# PHYS – PHYSICS

**PHYS 020**
**Physics 20**
**5 Credits Weekly (6-0-0)**
Physics 20 is equivalent to Alberta Education's Physics 20. Topics studied include displacement, velocity, acceleration, gravitational and frictional forces, circular motion, oscillatory motion, waves, work, and the Law of Conservation of Energy.
*Prerequisites: SCIE 010 or equivalent and MATH 010C or equivalent.*
*Co-requisites: MATH 020-1 or MATH 020-2 or equivalent.*

**PHYS 030**
**Physics 30**
**5 Credits Weekly (6-0-0)**
Physics 30 is equivalent to Alberta Education's Physics 30. Topics studied include the Law of Conservation of Momentum, electrical and magnetic forces and fields, simple AC and DC circuits, wave and particle behavior of light, and atomic structure.
*Prerequisites: PHYS 020 or equivalent AND (MATH 020-1 or MATH 020-2 or equivalent).*
*Co-requisites: MATH 030-1 or MATH 030-2 or equivalent.*

**PHYS 124**
**Physics for Life Sciences I**
**3 Credits Weekly (3-3-0)**
This is an algebra based physics course on motion of matter intended for students in life and medical sciences. Topics include kinematics, Newtonian mechanics, conservation of momentum and energy, rotational motion, statics and dynamics of extended bodies and simple harmonic motion. Students are introduced to aspects of modern physics. During the course students develop a conceptual understanding of physical principles, develop reasoning and problem-solving skills, and relate these physical principles to real-world situations relevant to biology and medicine. NOTE: Physics 30 is strongly recommended. Credit can only be obtained in one of PHYS 108, PHYS 124, PHYS 144, or ENPH 131.
*Prerequisites: Mathematics 30-1 and Physics 20.*

**PHYS 126**
**Physics for Life Sciences II**
**3 Credits Weekly (3-3-0)**
This course is an algebra-based physics course on electromagnetism intended for students in life and medical sciences. Topics include electrostatics, direct current circuits, magnetic fields, electromagnetic induction and alternating current circuits. Students are introduced to aspects of modern physics. During the course students develop a conceptual understanding of physical principles, develop reasoning and problem-solving skills, and relate these physical principles to real-world situations relevant to biology and medicine. NOTE: Credit can only be obtained in one of PHYS 109, PHYS 126, or PHYS 146.
*Prerequisites: A minimum grade of C- in PHYS 124.*

**PHYS 130**
**Wave Motion, Optics and Sound**
**3.8 Credits Total (45-18-0)**
This is a calculus based course intended for engineering students. Topics include spherical mirrors, thin lenses, simple harmonic motion, wave motion, interference, sound waves, light waves and diffraction. Note: Restricted to Engineering students.
*Prerequisites: Mathematics 30-1, Mathematics 31 and Physics 30.*

**PHYS 144**
**Mechanics**
**3 Credits Weekly (3-3-0)**
This is a calculus based physics course intended for students in the physical sciences or for students who completed physics in high school. Topics include kinematics, Newtonian mechanics, conservation of momentum and energy, rotational motion, statics and dynamics of extended bodies and simple harmonic motion. Students are introduced to aspects of modern physics. During the course students develop a conceptual understanding of physical principles, develop reasoning and problem-solving skills, and relate these physical principles to real-world situations. NOTE: Credit can only be obtained in one of PHYS 124, PHYS 144, or ENPH 131.
*Prerequisites: Mathematics 31, Mathematics 30-1, and Physics 30.*

**PHYS 146**
**Electromagnetism**
**3 Credits Weekly (3-3-0)**
This is a calculus-based physics course on electromagnetism intended for students in physical sciences or for students who completed physics in high school. Topics include electrostatics, direct current circuits, magnetic fields, electromagnetic induction and alternating current circuits. Students are introduced to aspects of modern physics. During the course students develop a conceptual understanding of physical principles, develop reasoning and problem-solving skills, and relate these physical principles to real-world situations. NOTE: Credit can only be obtained in one of PHYS 126 or PHYS 146.
*Prerequisites: A minimum grade of C- in PHYS 144.*

**PHYS 200**
**Introduction to Relativity**
**3 Credits Weekly (3-0-0)**
If you're curious about what Einstein's famous equation E=mc^2 actually means, or how you could end up twenty years older than your twin, then this is the course for you! We'll learn how Einstein's special theory of relativity addresses the limitations of classical physics, including time dilation and length contraction in fast-moving reference frames, the twin paradox, the Doppler effect, and conservation of relativistic momentum and energy. We'll finish off by discussing curved spacetime and black holes as a brief introduction to the general theory of relativity. Note: Students considering future enrolment in 300-level or higher PHYS (p. 1) courses are strongly encouraged to take MATH 114 (or both MATH 114 and one of MATH 120 or MATH 125) to satisfy the mathematics requirement.
*Prerequisites: A minimum grade of C- in one of PHYS 126 or PHYS 146, and one of MATH 114, MATH 120, or MATH 125.*

