

SCIENCE COURSES FOR NON-SCIENCE MAJORS

- ❖ Not all courses listed below will necessarily be offered every academic year.
- ❖ All courses listed below are three lecture hours per week or equivalent, unless otherwise stated. In addition, laboratory/tutorial time may be scheduled as required.
- ❖ *Note:* Most Computer Science courses require substantial time out of class in writing, correcting, and testing computer programs. Students should be prepared to devote a minimum of three to five hours a week per course to assignment work alone.

1ST YEAR COURSES

INTEGRATIVE BIOLOGY

BIOL-1013. Organisms and the Environment

Organisms interacting with other organisms and with their physical environment. Ecological impacts of human activity. This course is offered on-campus and as a distance course. (Intended for non-majors and students requiring preparation for BIOL-1111 and BIOL-1101.)(Not counted for credit in any Faculty of Science program.) (2 lecture hours a week.)

BIOL-1101. Cell Biology

Examination of the principles governing living systems, with emphasis on the molecular and cellular basis of life, molecular genetics, energetics, differentiation, and development. (Grade 12 "U" Biology or equivalent, or BIOM-1003 and BIOL-1013 are strongly recommended) (3 lecture, 3 laboratory hours a week.)

BIOL-1111. Biological Diversity

Principles governing living systems; the origins and diversity of life; evolution, reproduction, and heredity; the structure and function of viruses through plants and animals; basic principles of ecology. (Grade 12 "U" Biology or equivalent, or BIOM-1003 and BIOL-1013 are strongly recommended) (3 lecture, 3 laboratory hours a week.)

BIOMEDICAL SCIENCES

BIOM-1003. Biology of Organisms

Properties of living organisms from the level of the cell through tissues, organs and organ systems, genetics, to the functioning, integrated organism. This course is offered on-campus and as a distance course. (Intended for non-majors and students requiring preparation for BIOL-1111 and BIOL-1101) (Not counted for credit in any Faculty of Science program.) (2 lecture hours a week.)

CHEMISTRY

CHEM-1000. Introduction to Chemistry

This course stresses fundamental principles of chemistry, and is intended for students lacking SCH4U or equivalent, or requiring additional preparation for CHEM-1100 (General Chemistry I), CHEM-1103 (Topics in General Chemistry) and BIOC-1303 (Organic and Biological Chemistry for Health Sciences) . Topics include: basic atomic theory, the periodic table, stoichiometry, properties of gases and liquids, acid-base concepts and chemical equilibria, organic and polymer chemistry. This course can serve as a prerequisite for CHEM-1100, but may not be taken for credit in any Science program. (4 lecture hours and 2 tutorial hours per week; or 3 lecture hours and 1 tutorial hour) (Students who first completed CHEM-1100 may not subsequently enroll in CHEM-1000.)

CHEM-1003: Alchemy to Chemistry: Science Through the Ages

Science and technology shape the world in which we live. Nevertheless, sometimes the societal impact of scientific breakthroughs is not realized for a generation or more. In this course, key scientific discoveries and developments will be examined and discussed through the lens of a Chemist. Starting with the “ancients”, the course works through time to the present looking at how theories and the scientific method has developed and evolved over time. The course will focus on topics pertaining to chemistry, the science of substances and interactions. (It may be taken by Science students for credit, but does not count as a Science option towards the fulfilment of the specified requirements for a Science degree.) (3 lecture hours per week)

CHEM-1100. General Chemistry I

Introductory concepts in chemistry, including reactions of atoms, ions, and molecules, solution stoichiometry, thermochemistry, electronic structure of atoms, basic chemical bonding and molecular geometry, periodic properties of the elements, and the theory of gases. (Prerequisite: Grade 12“U” Chemistry or equivalent (CHEM-1000), or consent of the instructor.) (3 lecture, 3 laboratory/tutorial hours a week.)

CHEM-1103. Topics In General Chemistry

An introduction to selected topics in modern chemistry for engineering: atomic and molecular structure, properties of matter and the periodic table, macroscopic chemical systems, stoichiometry, properties of the equilibrium state and applications to thermochemistry and electrochemistry. (Prerequisite: Grade 12“U” Chemistry or equivalent.) (3 lecture, 3 laboratory hours a week.)

CHEM-1110. General Chemistry II

A continuation of CHEM-1100 covering topics such as chemical kinetics, general equilibrium theory, acid-base theory, chemical thermodynamics, and introduction to organic chemistry. (Prerequisite: CHEM-1100.) (3 lecture, 3 laboratory/tutorial hours a week.)

