physiology
STAT-1501(3) Elementary Biological Statistics I

MATH-1101(6) Introduction to Calculus
OR MATH-1103(3) Introduction to Calculus I
AND MATH-1104(3) Introduction to Calculus II
MATH-1201(3) Linear Algebra I
MATH-2102(3) Differential Equations I
PHYS-1101(6) Foundations of Physics
PHYS-2105(3) Mathematical Physics I
PHYS-2106(3) Mathematical Physics II
PHYS-2200(3) Electricity and Magnetism
PHYS-2202(3) Optics and Waves
PHYS-2302(6) Modern and Thermal Physics
PHYS-3202(3) Intermediate Mechanics
PHYS-3301(6) Quantum Mechanics
PHYS-3403(3) Thermal and Statistical Physics
PHYS-3901(3) Intermediate Physics Laboratory
PHYS-4001(6) Honours Thesis
PHYS-4201(6) Electrodynamics
PHYS-4602(3) Advanced Quantum Mechanics
PHYS-4901(3) Advanced Physics Laboratory

Plus a minimum of 6 credit hours from:

PHYS-2502(3) Radiation and the Environment
PHYS-2503(3) Medical Imaging
PHYS-3220(3)* Medical Physics and Physiological Measurement
STAT-2001(3) Elementary Biological Statistics II

Plus a minimum of 6 credit hours from:

PHYS-2102(3) Scientific Computing
PHYS-2103(3) Numeric and Symbolic Computing
PHYS-2803(3) Fundamentals of Digital Electronics
OR any 3000 or 4000 level PHYS course

*This course is taught through the University of Manitoba.

If necessary, alternate Mathematics or Physics courses can be substituted with written permission from the Department of Physics.

REQUIREMENTS FOR A MINOR IN PHYSICS

Degree:	Students completing any undergraduate degree program are eligible to complete the Minor.
Minor:	18 credit hours in PHYS, with a minimum of 12 credit hours above the 1000-level.
Residence Requirement:	Minimum 12 credit hours in PHYS.
Required Courses:	PHYS-1101(6) Foundations of Physics OR PHYS-1301(6) Introduction to Physics PHYS-2105(3) Mathematical Physics I *and 9 credits from the following:* PHYS-2106(3) Mathematical Physics II PHYS-2200(3) Electricity and Magnetism

PHYS-2202(3) Optics and Waves
PHYS-2302(6) Modern and Thermal Physics
With permission of the Physics Department Chair, a student may substitute PHYS-2102(3) Scientific Computing, PHYS-2103(3) Numeric and Symbolic Computing, PHYS-2112(3) Scientific Computing with Python, or PHYS-2803(3) Fundamentals of Digital Electronics for the above elective courses.

Restrictions: Students cannot declare the same subject as a Major and a Minor.

COURSE LISTINGS

PHYS-1005(6)	Concepts in Science
PHYS-1101(6)	Foundations of Physics
PHYS-1301(6)	Introduction to Physics
PHYS-1701(6)	Astronomy
PHYS-2001(3)	Directed Studies in Physics
PHYS-2102(3)	Scientific Computing
PHYS-2103(3)	Numeric & Symbolic Computing
PHYS-2105(3)	Mathematical Physics I
PHYS-2106(3)	Mathematical Physics II
PHYS-2110(3)	Statics
PHYS-2112(3)	Scientific Computing with Python
PHYS-2200(3)	Electricity and Magnetism
PHYS-2202(3)	Optics and Waves
PHYS-2302(6)	Modern and Thermal Physics
PHYS-2502(3)	Radiation and the Environment
PHYS-2503(3)	Medical Imaging
PHYS-2705(6)	Cosmology: Science Fact to Science Fiction
PHYS-2777(3)	The Study of Time
PHYS-2803(3)	Fundamentals of Digital Electronics
PHYS-2812(3)	The Physics of Music
PHYS-3103(3)	Special Topics in Physics
PHYS-3202(3)	Intermediate Mechanics
PHYS-3203(3)	Advanced Mechanics
PHYS-3301(6)	Quantum Mechanics
PHYS-3402(3)	Thermal Physics I
PHYS-3403(3)	Thermal and Statistical Physics
PHYS-3901(3)	Intermediate Physics Laboratory
PHYS-4001(6)	Honours Thesis
PHYS-4201(6)	Electrodynamics
PHYS-4302(3)	Condensed Matter Physics
PHYS-4303(3)	Subatomic Physics
PHYS-4501(6)	Introduction to General Relativity
PHYS-4602(3)	Advanced Quantum Mechanics
PHYS-4901(3)	Advanced Physics Laboratory

COURSE DESCRIPTIONS

All course descriptions for all undergraduate programs can now be found in the back portion of the print Undergraduate Academic Calendar. They are also available in one large PDF in the “Academic Calendar” section of the University website: http://uwinnipeg.ca/academics/calendar/index.html