

# PHYSICS (PHYS)

## **PHYS\*1010 Introductory Electricity and Magnetism Winter Only (LEC: 3, LAB: 3) [0.50]**

This is a course for engineering and physical science students on the phenomena of electromagnetism and introductory DC circuit analysis. Topics include electric charges and fields, electric potential and current, electric resistance, capacitance, inductance, magnetic fields, electric circuits, Ohm's Law, and application of Kirchhoff's Laws to node and mesh analysis of DC circuits. The course will conclude with an introduction to AC circuits.

**Prerequisite(s):** (1 of MATH\*1080, MATH\*1200), (4U Physics or equivalent)

**Restriction(s):** IPS\*1510

**Department(s):** Department of Physics

**Location(s):** Guelph

## **PHYS\*1020 Introductory Physics Summer Only (LEC: 3, LAB: 2) [0.50]**

This course stresses the fundamental properties of particles and waves, designed for students without 4U Physics or equivalent. Topics include: the motion of particles, force, field, momentum, energy and associated conservation laws; basic interactions between particles; properties of waves. It is expected that students will have at least 1 4U mathematics credit. This course is intended only for students who require the equivalent of 4U Physics in order to proceed to IPS\*1500, PHYS\*1130, PHYS\*1010, PHYS\*1080, or PHYS\*1070.

**Offering(s):** Offered through Distance Education format only.

**Department(s):** Department of Physics

**Location(s):** Guelph

## **PHYS\*1070 Physics for Life Sciences II Winter Only (LEC: 3, LAB: 3) [0.50]**

This course discusses physics of matter and energy at the macroscopic and microscopic levels, with special emphasis on topics of importance to the biological sciences. Topics include properties of waves, acoustics and hearing, optical systems and vision, quantum nature of radiation and its interaction with biomolecules, electricity, high energy radiation and radioactivity.

**Prerequisite(s):** (4U Physics or PHYS\*1020), 4U Mathematics

**Restriction(s):** IPS\*1510, PHYS\*1130, PHYS\*1300. This is a Priority Access Course. Enrolment may be restricted to particular programs, specializations or semester levels during certain periods. Please see the departmental website for more information.

**Department(s):** Department of Physics

**Location(s):** Guelph

## **PHYS\*1080 Physics for Life Sciences Fall and Winter (LEC: 3, LAB: 3) [0.50]**

This course discusses aspects of classical physics with particular emphasis on topics of importance in the biological and environmental sciences. Topics include mechanics and applications to anatomical problems, fluid statics and dynamics, molecular motion, diffusion, osmosis, and heat.

**Prerequisite(s):** (1 of 4U Physics, PHYS\*1020, PHYS\*1300), 4U Mathematics

**Restriction(s):** IPS\*1500, PHYS\*1000. This is a Priority Access Course. Enrolment may be restricted to particular programs, specializations or semester levels during certain periods. Please see the departmental website for more information.

**Department(s):** Department of Physics

**Location(s):** Guelph

## **PHYS\*1130 Physics with Applications Fall Only (LEC: 3, LAB: 1) [0.50]**

This is an introductory physics course for engineering students. Topics include measurement and error analysis, translational and rotational kinematics and dynamics, simple harmonic motion, waves, acoustics, and optics, with an emphasis on relevant applications of these physical concepts. The course will conclude with an introduction to quantum phenomena.

**Prerequisite(s):** (4U Calculus and Vectors or equivalent), (4U Physics or equivalent)

**Restriction(s):** IPS\*1500, PHYS\*1080

**Department(s):** Department of Physics

**Location(s):** Guelph

## **PHYS\*1300 Fundamentals of Physics Fall Only (LEC: 3, LAB: 3) [0.50]**

This course introduces students to fundamental phenomena in physics, with particular emphasis on applications to the biological sciences. Topics include: analyzing one-dimensional and two-dimensional motion; Newton's laws; momentum, energy and associated conservation laws; interactions between charges, resistive direct-current circuits; the fundamentals of waves, with applications to acoustics; ionizing radiation, radioactivity and medical applications. This course is designed for students who have not completed 4U Physics (or equivalent): students with credit in 4U Physics (or equivalent) may not take this course for credit.