**PHYS 208**
**Quantum Aspects of Physics**
**3 Credits Total (45-18-0)**
Quantum mechanics gives us some of the strangest phenomena in physics, but its principles are actually behind the technology we use every day (think computers, lasers, and LED lights). In this course, we'll examine the experimental evidence that led to the development of quantum mechanics, including the photoelectric effect, blackbody radiation and electron diffraction. We'll then introduce the Heisenberg uncertainty principle and the Schrödinger equation to describe simple harmonic oscillators, quantum tunneling, atomic spectra, and the hydrogen atom. The course's laboratory component puts us in the role of early 20th century physicists gathering evidence to demystify the strangeness of these phenomena!
*Prerequisites: Minimum grades of C- in MATH 114 and one of PHYS 126 or PHYS 146.*

**PHYS 224**
**Fluids and Heat**
**3 Credits Total (45-18-0)**
Why can we see our breath when we exhale outside on a cold winter day? In this course, we'll learn about the properties of fluids and the thermal properties of matter. We'll cover topics including buoyancy and hydrostatic pressure, temperature, thermal expansion, heat and energy transfer, the kinetic theory of gases, and the ideal gas law. The course's laboratory component lets us warm up to these topics further as we investigate the behaviour of fluids and the thermal properties of solids, liquids, and gases. Note: Students considering future enrolment in 300-level or higher PHYS (p. 1) courses are strongly encouraged to take MATH 114 (or both MATH 114 and one of MATH 120 or MATH 125) to satisfy the mathematics requirement.
*Prerequisites: A minimum grade of C- in one of PHYS 126 or PHYS 146 and in one of MATH 114, MATH 120, or MATH 125.*

**PHYS 226**
**Optics and Sound Waves**
**3 Credits Total (45-18-0)**
Ever wonder why putting on a pair of glasses can bring the world into focus? Interested in learning how flutes and other wind instruments work? In this course, we'll learn how wave mechanics governs these behaviours. We'll study mechanical and sound waves, simple harmonic motion, and geometric optics, including applications like microscopes, telescopes, Doppler radar, spectrometers, holograms, seismic waves, and molecular vibrations. The course's laboratory component will let us see and hear how waves behave as they propagate and interact with their environment. Note: Students considering future enrolment in 300-level or higher PHYS (p. 1) courses are strongly encouraged to take MATH 114 (or both MATH 114 and one of MATH 120 or MATH 125) to satisfy the mathematics requirement.
*Prerequisites: A minimum grade of C- in PHYS 126 or PHYS 146, and in one of MATH 114, MATH 120, or MATH 125.*

**PHYS 242**
**Physics of Planetary Exploration**
**3 Credits Weekly (3-0-0)**
What would it take to travel to Mars? In this course, we'll study the physical principles that govern the design of interplanetary missions within the solar system, using Newton's universal law of gravity and Kepler's laws of planetary motion to understand transfer orbits between planets and to their satellites (natural and human-made!). We'll also discuss past, present, and future space missions, and the operating principles of spacecraft instrumentation and sensors. Note: Students considering future enrolment in 300-level or higher PHYS (p. 1) courses are strongly encouraged to take MATH 114 (or both MATH 114 and one of MATH 120 or MATH 125) to satisfy the mathematics requirement.
*Prerequisites: A minimum grade of C- in one of PHYS 126 or PHYS 146, and one of MATH 114, MATH 120, or MATH 125.*

**PHYS 244**
**Mechanics**
**3 Credits Weekly (3-0-0)**
This course expands on first-year mechanics, examining oscillating systems, normal modes, conservative forces, and energy. Lagrangian and Hamiltonian dynamics are introduced, including variational calculus, Hamilton's Principle, generalized coordinates, constraints, Lagrange multipliers, the Hamiltonian, conservation laws, and Hamiltonian dynamics. Further topics include central forces, orbital motion, and scattering. Note: It is recommended that MATH 115 be taken concurrently with, or prior to taking this course.
*Prerequisites: Minimum grades of C- in one of PHYS 126 or PHYS 146, and MATH 114, and MATH 120 or MATH 125.*

