

PHYSICS (PHYS)

PHYS 1190 Fundamentals of Physics

3 credit hours

The intent of this course is to develop fundamental skills, tools, and conceptual understanding in physics, with a focus on topics/skills that are essential for subsequent study of physics. Students study motion and dynamics of objects in one and two dimensions, including discussions of projectiles, friction, circular motion and dynamics, and collisions including conservation of momentum and energy.

Note: Students who have credit for a university PHYS course cannot subsequently take PHYS 1190 for credit. PHYS 1190 cannot be taken concurrently with any other PHYS course

PHYS 1210 University Physics I

3 credit hours

Prerequisite: Nova Scotia Grade 11 Physics or PHYS 1190

This calculus-based physics course is intended primarily for (astro) physics and chemistry majors and engineers. Topics include kinematics, Newton's laws of motion, conservation of energy and momentum, rotational dynamics, and Newton's law of gravitation. Students focus on problem solving skills. Classes 3 hrs. and lab/tutorial 3 hrs. per week.

PHYS 1211 University Physics II

3 credit hours

Prerequisite: PHYS 1210 [formerly PHYS 1100]; and either MATH 1210 or MATH 1190

This calculus-based physics course is a continuation of PHYS 1210, and covers the topics of oscillations and waves, thermodynamics, and electricity and magnetism. Classes 3 hrs. and lab/tutorial 3 hrs. per week

PHYS 1370 Scientific Method PHIL 1255

3 credit hours

Prerequisite: Nova Scotia grade 11 physics or chemistry and Nova Scotia grade 12 math or equivalent; or permission of the instructors

This course provides a historical and logical analysis of methods commonly used in science, and is normally taught by faculty from both the Department of Astronomy and Physics and the Department of Philosophy. Topics include science vs. pseudo-science, natural vs. social sciences, modes of reasoning, observation and experimentation, construction and empirical testing of theories and models, and thought experiments.

PHYS 1500 Introduction to Modern Physics

3 credit hours

Prerequisite: PHYS 1210 [formerly PHYS 1100]; and either MATH 1210 or MATH 1190

The special theory of relativity and early ideas in quantum mechanics are introduced. Topics in relativity include departures from Newtonian theory, Lorentz transformations, space and time dilation, the "Twin Paradox", and relativistic dynamics. Topics in quantum mechanics include the quantum theory of light, the Bohr model of the atom, the wave nature of particles and the Schrödinger equation applied to simple one-dimensional problems.

PHYS 2302 Mechanics I

3 credit hours

Prerequisite: PHYS 1211 and MATH 1211

Students develop skills in setting up and solving problems in physics and applying mathematical skills through an exploration of Newton's Laws of motion. Topics include a review of vectors and coordinate systems, rectilinear motion, projectile motion, conservation of energy, simple harmonic motion, accelerating frames of reference, and celestial mechanics.

Note: Credit will not be given for both PHYS 2300 and PHYS 2302.

PHYS 2303 Mechanics II

3 credit hours

Prerequisite: PHYS 2302, MATH 2311, and MATH 2301

This is a continuation of PHYS 2302, where students develop their problem-solving skills with increasingly sophisticated topics in Classical Mechanics. These topics include central forces (celestial mechanics), many-body and rigid-body dynamics, conservation of momentum and angular momentum, coupled oscillators, and waves.

Note: Credit will not be given for both PHYS 2301 and PHYS 2303.

PHYS 2410 Electricity and Magnetism

3 credit hours

Prerequisite: PHYS 1211 [formerly PHYS 1101] and MATH 1211

This course is a comprehensive introduction to concepts of electricity and magnetism. Topics include electric fields and potentials, motion of charged particles in electric and magnetic fields, elementary circuit analysis, EM induction, capacitors and inductors. Classes 3 hrs. and lab 3 hrs. per week.

PHYS 2510 Thermodynamics

3 credit hours

Prerequisite: PHYS 1211, MATH 2311 MATH 2301

Students are introduced to the basic ideas of thermal physics, including temperature, heat, work, entropy and free energy. These ideas are expanded into the first and second laws of thermodynamics, with applications including phase transitions, engines, refrigerators, and batteries. Classes 3 hrs. and lab 3 hrs. per week.

PHYS 3200 Mathematical Methods in Physics I

3 credit hours

Prerequisite: PHYS 2303 and MATH 2303

Students focus on the mathematics needed to solve problems in advanced physics courses. Topics include separation of variables, the method of Frobenius, the Wronskian integral, Green's functions, Dirac notation, eigenfunctions and eigenkets, Hermitian operators, properties of analytic functions, Cauchy's Integral Theorem, Laurent expansions and the calculus of residues.

Note: Credit for PHYS 3200 cannot be given to students who have completed MATH 4436 and 3405.

PHYS 3210 Computational Methods in Physics

3 credit hours

Prerequisite: PHYS 3500 and PHYS 3200, and either CSCI 1226 or CSCI 1227

Students are introduced to computational methods of solving mathematically difficult or tedious problems. Students focus on some of the algorithms most useful to a physicist, including root-finding, spline fitting, Richardson extrapolation, Romberg integration, Runge-Kutta and Monte Carlo methods. Students apply learned algorithms to problems in computational (astro) physics.

PHYS 3300 Classical Mechanics

3 credit hours

Prerequisite: PHYS 1500, PHYS 2303, and MATH 2303

Students study the calculus of variations, constrained problems, and generalised Lagrangian and Hamiltonian dynamics. Applications are made to oscillations, the "brachistochrone problem", central force problems, rigid bodies, and the motion of tops. Additional topics include relativistic mechanics, canonical perturbation theory, and chaos.