**Restriction(s):** SPH 4U (or equivalent) PHYS\*1020, PHYS\*1070. This is a Priority Access Course. Enrolment may be restricted to particular programs, specializations or semester levels during certain periods. Please see the departmental website for more information.

**Department(s):** Department of Physics

**Location(s):** Guelph

## **PHYS\*1600 Contemporary Astronomy Fall Only (LEC: 3) [0.50]**

This course is designed for non-science students. Emphasis will be on the interdisciplinary and contemporary aspects of astronomy with the object of providing a perspective of our place in the physical universe. Topics will include the solar system, stars and stellar evolution, pulsars, black holes, quasars and cosmology. Students are encouraged to suggest and participate in discussion on items of special interest.

**Offering(s):** Offered through Distance Education format only.

**Restriction(s):** Students with standing in any other 1000 level course credit in physics (except (PHYS\*1020 or PHYS\*1300), PHYS\*1810)) may not use this course for credit. BSC students may not take this course for credit.

**Department(s):** Department of Physics

**Location(s):** Guelph

## **PHYS\*1810 Physics of Music Winter Only (LEC: 3) [0.50]**

This course is designed for arts and social science students with an interest or background in music. The fundamentals of vibrations and waves will be introduced and applied to a study of archetypal instruments. The psychoacoustic basis of pitch and loudness will be discussed

**Equate(s):** MUSC\*1090

**Restriction(s):** Students who have standing in any 1000 level physics course (except PHYS\*1020 or PHYS\*1600) may not enrol in this course. BSC students may not take this course for credit.

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*2030 Biophysics of Excitable Cells Winter Only (LEC: 3, LAB: 1) [0.50]**

An intermediate biophysics course with special emphasis on the physical properties of nerve cells and of biological transducers such as the ear and the eye.

**Prerequisite(s):** 1.00 credits in physics (excluding PHYS\*1020, PHYS\*1600, PHYS\*1810)

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*2180 Experimental Techniques in Physics Winter Only (LEC: 3, LAB: 3) [0.50]**

This course is designed to aid students in the development of core practical skills in physics. Students will be required to conduct a series of experiments exploring fundamental concepts in mechanics, electricity & magnetism, thermal physics, as well as the experimental basis of quantum physics. There will be a strong emphasis on data and error analysis with a variety of software applications.

**Prerequisite(s):** PHYS\*2330

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*2240 Thermal Physics Fall Only (LEC: 3) [0.50]**

This course will introduce students to the basic ideas of thermal physics, including temperature, heat, work, thermal and diffusive equilibrium, and the Boltzmann distribution. The statistical basis for entropy and for thermodynamics will be discussed. Applications of thermodynamics to both non-interacting and interacting systems will be presented.

**Prerequisite(s):** (1 of IPS\*1510, MATH\*1210, MATH\*2080), (IPS\*1500 or PHYS\*1080)

**Restriction(s):** CHEM\*2820

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*2310 Mechanics Winter Only (LEC: 4) [0.50]**

This course continues building the foundation in mechanics begun in the first year. Topics include, one, two and three dimensional motion, damped and forced harmonic oscillator, gravitation and orbital motion, special relativity, noninertial reference frames, and rigid body dynamics.

**Prerequisite(s):** MATH\*2270, (1 of IPS\*1500, PHYS\*1000, PHYS\*1080)

**Restriction(s):** PHYS\*2440

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*2330 Electricity and Magnetism I Fall Only (LEC: 4) [0.50]**

This course continues building the foundation in electricity and magnetism begun in the first year and is intended for students proceeding to advanced studies in the physical sciences. Topics include vector calculus, electric fields, potential, electric work and energy, Gauss's Law, Poisson's and Laplace's equations, capacitors, D.C. circuits, transients and dielectric materials.