**PHYS 250**
**Introduction to Biophysics**
**3 Credits Weekly (3-0-0)**
Why can't chickens fly? How does a 3-metre long strand of DNA fit into a 100-micrometre wide cell? In this course, students apply physical principles learned in first-year physics to study life, from the atomic level to cellular and organism scales. Topics include biomechanics with an introduction to kinesiology, transport of energy and materials in biological systems with an introduction to diffusion and motion in dissipative media, bio-fluid with an introduction to the cardiovascular system, the elastic properties of biological material and biopolymers like DNA, and the electric properties of biomaterial with an introduction to the nervous systems. Note: Students considering future enrolment in 300-level or higher PHYS (p. 1) courses are strongly encouraged to take MATH 114 (or both MATH 114 and one of MATH 120 or MATH 125) to satisfy the mathematics requirement.
*Prerequisites: A minimum grade of C- in one of PHYS 126, PHYS 146, or CHEM 102, and one of MATH 114, MATH 120, or MATH 125; BIOL 107 is recommended.*

**PHYS 252**
**Physics of the Earth**
**3 Credits Weekly (3-0-0)**
What can we learn about our planet from an earthquake, a meteorite impact, or an explosion? How can we use the basic concepts of physics to explain complicated planetary processes that shape the earth? In this course, we'll learn how to apply basic mechanics, electricity and magnetism, waves, and/or thermodynamics principles to the physical processes that guide more complex studies in geophysics, geomagnetism, atmospheric physics, and oceanography. Note: Students considering future enrolment in 300-level or higher PHYS (p. 1) courses are strongly encouraged to take MATH 114 (or both MATH 114 and one of MATH 120 or MATH 125) to satisfy the mathematics requirement.
*Prerequisites: A minimum grade of C- in PHYS 126 or PHYS 146, and in EASC 101, and one of MATH 114, MATH 120, or MATH 125.*

**PHYS 261**
**Physics of Energy**
**3 Credits Weekly (3-0-0)**
This course first identifies the various forms of energy consumed by modern society. The conversion of energy is traced from natural resources to usable forms considering both the fundamental laws of thermodynamics and the practical concerns of cost and environmental consequences. Next, the benefits and drawbacks of non-renewable energy sources such as fossil fuels and nuclear power are discussed and compared to renewable sources such as hydroelectric and solar power. Finally, the development of alternative energy resources is discussed.
*Prerequisites: Minimum grade of C- in one of PHYS 109, PHYS 126 or PHYS 146.*

**PHYS 301**
**Nuclear Physics**
**3 Credits Weekly (3-0-0)**
This course is a study of the fundamental nuclear properties, the shell model, the collective model, stability of nuclei, isotopes, radioactive decay, nuclear reactions, kinematics, conservation laws, nuclear fission and fusion, nuclear reactors, particle accelerators, detectors, a brief introduction to particle physics and the Standard Model. The course also includes applications such as carbon dating, tracer techniques, cancer therapy and connections to astrophysics.
*Prerequisites: Minimum grade of C- in PHYS 208 and MATH 115.*

**PHYS 302**
**An Introduction to Particle Physics**
**3 Credits Weekly (3-0-0)**
What is the Universe made of at its smallest scale? From the humble electron to the massive Higgs boson, we follow the progress of the Standard Model as it classifies the myriad subatomic particles by their interactions and symmetries. Students apply the techniques of quantum mechanics and Feynman diagrams to calculate the properties of matter.
*Prerequisites: A minimum grade of C- in PHYS 200, PHYS 208, and MATH 115.*

**PHYS 308**
**An Introduction to Semiconductors and Superconductors**
**3 Credits Weekly (3-0-0)**
This course builds on PHYS 208 to provide students with a detailed understanding of the behaviour of condensed matter arising from the quantum nature of many particle systems at the microscopic level. Starting with probability distribution functions for classical thermodynamic systems, the theory is extended to quantum mechanical systems leading to a description of lasers. These tools allow the construction of models that explain the features of inter-atomic bonds, molecular spectra and the emergent properties of solids such as electrical conductivity, semiconductivity and superconductivity.
*Prerequisites: Minimum grades of C- in PHYS 208 and MATH 115.*

**PHYS 320**
**Origin of the Elements**
**3 Credits Weekly (3-0-0)**
Biology, chemistry, and earth sciences all study processes involving chemical reactions. But where do we get the elements in atoms, molecules, and compounds? This course studies the origin and evolution of the matter in the universe. Based on the current theories, the universe started with the Big Bang, created lighter elements such as hydrogen, helium, and lithium at early stages. The transmutation of these elements into heavier forms is then traced by examining the gravitational collapse of interstellar clouds that leads to stellar formation. The endpoint of this sequence, namely the production of new elements (nucleosynthesis) at the cores of stars and as a result of supernova events is discussed. During the course we also examine the suitable environments where the interaction of atomic material leads to the formation of complex compounds, molecules, and even the fundamental building blocks of life. Note: ASTR 122 is recommended.
*Prerequisites: Minimum grade of C- in any one of PHYS 208, 224, 244, and in MATH 115 and CHEM 102.*