COMPUTER SCIENCE: COURSES**COMP-1047. Computer Concepts for End-Users**

Introduction to the concepts of operation of a computer system, including hardware and software. Development of conceptual understanding of word processors, databases, spreadsheets, etc., and practical experience with their use. Networking concepts and data communication concepts will be introduced. The Internet will be introduced with students having access to internet resources. Management information systems including the systems development lifecycle will be discussed. Fundamental concepts of algorithm development and programming will be introduced. Hands-on experience with microcomputers as well as a distributed-computing environment will be involved. In addition to lecture time, laboratory/tutorial time may be scheduled as required. (May not be used to fulfill the major requirements of any major or joint major in Computer Science.) (3 lecture hours)

COMP-1400. Introduction to Algorithms and Programming I

This course is the first of a two-course sequence designed to introduce students to algorithm design and programming in a high-level language such as C. The main objectives of the course are to develop the ability to identify, understand and design solutions to a wide variety of problems. Topics include: computer system overview, hardware and software, problem solving steps, concepts of variables, constants, data types, algorithmic structure, sequential logic, decisions, loops, modular programming, one-dimensional arrays, text files. If possible, problems like searching/sorting will be addressed. (3 lecture hours and 1.5 laboratory hours a week)

ECONOMICS: COURSES

ECON-1100. Introduction to Economics I

An introduction to microeconomics intended to provide students with the tools necessary to begin to understand and evaluate how resources are allocated in a market economy. Specific topics include how markets function, theories of the business firm, of consumer behaviour and of income distribution. The economic roles of labour unions and government are also covered. The theories are applied to contemporary Canadian economic problems.

ECON-1110. Introduction to Economics II

This course is an introduction to macroeconomics. The emphasis is upon measuring and explaining what determines economic aggregates such as the total national product (GDP) and the level of prices and employment. The role of money and financial institutions, the impact of international trade and the policy options available to governments for coping with inflation and unemployment are discussed in detail.

ENVIRONMENTAL SCIENCE

ESCI-1000. Natural Hazards and Disasters

The Earth's component systems and their interrelationships. Earth hazards and the Earth's interior processes: volcanism and earthquakes. Hazards and surface processes: landslides and floods. Atmospheric hazards: storms, hurricanes and tornadoes. (May be taken by Science students for credit, but does not count as a Science option towards the fulfillment of the specified requirements for a Science degree). (2 lecture hours per week)

ESCI-1010. Our Changing Earth

Origin of the universe and solar system; focus on the Earth and moon; earliest life forms. Measurement of geological time. Global climatic change in geological history; drifting continents; deserts, floods and ice sheets. Fossils and evolution; extinctions and probable causes. Human evolution and migrations; early technologies. (May be taken by Science students for credit, but does not count as a Science option towards the fulfillment of the specified requirements for a Science degree). (2 lecture hours a week)

ESCI-1020. Introduction to Planetary Science

An introduction to the origin of the Universe and Solar System. Topics include: the Big Bang theory; origin and organization of matter; and formation of galaxies, nebulae, stars, and planetary systems. The focus is on the geological features of planets, moons, asteroids, and comets. Coverage includes historical perspectives and current theory on astronomy, measurement of the ages of the Universe and Solar System, space exploration, Moon and Mars missions, analyses of NASA satellite images, the origin and evolution of life in the Solar System, and the search for possible extra-terrestrial life and intelligence in the Universe. (May be taken by Science students for credit, but does not count as a Science option towards the fulfillment of the specified requirements for a Science degree.) (3 lecture hours a week.)

ESCI-1120. Introduction to Geomorphology

The landscapes of the earth, with particular reference to the glaciers, coastlines, rivers, and northern permafrost regions of Canada. (3 lecture hours a week.)

ESCI-1130. Atmosphere and Climate

An introduction to the atmosphere and the basic principles of meteorology and climatology. Topics include weather systems, atmospheric pollution and inadvertent climate modification, climate change and relationships between climate and living organisms. (3 lecture hours a week.)

ESCI-1141 Cartography and Digital Mapping

This introductory course focuses on the key elements of map design, representation of spatial data and map interpretation. Topics will include-projections, datums and coordinate reference systems, scale properties and unit calculations, map symbology and map accuracy. Different mapping approaches, such as choropleth, isoline and dot mapping will be utilized throughout the course. Web-based mapping will be introduced. Maps will be designed, generated, and interpreted using paper-based media and modern cartographic software in a laboratory setting. (2 lecture, 2 laboratory hours a week.)