**Prerequisite(s):** IPS\*1510 or [(MATH\*1210 or MATH\*2080), (1 of PHYS\*1010, PHYS\*1070, PHYS\*1130)]

**Restriction(s):** PHYS\*2460

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*2340 Electricity and Magnetism II Winter Only (LEC: 4) [0.50]**

This course is a continuation of PHYS\*2330. Topics include magnetic forces and fields, the Biot-Savart equation, Ampere's Law, magnetic induction, LRC transients, A.C. circuits and magnetic materials.

**Prerequisite(s):** PHYS\*2330

**Restriction(s):** PHYS\*2470

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*2600 General Astronomy Fall Only (LEC: 4, LAB: 1) [0.50]**

An introduction to astronomy, this course covers the solar system, the sun, stellar and galactic structure.

**Offering(s):** Offered through Distance Education format only.

**Prerequisite(s):** IPS\*1500 or [(1 of PHYS\*1010, PHYS\*1070, PHYS\*1080, PHYS\*1130, PHYS\*1300), (1 of MATH\*1030, MATH\*1080, MATH\*1160, MATH\*1200)]

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*3000 Optics: Fundamentals and Applications Winter Only (LEC: 3) [0.50]**

This course will introduce students to the fundamental principles of wave and geometric optics, with an emphasis on applications. Topics will include reflection, refraction, diffraction, interference, and polarization, as well as fibre optics, imaging systems and lasers.

**Prerequisite(s):** PHYS\*2340, PHYS\*3130

**Restriction(s):** PHYS\*3220

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*3080 Energy Winter Only (LEC: 3) [0.50]**

This course covers energy resources and the production, transmission, interconversion, consumption and waste of energy in the industrial society. Emphasis is placed on environmental impact and human safety. Topics include fossil fuels, nuclear fission and fusion, wind and solar power, the hydrogen economy, and conservation strategies.

**Offering(s):** Offered through Distance Education format only.

**Prerequisite(s):** IPS\*1500 or [PHYS\*1080, (1 of MATH\*1000, MATH\*1080, MATH\*1200)], (1 of IPS\*1510, PHYS\*1010, PHYS\*1070, PHYS\*1130)

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*3130 Mathematical Physics Fall Only (LEC: 3) [0.50]**

This course covers a number of mathematical techniques that are required in all areas of physics. Curvilinear coordinates, special functions, Fourier series and integral transforms, Green's functions, and a number of advanced topics will be discussed. The course emphasizes the application of these techniques to solve a variety of physics problems, providing context to the fundamental tools of the discipline.

**Prerequisite(s):** (1 of MATH\*1160, MATH\*2150, MATH\*2160), MATH\*2200, MATH\*2270, PHYS\*2310, PHYS\*2340

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*3170 Radioactivity and Radiation Interactions Fall Only (LEC: 3) [0.50]**

This course will provide a fundamental understanding of radiation physics and dosimetry, as well as assist students in the development of their problem solving skills in this field. Topics will include: atomic and nuclear structure, radioactivity, interaction of radiation with matter, radiobiology, radiation dosimetry, and external radiation protection. Throughout the course, applications of radiation physics in medicine will be highlighted.

**Prerequisite(s):** (1 of IPS\*1510, MATH\*1210, MATH\*2080), (MATH\*2170 or MATH\*2270)

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*3230 Quantum Mechanics I Fall Only (LEC: 4) [0.50]**

This course consists of a formal treatment of quantum mechanics. Topics include wave packets and free particle motion, the Schrodinger equation, harmonic oscillator, piecewise constant potentials, central forces and angular momentum, and the hydrogen atom.

