PHYS – PHYSICS

PHYS 020
Physics 20
5 Credits
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
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
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
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
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
This is a calculus based physics course intended for students in the physical 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. NOTE: Credit can only be obtained in one of PHYS 108, PHYS 124, PHYS 144, or ENPH 131.
Prerequisites: Mathematics 31, Mathematics 30-1 and Physics 30.

PHYS 146
Electromagnetism
3 Credits
This is a calculus-based physics course on electromagnetism intended for students in physical 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. NOTE: Credit can only be obtained in one of PHYS 109, PHYS 126, or PHYS 146.
Prerequisites: A minimum grade of C- in PHYS 144.

PHYS 200
Introduction to Relativity
3 Credits
This course explains Einstein's Special Theory of Relativity and includes brief introduction to general relativity. First, the limitations of classical physics are examined. These shortcomings are then addressed by the special theory of relativity. The student learns to use the theory to calculate time and length intervals in fast moving reference frames. The theory is further applied to describe the Doppler effect, the twin paradox and the conservation of relativistic energy and momentum. The course concludes with a brief introduction to the general theory of relativity, curved spacetime and black holes.
Prerequisites: A minimum grade of C- in one of PHYS 109, PHYS 126 or PHYS 146, and in MATH 114.

PHYS 208
Quantum Aspects of Physics
3 Credits
This course begins with the experimental evidence leading to the development of quantum mechanics, including the photoelectric effect, the Compton effect, X-ray production and electron diffraction. Further topics include a discussion of the Heisenberg uncertainty principle and the Schrödinger theory of quantum mechanics, one dimensional potential wells and barriers, tunneling, the simple harmonic oscillator, atomic physics, the hydrogen atom and the periodic table. In the laboratory component of the course, students reproduce the details of various classical experiments leading to the discovery of the quantum nature of matter and light.
Prerequisites: Minimum grade of C- in PHYS 109, PHYS 126, or PHYS 146, and in MATH 113 or MATH 114.

PHYS 212
Revolutions in Physics: The Structure of the Universe
3 Credits
This course traces the development of our understanding of the physical universe from ancient to modern times. Students examine the nature of physics, its historical development, the development of physical theories, and the nature of scientific questions and answers. The focus of the course is epistemological aspects of physics rather than on systematic formulization and problem solving.
Prerequisites: Minimum grade of C- in one of PHYS 109, PHYS 126 or PHYS 146.

PHYS 224
Fluids and Heat
3 Credits
Students learn the basic thermal properties of matter as well as properties of fluids. Topics include the static and dynamic behaviour of fluids, temperature, thermal expansion, ideal gas laws, thermal energy, specific and latent heats, calorimetry, heat transfer, thermal processes, the Carnot engines, refrigerators, and the laws of thermodynamics. Other topics include the kinetic theory of gases, mean free path, the laws of probability and statistical physics, enthalpy and entropy. In the laboratory component of the course, students investigate the physical properties of fluids and the thermal properties of matter.
Prerequisites: A minimum grade of C- in one of PHYS 109, PHYS 126, or PHYS 146 and in MATH 114.

PHYS 226
Optics and Sound Waves
3 Credits
Students learn the basic principles of wave mechanics. Topics include simple harmonic motion, mechanical waves, sound waves, geometrical and physical optics. Students are introduced to applications such as microscopes, telescopes, Doppler radar, spectrometers, holograms, seismic waves and molecular vibrations. Advanced topics including matter waves and quantum properties of light is discussed. In the laboratory component of the course, students investigate the physical principles of mechanical waves, sound and light.
Prerequisites: A minimum grade of C- in PHYS 109, PHYS 126, or PHYS 146, and in MATH 114.

PHYS 242
Physics of Planetary Exploration
3 Credits
Students study the physical principles that govern the design of interplanetary missions within the Solar System. Topics include Newton's Universal Law of Gravity, Kepler's Laws of Planetary Motion, orbital elements, and the planning of transfer orbits between planets. Further topics include past, present, and future space missions and the operating principles of spacecraft instrumentation and sensors.
Prerequisites: A minimum grade of C- in one of PHYS 109, PHYS 126, or PHYS 146, and in MATH 114.

PHYS 244
Mechanics
3 Credits
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: A minimum grade of C- in one of PHYS 109, PHYS 126, or PHYS 146, and a minimum grade of C- in MATH 114, and in MATH 120 or MATH 125.

PHYS 250
Introduction to Biophysics
3 Credits
In this course students apply physical principles learned in first year physics to biological problems. Topics such as biomechanics with an introduction to kinesiology; and 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: BIOL 107 is recommended.
Prerequisites: A minimum grade of C- in PHYS 109, PHYS 126, PHYS 146, or CHEM 102, and in MATH 114.

PHYS 252
Physics of the Earth
3 Credits
In this course students apply basic mechanics, electricity and magnetism, waves, and thermodynamic principles to planetary processes, with a focus on the Earth, leading to an understanding of the basic physical principles guiding the studies of geophysics, geomagnetism, atmospheric physics and oceanography.
Prerequisites: A minimum grade of C- in PHYS 109, PHYS 126, or PHYS 146, and in EASC 101, and in MATH 114.

PHYS 255
Introduction to Robotics
3 Credits
This course offers an introduction to basic concepts in robotics focusing on perception of the environment, locomotion, movement and pathway planning, power management, sustainable energy sources, control, and decision making. Students apply concepts learned through multidisciplinary projects in a laboratory setting.
Prerequisites: A minimum grade of C- in one of PHYS 109, PHYS 126, or PHYS 146.

PHYS 261
Physics of Energy
3 Credits
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
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
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: Minimum grade of C- in PHYS 200, PHYS 208 and MATH 115.

PHYS 308
An Introduction to Semiconductors and Superconductors
3 Credits
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 grade of C- in PHYS 208 and MATH 115.

PHYS 320
Origin of the Elements
3 Credits
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
This course focuses on how the Earth and the other planetary bodies in our solar system were formed, and makes comparisons between the planets in our solar system and those planets found around other stars in the Milky Way galaxy. During this course, two compelling questions will be addressed: "How common are Earth-like planets and are other planetary systems similar to ours and, if not, why not?"
Prerequisites: A minimum grade of C- in PHYS 224 or in PHYS 244 or a minimum grade of C- in both EASC 206 and either MATH 113 or MATH 114.

PHYS 330
Statistical Mechanics and Thermodynamics
3 Credits
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
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 grade of C- in MATH 115, and in any two of PHYS 208, PHYS 224, PHYS 226, PHYS 244, PHYS 250 or PHYS 252.

PHYS 372
Quantum Mechanics
3 Credits
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 grade of C- in PHYS 208 and PHYS 244.

PHYS 390
Advanced Physics Laboratory
3 Credits
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 grade 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
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
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
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.