ENVIRONMENTAL STUDIES

ESTU-1100. Humans and the Environment - An Introduction to Environmental Studies

Humans use energy and resources from our natural surroundings to live, and to develop our societies and cultures. This use has an impact on other animals and plants, and on the air, water, and land. Our impact is now so great that we are in danger of depleting or destroying many of the natural systems on which we depend. This course will examine our relationship with, and impact on, the environment, with reference to the physical, cultural, economic, political, and ethical elements. Sustainable practices will also be discussed. Topics may include: human sustainability and population growth, aquatic and terrestrial sustainability, food and agriculture, water resources, energy production, and climate change. (Can be taken as a Social Science option) (Three lecture hours per week)

FORENSIC SCIENCE: COURSES

FRSC-1107. Introductory Crime Scene Investigation

This course will introduce students to the theoretical background of scientific methods used in Forensic Sciences and their practical applications to crime scene investigation within the multidisciplinary Forensic fields. The focus of the course is exploration and examination of evidence found at crime scenes. The students learn the discovery, identification, collection, examination and processing of various types of Forensic evidence.

PHYSICS: COURSES

PHYS-1000. Introduction to Astronomy I

The solar system with emphasis on the results of recent space exploration. This is a descriptive course suitable for the non-scientist. (May be taken by B.Sc. students for credit, but does not count as a Physics course or other science course towards the fulfillment of the requirements for the B.Sc. degree.) (2 lecture hours a week.)

PHYS-1010. Introduction to Astronomy II

The stars, galaxies, including pulsars, black holes, and quasars. Current theories of the structure of the universe will be discussed. This is a descriptive course suitable for the non-scientist. (May be taken by B.Sc. students for credit, but does not count as a Physics course or other science course towards the fulfillment of the requirements for the B.Sc. degree.) (2 lecture hours a week.)

PHYS-1300. Introductory Physics for Life Sciences I

This is an algebra-based course intended for students interested in the biological or health sciences, or related disciplines. The topics covered include the basic mechanical concepts of force, work and energy, properties of matter, and heat, with examples and applications drawn from the modeling of biological systems. (Prerequisites: one 4 "U" or OAC mathematics course or equivalent.) (3 lecture hours a week, 2 laboratory hours and 1 tutorial hour every week) (Anti-requisites: PHYS-1305, PHYS-1400.) (Open to students in Human Kinetics, Forensic Science, Bachelor of Arts and Science, and all programs within in the Faculty of Science; exceptions only with the permission of the Head or designate.)

PHYS-1305. Introductory Physics for Life Sciences I (B)

This is an algebra-based course intended for students interested in the biological or health sciences, or related disciplines. The topics covered include the basic mechanical concepts of force, work and energy, properties of matter, and heat, with examples and applications drawn from the modeling of biological systems. This course serves as the prerequisite for PHYS-1400 and GENG-1110. Majors in Science and Majors in Engineering will not be given credit for this course. (Antirequisite: PHYS-1300.) (Prerequisites: One 4U or OAC mathematics course or equivalent.) (3 lecture hours a week.)

PHYS-1310. Introductory Physics for Life Sciences II

This course is a continuation of PHYS-1305 intended for students interested in the biological or health sciences, or related disciplines. The topics covered include wave motion, sound, electricity and magnetism, light, and an

introduction to topics in modern physics involving the life sciences such as the quantum nature of radiation and its interaction with biomolecules, high energy radiation and radioactivity, and the statistical treatment of data. (Prerequisite: PHYS-1300 or PHYS-1400.) (3 lecture hours per week, 1 tutorial hour and 2 laboratory hours every week.) (Antirequisites: PHYS-1410.) (Open to students in Human Kinetics, Forensic Science, Bachelor of Arts and Science, and all programs within in the Faculty of Science; exceptions only with the permission of the Head or designate.)

PHYS-1400. Introductory Physics I

Mechanics; properties of matter and heat. A calculus-based course. (Prerequisites: Grade 12“U” Advanced Functions and Introductory Calculus or equivalent.) Recommended co-requisite: MATH-1720.) (3 lecture hours a week, 2 laboratory hours and 1 tutorial hour every week). Open to students in Human Kinetics, Forensic Science, Bachelor of Arts and Science, , and all programs within in the Faculty of Science; exceptions only with the permission of the Head or designate. (Antirequisites: PHYS-1300, PHYS-1305.)

PHYS-1410. Introductory Physics II

Wave motion, sound, electricity and magnetism, light, and modern physics. (Prerequisite: PHYS-1400 or GENG-1110.) (3 lecture hours per week, 1 tutorial hour and 2 laboratory hours every week.) (Antirequisites: PHYS-1310) (Open to students in Engineering, Human Kinetics, Forensic Science, Bachelor of Arts and Science, and all programs within in the Faculty of Science; exceptions only with the permission of the Head or designate.)