**Prerequisite(s):** (1 of MATH\*1160, MATH\*2150, MATH\*2160), (MATH\*2170 or MATH\*2270), (PHYS\*2340 or PHYS\*2470)

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*3400 Advanced Mechanics Fall Only (LEC: 3) [0.50]**

This course covers Lagrangian mechanics and Hamiltonian mechanics. Topics include least action principles, Poisson brackets, Liouville's theorem, Hamilton- Jacobi theory, the transition to quantum mechanics and introduction to non-linear dynamics.

**Prerequisite(s):** (MATH\*2170 or MATH\*2270), (PHYS\*2310 or PHYS\*2440)

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*3510 Intermediate Laboratory Fall and Winter (LAB: 6) [0.50]**

This modular course consists of experiments in modern and classical physics. Modules include laboratory instrumentation employing computers, modern physics, waves and optics, molecular physics, biophysics, and solid state physics.

**Prerequisite(s):** PHYS\*2180 or (NANO\*2100, PHYS\*2310)

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*4001 Research in Physics Fall Only (LAB: 6) [0.50]**

This course is the first part of the two-semester course PHYS\*4001/2. This is a two-semester (F-W) course in which students apply their knowledge and skills through independent research of an experimental or theoretical nature within physics. Students will be required to present their results in both oral and written reports. Students must make arrangements with a faculty supervisor and obtain approval of the course co-ordinator before course selection. Approval of the course co-ordinator will only be granted upon receipt of a completed registration form, available from the co-ordinator during the course selection period. This is a two-semester course offered over consecutive semesters.

When you select it, you must select PHYS\*4001 in the Fall semester and PHYS\*4002 in the Winter semester. A grade will not be assigned to PHYS\*4001 until PHYS\*4002 has been completed.

**Prerequisite(s):** PHYS\*3510

**Restriction(s):** PHYS\*4510. Instructor consent required.

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*4002 Research in Physics Winter Only (LAB: 6) [0.50]**

This course is the second part of the two-semester course PHYS\*4001/2. This is a two-semester (F-W) course in which students apply their knowledge and skills through independent research of an experimental or theoretical nature within physics. Students will be required to present their results in both oral and written reports. Students must make arrangements with a faculty supervisor and obtain approval of the course co-ordinator before course selection. Approval of the course co-ordinator will only be granted upon receipt of a completed registration form, available from the co-ordinator during the course selection period. This is a two-semester course offered over consecutive semesters. When you select it, you must select PHYS\*4001 in the Fall semester and PHYS\*4002 in the Winter semester. A grade will not be assigned to PHYS\*4001 until PHYS\*4002 has been completed.

**Prerequisite(s):** PHYS\*4001

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*4040 Quantum Mechanics II Winter Only (LEC: 4) [0.50]**

This is a second course in quantum mechanics. Topics include spin and two-level systems, quantum systems of multiple particles, quantum description of fermions and bosons, time independent perturbation theory, and the fine structure of hydrogen.

**Prerequisite(s):** PHYS\*3230

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*4070 Clinical Applications of Physics in Medicine Winter Only (LEC: 3) [0.50]**

This course provides an overview of the application of physics to medicine. The physical concepts underlying the diagnosis and treatment of disease will be explored. Topics will include general imaging principles such as resolution, intensity, and contrast; x-ray imaging and computed tomography; radioisotopes and nuclear medicine, SPECT and PET; magnetic resonance imaging; ultrasound imaging and radiation therapy.

**Prerequisite(s):** ENGG\*3390 or PHYS\*3130

**Restriction(s):** ENGG\*4040, PHYS\*4560

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*4120 Atomic and Molecular Physics Fall Only (LEC: 3) [0.50]**

The application of quantum theory to atomic and molecular structure, and the interaction between electromagnetic radiation and atoms and simple molecules.

**Prerequisite(s):** PHYS\*4040

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*4130 Subatomic Physics Winter Only (LEC: 3) [0.50]**

This course surveys the field of subatomic physics from radioactive emanations to conjectured subunits of nucleons. Topics include quark models; strong, electromagnetic and weak interactions; isospin, strangeness, conservation laws and symmetry principles; systematics of nuclear properties, nuclear radioactivity, nuclear models and reactions.