**PHYS 324**
**Origins of Planetary Systems**
**3 Credits Weekly (3-0-0)**
Are we alone in the universe? If not, how would we know? This course focuses on discovery methods for extrasolar planets, how the Earth and the other planetary bodies in our solar system were formed, and compares the planets in our solar system with those planets found around other stars in the Milky Way galaxy. During this course, three compelling questions will be addressed: "How common are Earth-like planets, are other planetary systems similar to ours, and what types of extrasolar planets would be suitable for life ?"
*Prerequisites: A minimum grade of C- in PHYS 224 or PHYS 244, or in both EASC 206 and MATH 114.*

**PHYS 330**
**Statistical Mechanics and Thermodynamics**
**3 Credits Weekly (3-0-0)**
This course develops the laws of thermodynamics from a statistical perspective. Assuming a simple model for small-scale interactions between individual particles, the statistical representation of systems with a large number of such particles is constructed using simple probability theory. The rules governing how such systems evolve with time are discussed in terms of how they lead to the laws of thermodynamics. Additional applications of these tools is also discussed. Note: completion of PHYS 244 is recommended before taking this course.
*Prerequisites: A minimum grade of C- in MATH 115, PHYS 208, and PHYS 224.*

**PHYS 332**
**Computational Physics**
**3 Credits Weekly (3-3-0)**
This course introduces students to computational techniques used in physics. Topics include basic computational principles, differentiation and integration, ordinary and partial differential equations, matrix manipulation, variational techniques and stochastic methods, with application to physical systems in mechanics, heat and thermodynamics, waves, electromagnetism, quantum mechanics, condensed matter, geophysics, and biophysics.
*Prerequisites: Minimum grades of C- in MATH 115 and any two of PHYS 208, PHYS 224, PHYS 226, PHYS 244, PHYS 250, or PHYS 252.*

**PHYS 372**
**Quantum Mechanics**
**3 Credits Weekly (3-0-0)**
How do the foundational ideas of quantum mechanics blossom into the formal equations that physicists use to describe atomic systems? This course begins with the wave function and its physical interpretation. The Schrödinger equation is solved for free particles and one-dimensional potentials. Once the model becomes highly developed, solutions are extended to three-dimensional systems with orbital angular momentum. Practical applications of quantum mechanics are discussed. Course changed from PHYS 472.
*Prerequisites: Minimum grades of C- in MATH 115 and one of PHYS 208, PHYS 224, or PHYS 244.*

**PHYS 390**
**Advanced Physics Laboratory**
**3 Credits Weekly (0-4-0)**
This laboratory course introduces students to advanced experiments and analytical methods in physics. Methods of experimental design, experimental techniques, and error analysis are discussed. Students apply these methods to experiments selected from classical and modern physics.
*Prerequisites: Minimum grades of C- in PHYS 208 and in one of PHYS 200, PHYS 224, PHYS 226, PHYS 244, PHYS 250, or PHYS 252.*

**PHYS 398**
**Independent Study**
**3 Credits Total (0-0-72)**
This course permits an intermediate-level student to work with a faculty member to explore a specific topic in depth through research or through directed reading in primary and secondary sources. The student plans, executes and reports the results of their research or study project under the direction of a faculty supervisor. To be granted enrollment in the course, the student must have made prior arrangements with a faculty member willing to supervise his or her project. This course can be taken twice for credit.

**PHYS 495**
**Special Topics in Physics and Astrophysics**
**3 Credits Weekly (3-0-0)**
In this course, students examine one or two topics of specialization in physics and/or astrophysics in-depth. Topics can vary with the interests of students and the instructor. Consultation with the department is required prior to registration.
*Prerequisites: Consent of the department.*

**PHYS 498**
**Advanced Independent Study**
**3 Credits Total (0-0-72)**
This course permits a senior-level student to work with a faculty member to explore a specific topic in depth through research or through directed reading in primary and secondary sources. The student plans, executes and reports the results of their research or study project under the direction of a faculty supervisor. To be granted enrollment in the course, the student must have made prior arrangements with a faculty member willing to supervise his or her project. This course can be taken twice for credit. Consent of Department required.