PHYS-1500. From Symmetry to Chaos in the Universe: An Introduction to Theoretical Methods in Contemporary Physics

An introduction to the pillars of 20th and 21st century physics which form the basis of subsequent courses in physics and the basis of current research: complexity and chaos, special and general relativity, quantum phenomena, symmetry and symmetry breaking, and cosmology. Motivated by these pillars, mathematical tools and techniques that are used extensively in physics for practical problem solving and data analysis are introduced at a first-year level. Computer-aided graphical and approximate computational methods will also be introduced. (Prerequisites: PHYS-1400, MATH-1720, and MATH-1250) (3 lecture hours and one tutorial hour per week.)

MATHEMATICS COURSES

MATH-1020. Mathematical Foundations

This course will cover mathematical logic, proof methods and development of proof techniques, mathematical induction, sets, equivalence relations, partial ordering relations and functions. (Prerequisite: One of COMP-1000, MATH-1250, MATH-1260 or MATH-1270.) (2 lecture hours, 2 tutorial hours per week.)

MATH-1250. Linear Algebra I

This course will cover linear systems, matrix algebra, determinants, n-dimensional vectors, dot product, cross product, orthogonalization, eigenvalues, eigenvectors, diagonalization and vector spaces. (Prerequisites: Both Ontario Grade 12 Advanced Functions (MHF4U) and Calculus and Vectors (MCV4U) or MATH-1280.) (Antirequisites: MATH-1260, MATH-1270.) (3 lecture hours, 2 tutorial hours per week.)

MATH-1260. Vectors and Linear Algebra

This course is for students without Ontario Grade 12 Calculus and Vectors (MCV4U). The course MATH-1250 is for students with MCV4U. This course will cover vectors, three-dimensional geometry, linear systems, matrix algebra, determinants, n- dimensional vectors, dot product, cross product, orthogonalization, eigenvalues, eigenvectors, diagonalization and vector spaces. (Prerequisite: Ontario Grade 12 Advanced Functions (MHF4U).) (Antirequisites: MATH-1250, MATH-1270.) (4 lecture hours, 2 tutorial hours per week.)

MATH-1270. Linear Algebra (Engineering)

This course will cover linear systems, linear transformations, matrix algebra, determinants, vectors in R_n , dot product, orthogonalization, diagonalization, eigenvectors and eigenvalues, in the context of and with an emphasis on a broad range of applications in Science and Engineering. (Prerequisite: MATH-1280 or both Ontario Grade 12 Advanced Functions (MHF4U) and Calculus and Vectors (MCV4U)) (Antirequisite: MATH-1250, or MATH-1260.) (3 lectures hours, 1 tutorial hour per week.)

MATH-1280. Access to Linear Algebra

This course will cover matrix algebra, linear systems, vectors, lines and planes in three-dimensional space, equations and inequalities in one variable and linear relations. This course serves as the prerequisite for MATH-1250 and MATH-1270. Majors in Science and majors in Engineering will not be given credit for this course. (3 lecture hours, 1 tutorial hour per week.)

MATH-1720. Differential Calculus

This course will cover trigonometric functions and identities, inverse trigonometric functions, limits and continuity, derivatives and applications, mean value theorem, indeterminate forms and l'Hôpital's rule, antiderivatives and an introduction to definite integrals. This course is for students who have taken both Ontario Grade 12 Advanced Functions (MHF4U) and Ontario Grade 12 Calculus and Vectors (MCV4U). Students who do not have credit for MCV4U should take MATH-1760. (Prerequisites: Ontario Grade 12 Advanced Functions (MHF4U) and Ontario Grade 12 Calculus and Vectors (MCV4U) or MATH-1780.) (Antirequisite: MATH-1760.) (3 lecture hours, 2 tutorial hours per week.)

MATH-1730. Integral Calculus

This course will cover antiderivatives, the definite integral and the fundamental theorem of calculus, techniques of integration, applications, improper integrals, sequences and series, convergence tests, power series, Taylor and Maclaurin series, and polar and parametric coordinates. (Prerequisite: MATH-1760 or MATH-1720.) (3 lecture hours, 1 tutorial hour per week.)