**Prerequisite(s):** PHYS\*4040

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*4150 Solid State Physics Winter Only (LEC: 3) [0.50]**

The topics covered in this course include: bonding in solids, thermal and electrical properties of solids, energy bands, imperfections in solids, properties of semiconductors and insulators.

**Prerequisite(s):** PHYS\*4040, PHYS\*4240

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*4180 Advanced Electromagnetic Theory Fall Only (LEC: 3) [0.50]**

This course covers Maxwell's equation, Lorentz-force law, conservation of charge, and conservation of energy (Poynting's theorem). In addition, the course will discuss potentials, gauge transformations, wave equations, and multipole expansions as well as Green's functions for the Poisson and wave equations. Additional topics include electrostatics and magnetostatics (including boundary-value problems), motion of charged particles in electromagnetic fields, and propagation and generation of electromagnetic waves.

**Prerequisite(s):** (PHYS\*2340 or PHYS\*2470)

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*4240 Statistical Physics II Fall Only (LEC: 3) [0.50]**

A continuation of PHYS\*2240 including a discussion of the grand canonical distribution, quantum statistics, and transport theory.

**Prerequisite(s):** (PHYS\*2240 or PHYS\*3240), PHYS\*3230

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*4500 Advanced Physics Laboratory Fall and Winter (LAB: 6) [0.50]**

This is a modular course for students in any physics-related major in which techniques of nuclear, solid state and molecular physics will be studied.

**Prerequisite(s):** PHYS\*3510

**Restriction(s):** This is a Priority Access Course. Enrolment may be restricted to particular programs, specializations or semester levels during certain periods. Please see the departmental website for more information.

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*4540 Molecular Biophysics Winter Only (LEC: 3) [0.50]**

Physical methods of determining macromolecular structure: energetics, intramolecular and intermolecular forces, with applications to lamellar structures, information storage, DNA and RNA, recognition and rejection of foreign molecules.

**Prerequisite(s):** 0.50 credits in biochemistry, (CHEM\*3860 or PHYS\*3230)

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*4910 Advanced Topics in Physics I Unspecified (LEC: 3) [0.50]**

The content of this course is determined by the interests of the students. Possible topics include fluid mechanics, theory of elastic solids, general relativity, astrophysics, and chaos. This course is not offered every year.

**Prerequisite(s):** (1 of MATH\*1160, MATH\*2150, MATH\*2160), (MATH\*2170 or MATH\*2270), [(PHYS\*2450, PHYS\*2470) or (PHYS\*2180, PHYS\*2310, PHYS\*2340)]

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*4920 Advanced Topics in Physics II Unspecified (LEC: 3) [0.50]**

The content of this course is determined by the interests of the students. Possible topics include fluid mechanics, theory of elastic solids, general relativity, astrophysics, and chaos. This course is not offered every year.

**Prerequisite(s):** (1 of MATH\*1160, MATH\*2150, MATH\*2160), (MATH\*2170 or MATH\*2270), [(PHYS\*2450, PHYS\*2470) or (PHYS\*2180, PHYS\*2310, PHYS\*2340)]

**Department(s):** Department of Physics

**Location(s):** Guelph

**PHYS\*4930 Advanced Topics in Physics III Unspecified (LEC: 3) [0.50]**

The content of this course is determined by the interests of the students. Possible topics include fluid mechanics, theory of elastic solids, general relativity, astrophysics, and chaos. This course is not offered every year.

**Prerequisite(s):** (1 of MATH\*1160, MATH\*2150, MATH\*2160), (MATH\*2170 or MATH\*2270), [(PHYS\*2450, PHYS\*2470) or (PHYS\*2180, PHYS\*2310, PHYS\*2340)]

**Department(s):** Department of Physics

**Location(s):** Guelph