PHYS 3410 Electromagnetism

3 credit hours

Prerequisite: PHYS 1500, PHYS 2410, MATH 2301, MATH 2303, and MATH 2311

This course is a comprehensive introduction to the mathematical theory of electric and magnetic fields. Topics include electric field and potential, Gauss' law, capacitance, Ampere's law, the Law of Biot and Savart, and magnetization of matter.

Note: Credit will not be given for both PHYS 2400 and PHYS 3410.**PHYS 3500 Quantum Mechanics I**

3 credit hours

Prerequisite: PHYS 1500, PHYS 2303 and MATH 2303

Students build on the foundations set in PHYS 1500. Topics in this course include the (time-independent) Schrodinger equation, one-dimensional potentials, barriers and tunnelling, the Heisenberg Uncertainty Principle, Dirac notation, expectation values, the three-dimensional Schrodinger equation, single-electron atoms, spin, and identical particles.

PHYS 3510 Statistical Mechanics

3 credit hours

Prerequisite: PHYS 2510, PHYS 3200 and PHYS 3500

Students discover how thermal physics concepts including temperature, entropy, thermal radiation, heat, work, and chemical energy can be described in terms of the discrete quantum states of the components of the system. Applied topics such as cryogenics, phase transitions, or semiconductor physics may also be explored.

PHYS 3600 Experimental Physics I

3 credit hours

Prerequisite: Either PHYS 2410 or PHYS 2510

Students develop the necessary skills to be a successful experimental (astro)physicist. Students assemble labs from advanced experimental equipment including computers and other digital devices, perform the experiment possibly over several weeks, and communicate their results in a scientifically useful fashion.

PHYS 4200 Mathematical Methods in Physics II

3 credit hours

Prerequisite: either PHYS 3200 or MATH 3405/MATH 4436

In this continuation of PHYS 3200, students cover topics in mathematical physics, including special functions (Gamma, Beta, Digamma, Bessel, Neumann, spherical Bessel), Fourier series and transforms (both discrete and continuous), and an introduction to Group theory including Lie groups culminating in the classification of baryons.

PHYS 4370 Philosophy of Physics PHIL 4515

3 credit hours

Prerequisite: PHYS 2410, PHYS 3500 and PHIL prerequisites as outlined in paragraph 8 in the Philosophy Calendar entry; or permission of the instructors

This course explores methodological, conceptual, metaphysical, and epistemological questions that arise in modern physics. Possible topics include scientific revolutions, experimentation, laws of nature, space, time, matter, causality, indeterminism, non-locality, thought experiments, and theoretical unification.

PHYS 4380 Fluid Dynamics

3 credit hours

Prerequisite: PHYS 3200 and PHYS 3300

This course introduces students to the fundamentals of fluid dynamics. Discussion embraces both compressible and incompressible fluids and includes the continuity equation, the Navier-Stokes equation, Bernoulli's theorem, viscosity, the Reynolds number, vorticity, and numerous applications to "real world" problems. Some specialized numerical techniques for solving complex problems in fluid dynamics may also be discussed.

PHYS 4390 General Relativity

3 credit hours

Prerequisite: PHYS 3200 and PHYS 3300

This is an advanced course introducing Einstein's theory of general relativity and the curvature of space-time. Topics shall include manifolds, Riemannian geometry, Einstein's equations, and applications to cosmology and black holes.

PHYS 4410 Electrodynamics

3 credit hours

Prerequisite: PHYS 3410 and PHYS 3200

This course is a continuation of PHYS 3410, which focused primarily on electro and magnetostatics, and turns to the more general theory of electrodynamics. Topics include Faraday's law of induction, Maxwell's equations in vacuo and matter, the Poynting vector, electromagnetic waves, wave guides, scalar and vector potentials, gauge transformations, Lienardt-Wiechart potentials, radiation from moving charges, and relativistic electrodynamics.

Note: Credit will not be given for both PHYS 3400 and PHYS 4410.**PHYS 4500 Quantum Mechanics II**

3 credit hours

Prerequisite: PHYS 3200, PHYS 3300, and PHYS 3500

This course is a continuation of PHYS 3500, and covers topics such as time-independent perturbation theory, the variational principle, the Wentzel-Kramers-Brillouin (WKB) approximation, time-dependent perturbation theory, the adiabatic approximation, and scattering.

PHYS 4501 Quantum Mechanics III

3 credit hours

Prerequisite: PHYS 4500

This advanced course in Quantum Mechanics covers a selection of topics that may include scattering, lasers, relativistic quantum dynamics (Dirac theory), second quantization, and field theory.

PHYS 4510 Subatomic Physics

3 credit hours

Prerequisite: PHYS 3500

Students are introduced to modern nuclear and particle physics. Topics may include the nucleon-nucleon interaction, the deuteron, the nuclear shell model, dynamical probes of nuclei (electron, photon, and hadron scattering), the structure of nucleons and mesons, electroweak interactions.

PHYS 4600 Experimental Physics II

3 credit hours

Prerequisite: PHYS 3600

This course is designed primarily for honours physics students to study advanced topics in physics and/or astrophysics in the laboratory. Students are responsible for setting up and performing the experiments, writing computer programs to aid the analysis, and preparing and presenting their results in a professional manner. The majority of work will be project-based, each project conceived and built by the students from equipment available in the lab.

PHYS 4790 Research Thesis

6 credit hours

Prerequisite: honours standing

A research project carried out by the student under the supervision of a faculty member in the Department throughout the Honours year. The project should be in the area of astrophysics for students in the honours astrophysics program. Results are written up in a formal thesis that adheres to standard University-set guidelines. Directed study 3 hrs. per week; 2 semesters.

PHYS 4826 – 4849 Special Topics in PHYS

3 credit hours

Prerequisite: permission of instructor**PHYS 4876 – 4899 Directed Study in PHYS**

3 credit hours

Prerequisite: permission of instructor