MATH-1760. Functions and Differential Calculus

This course will cover a review of functions, trigonometric functions and identities, transcendental functions, inverse trigonometric functions, introduction to limits, continuity, derivatives and applications, mean value theorem, indeterminate forms and l'Hôpital's rule, antiderivatives and an introduction to definite integrals. This course is for students who have taken Ontario Grade 12 Advanced Functions (MHF4U), but have not taken Ontario Grade 12 Calculus and Vectors (MCV4U). Students who have credit for MCV4U should take MATH-1720. The course is equivalent to MATH-1720 for all prerequisite purposes. (Prerequisite: Ontario Grade 12 Advanced Functions (MHF4U).) (Antirequisite: MATH-1720.) (4 lecture hours, 2 tutorial hours per week.)

MATH-1780. Access to Differential Calculus

The course will cover straight lines, relations and functions, trigonometric functions, limits, derivatives, curve sketching, equations and inequalities, transformations, symmetry, exponential and logarithmic functions. This course serves as the prerequisite for MATH-1720 and MATH-1760. Majors in Science, majors in Engineering and students with at least 70% in Ontario Grade 12 Advanced Functions (MHF4U) will not be given credit for this course. (Antirequisites: MATH-1760, or MATH-1720) (3 lecture hours, 1 tutorial hour per week.)

MATH-1980. Mathematics for Business

An introduction to concepts and techniques of mathematics useful in business situations. Topics include mathematical modeling of qualitative scenarios, linear simultaneous equations, inequalities, exponential and logarithmic functions, graphical linear programming, and probability. This course is intended for students in Business Administration. May not be taken for credit in any program within the Faculty of Science or the Faculty of Engineering. (Prerequisite: Any grade 12 "U" math course, or MATH-1780.) (3 lecture hours, 1 tutorial hour per week.)

2ND YEAR COURSES (This is for those student who like to continue elective from the same field/program of previous 1st year elective selection)

INTEGRATIVE BIOLOGY: COURSES

BIOL-2040.Human Physiology I

Introduction to human physiology: a systems approach. Topics include homeostasis and feedback control, enzymes and energy, membrane transport, metabolism, and the nervous, skeletal muscle, and cardiovascular systems. This course is offered on-campus and a distance course. (Prerequisites: any two first year biology courses.) (3 lecture hours a week.)

CHEMISTRY

CHEM-2003. Chemistry in the Marketplace

The basic notions of chemistry will be introduced and discussed in a qualitative manner with a view to understanding chemistry and materials encountered in everyday life. The course will provide an appreciation for the ubiquitous nature and importance of chemicals and chemical processes. Discussion will include a variety of topics such as chemistry in the home, plastics, drugs, cosmetics, biotechnology, chemistry and computer technology, nuclear power and pollution. The course is intended for students with no formal background in chemistry. (Not open to first-year students or students in any Science program. May not be used for credit in any Science program.) (2 lecture hours a week.)

PHYSICS

PHYS-2000. The Exoplanet Revolution

This course will examine the development and evolution of our understanding of the nature and origins of planetary systems before and after the discovery of the first exoplanets. Students will learn about the various methods used to detect and measure exoplanets, and will actively engage in the analysis of data collected through remote off-site telescopes. The course will include a review of recent discoveries regarding the different classes of planets that exist and their characteristics and origins. It will also look more closely at planets found in the habitable zones around their stars and the conditions that exist there, particularly in planetary atmospheres. Finally, it will review the latest developments in new telescope technologies and space missions and what their capabilities should allow astronomers to discover in coming years. (Prerequisite: PHYS-1000 or PHYS-1010.) (May be taken by B.Sc. students for credit, but does not count as a Physics course or other science course towards the fulfillment of the requirements for the B.Sc. degree.) (3 lecture hours a week.)

PHYS-2050.Physics and Society-The Past

Discoveries in astronomy have altered the way we perceive ourselves, our planet, and our place in the universe. This course, 'From Antiquity to Newton', reviews the contributions made by the Egyptians, Babylonians, Greeks, and Islamic cultures, together with medieval Christian views and on to the emergence of modern science. The course - which is a blend of physics, history, philosophy and religion - will also examine how we came to move from 'geocentric' to a 'heliocentric' view of the solar system, by examining the contributions of Copernicus, Brahe, Kepler, Galileo and Newton. (2 lecture hours a week.) Does not count towards the major requirements for a degree in the Department of Physics.

PHYS-2060.Physics and Society-The Present

Modern society is dominated by the dramatic development of physics and technology from the industrial revolution to the present. This development and its impact on society are explored in the course. A number of topics of current interest such as, nuclear energy, world energy supplies, pollution, global warming, climate change, and possible solutions to the energy crisis are discussed in detail. This course gives students who are majoring in the arts, humanities, business, law, and biomedical sciences an introduction to modern ideas in Physics and to see how these ideas affect our day-to-day lives. (2 lecture hours a week.) Does not count towards the major requirements for a degree in the Department of Physics.

PHYS-2200.EM Fields and Photons

Electrostatic fields and potentials. Charges and capacitance. Currents and conduction in solids. Magnetic fields; induction; introduction to Maxwell equations, electromagnetic waves, and photons; the photoelectric effect. (Prerequisite: PHYS-1410 or equivalent.) (3 lecture, 3 laboratory hours a week.)

PHYS-2250. Optics

Geometrical optics: review of laws of reflection and refraction; lenses and mirrors (matrix optics); stops, optical systems, aberrations. Introduction to wave optics; interferometry, diffraction, polarization, Fresnel equations, elements of dispersion theory. (Prerequisites: PHYS-1410 and MATH-1730.) (3 lecture, 3 laboratory hours a week.)

PHYS-2500. Intermediate Mechanics

Classical mechanics at the intermediate (second-year) level: Newton's Laws and consequences – Galilean invariance, conservation theorems, applications to rectilinear motion and motion in two/three dimensions; introduction to noninertial reference frames, particularly in rectilinear motion; driven oscillators with damping; central forces, the Kepler problem; dynamics of rigid bodies – planar motion; special relativity – Lorentz transformations, relativistic kinematics and dynamics. (Prerequisites: PHYS-1410 and MATH-1730, or equivalent; Recommended: PHYS-1500.) (3 lecture hours and 1 tutorial hour per week.)

COMPUTER SCIENCE: COURSES

COMP-2057. Introduction to the Internet

Students will be introduced to the Internet as a global information infrastructure, including fundamental concepts in protocols and services, packaging of data, and data transmission. Common tools and multimedia such as HTML, CSS, and CMS, used for the development of websites will also be introduced. Web page design, quality, accessibility and security issues will be discussed. How Web browsers and search engines work will be demonstrated. Social networks and other current Internet applications will be examined. In addition to lecture time, laboratory/ tutorial time may be scheduled as required. (Prerequisite: COMP-1047 or COMP-2067 or COMP-1400.) (May not be used to fulfill the major requirements of any major or joint major in Computer Science.) (3 lecture hours a week)

COMP-2067. Programming for Beginners

This course introduces fundamental computer programming principles and structured programming concepts, with an emphasis on good programming. Stages of the software development cycles are introduced: analysis, design, implementation, debugging and deployment. May not be used to fulfill the major requirements of any major or joint major in Computer Science.) (3 lecture hours).

COMP-2077. Problem Solving and Information on the Internet

Students will be introduced to logic and critical appraisals including reasoning skills and critical thinking in the computer age. Problem solving and heuristics will be discussed including how to solve problems by coming up with the right strategies. Searching using Boolean logic to pinpoint useful and reliable information will be introduced. Methods for being self-critical and critical of web information in order to perform evaluations will be studied. (Prerequisites COMP-1047 and COMP-2057.) (This course may not be taken to fulfill the major requirements of any major or joint major in Computer Science.) (3 lecture hours a week.)

COMP-2097. Social Media Marketing for End Users

This course provides review, analysis and use of social media and mobile technologies such as Instagram (tm), Facebook (tm), twitter (tm) LinkedIn (tm), texting, and using mobile devices such as laptops, ios (tm) devices, and Android devices. Topics to be covered include: a comprehensive review of available social media and mobile technology, use of social media and mobile technology for sharing of knowledge and for group interaction, security and privacy, ethical principles in social media, methods for analyzing end-user requirements for a social media application, strategies for designing, implementing, and maintaining an ethically-sound social media campaign, and measurement and assessment of social media analytics using industry standard tools and techniques. (This course may not be taken to fulfill the major requirements of any major or joint major in Computer Science.) (3 lecture hours).

ENVIRONMENTAL SCIENCE

ESCI-2010. Geology and the Environment

Effect of geological factors on the environment; pollution of groundwater, ground subsidence, nuclear waste disposal, subsurface disposal of liquid wastes, earthquake prediction and control. This course is designed specifically for the non-scientist. (May not be taken for credit towards a B.Sc. Degree in Environmental Science.) (2 lecture hours a week or equivalent.)

ESCI-2020. Discovering Dinosaurs

The origin, evolution, behaviour, ecology, and extinction of dinosaurs, and how these aspects of dinosaur science are understood through the study of their fossils. How the public perception and scientific interpretation of dinosaurs have changed over time as a result of new discoveries. (3 lecture hours per week)

ESCI-2101. Earth Materials

An introduction to the fundamental properties and characteristics of Earth materials. Topics include the nature of minerals (the principal components of sediments, soils and rocks), and the general chemical, mineralogical and physical characteristics of Earth materials. Coverage includes how geochemical and geophysical methods are used to determine the properties of Earth materials. (2 lecture and 3 laboratory hours/week.)(Prerequisites: ESCI-1111 or ESCI-1100 or consent of instructor.)

ESCI-2131. Introduction to Geochemistry

Introduction to the application of chemical principles to the natural environment. Fundamental concepts in thermodynamics, acid-base equilibria, solubility, reduction-oxidation, organic chemistry, environmental mineralogy, and isotope geochemistry will be discussed in the context of the chemical character of environmental material, and environmental problems. (Prerequisites: CHEM-1100, CHEM-1110.) (3 lecture and/or tutorial hours per week.)

ESCI-2141. Hydrology

Fundamental processes in physical hydrology that control movement and storage of water within a watershed or catchment basin. Components of the water balance (precipitation, interception, infiltration, evapotranspiration, runoff, storage) and their variations in space and time. Theoretical and practical approaches to measurement and forecasting of components and their linkages. Special consideration of snowmelt, streamflow, wetlands, and human impacts. (Prerequisites: one of ESCI-1120, ESCI-1130 or ESCI-1100; and one of SOSC-2500, STAT-2910, or other University-level mathematics or statistics course; or consent of instructor.) (3 lecture, 2 laboratory hours a week.)

ESCI-2201. Climatology

A study of the major climatic elements, with special emphasis on the radiation budget, energy systems, and the hydrological cycle of Earth and the human environment. Climate classification, climatic change, climatological techniques, and aspects of applied climatology also will be examined. (Prerequisites: ESCI-1130.) (2 lecture, 2 laboratory hours a week.)

ESCI-2300. Introduction to Oceanography

Examination of the physical, chemical, geological and biological aspects of the oceans. Topics will include the interconnectedness of global climate, ocean currents, waves and tides, anthropogenic stressors, and their influence on marine biodiversity and ecosystems. (3 lecture hours a week.)

ESCI-2400. Geomorphology

The geological processes operating on or near Earth's surface and the development and evolution of erosional and depositional landforms as a result of glacial ice, permafrost, wind, running water, gravity, waves and tides, and exposure to the atmosphere. (3 lecture hours a week.)

ESCI-2411. Introduction to Petrology

Petrography, textures, composition and classification of igneous and metamorphic rocks. Evolution of magmatic systems. Nature and causes of metamorphism. Relationship between global tectonics and magmatic and metamorphic processes. (Prerequisite: ESCI-2101 or consent of instructor.) (2 lecture, 3 laboratory hours a week.)

ESCI-2421. Soils and Sediments

An introduction to the properties and characteristics of soils and sediments, the materials that cover much of Earth's surface and underlie surface water bodies. Topics include the formation and structure of soils and sediments, and how they are described, classified, and analyzed. Coverage includes the geographic distribution of soils and their importance as an environmental resource. (3 lecture and 2 laboratory hours per week.)

(Prerequisites: ESCI-1111 or ESCI-1100.)

ESCI-2600. Principles of Resource Management

Systems analysis methodologies, scientific theories, ecological approaches, and sustainable resource management principles will be presented to examine the interrelationships governing the availability and cumulative impacts of utilizing both renewable and non-renewable resources. Resource management auditing methods and techniques will be applied for the assessment of several indicators, including carrying capacity, ecological footprints, demographic transition, energy flows, agrosystems, land degradation, air and water quality, deforestation, biodiversity and successional changes. Discussions will also focus on integrative and adaptive resource management techniques and best management practices. (3 lecture hours a week.)

ESCI-2610. Environmental Decision Analysis

Earth systems, including climatic extremes, the industrialized ecosystem; decisions under uncertainty in mineral-resource exploration and development; rational approach to decision making, alternatives to decision analysis; environmental impact assessment and risk management, expert systems approach to environmental problem solving, applications in less developed countries. (3 lecture hours a week.)

ESCI-2620. Environmental Auditing in Mineral Resource Development

Cyclical flow of energy and matter in nature, human interaction with environmental processes, elements of policy analysis; environmental management systems and environmental impact assessment; environmental audit processes, steps in design and delivery; mineral resource development and the audit protocols; from audit to action plan, auditing the audit. (3 lecture hours a week.)

ESCI-2630. Geology and International Development

Aid, international development, and Earth processes; integration of water-resource management, soil conservation and agroforestry; geological hazards in a tropical setting; small-scale mining and conservation of mineral resources; engineering an improved quality of life in developing nations. (May not be taken for credit towards a B.Sc. Degree in Environmental Science.) (2 lecture hours a week or equivalent.)

ESCI-2701. Geospatial Data Collection and Database Design

Geospatial data are continuously being collected in real-time and in large quantities, at different scales and for different purposes. This course will explore fundamental database concepts in non-spatial contexts (entity-relationship model, object-oriented database design) and introduce spatial considerations (geometric objects, topology, connectivity) when creating geodatabases. Methods for building effective relational and spatial databases using modern geospatial and non-geospatial software, as well as query-based languages such as SQL. Data capture equipment and tools, such as UAVs (drones), total survey stations, GPS, and online spatial catalogues (including census, climate, and municipal) will be utilized to collect and import spatial and aspatial data into geodatabases. Data quality and assurance, database management systems and geodatabase enterprise solutions, mining of big spatial data, implications of data sharing, and construction of metadatabases will also be discussed. (Prerequisite: ESCI-1151.) (2 lecture, 2 laboratory hours per week.)

ESCI 2705. Applied Geophysics

Fundamental physical properties and parameters of matter, including density, conductivity, radioactivity, magnetism, dielectric constant and seismic velocity. Theory and principles of geophysical techniques used to assess and monitor near-surface variations in physical properties, including resistivity imaging, electromagnetic mapping, magnetometry, ground penetrating radar, and seismic imaging. Applications will focus on environmental problems, but may include geological, forensic, and archaeological studies. May be offered as a full-time two-week course during Inter/Summer session, or as a lecture and laboratory course during the Fall semester. (Prerequisite: ESCI 1111.) (MATH 1720/1760 and PHYS 1310/1410 recommended.)

ESCI-2711. Scripting and Programming in GIS

Knowledge and competence in programming are an essential skill set and a critical requirement for most

geospatial job opportunities. This course will introduce the basics of constructing scripts (lists, loops, syntax, classes, objects) and programming them into a GIS framework for the purpose of automating workflows, visualizing geospatial data, building and running tools from GUIs and APIs. Other topics will include: methods to enhance functionalities within current geospatial software and web-based systems, the utilization of geospatial libraries, and the construction of effective tools for spatial analysis purposes using Python and other programming languages. (2 lecture, 2 laboratory hours per week.)

ENVIRONMENTAL STUDIES

ESTU-2100. Canadian Regional Environments

Canada is a complex and varied nation. The environmental issues that concern each region of the country are also complex and varied. This course surveys the dominant environmental issues and impacts in each region of Canada, and explores the reasons for the regional variation through a variety of lenses: its physical landscape, its resource opportunities and challenges, its historical settlement patterns and economic development, and its social, cultural, and demographic structure. This context is used to develop an understanding of current environmental news and events across the country. (Can be taken as a Social Science option.) (Three lecture hours per week.)

ESTU-2500. Concepts for Ecosystem Management

An introduction to ecosystem management and how ecological information is used in Canadian environmental policy and programs. This course will examine the current biodiversity crisis, how it relates to ecosystem services and human well-being and common measurement techniques used to characterize and monitor ecosystems, their function and health. Topics will include an overview of ecosystem monitoring techniques including land and aquatic-based survey tools, quantifying ecosystem production, species presence, species diversity and habitat classification. Topics and case studies of ecosystem management related to environmental impact assessment, ecosystem restoration, conservation, non-native species, pest management, and species re-introductions will be introduced. Case studies will be placed in the context of major Canadian and Ontario environmental legislation that utilizes ecological concepts to demonstrate how environmental programs adopt measurements and metrics reviewed in the course. (3 lecture hours per week.) (Prerequisites: ESTU-1100 or ESCI-1100; or BIOL-1013 or BIOL-1111).

ECONOMICS: COURSES

ECON-2000. Life Choices and Economics

The course is designed for Arts and Social Sciences students. It will introduce them to key concepts and methods in Microeconomics. The application and understanding of economic analysis as applied to individual decision-making and public policy will be emphasized. The course provides a non-technical and intuitive way for students to master an understanding of real world problems. (May not be taken for credit in any program within the School of Business, or Faculty of Engineering. Science students may take the course only as a Social Sciences option.) (Antirequisite: ECON-1100.)

ECON-2010. Life Choices and Economics II

The course is designed for Arts and Social Sciences students. It will introduce them to key concepts and methods in Macroeconomics. Key Macroeconomic concepts, such as unemployment, inflation, international trade, and investment will be examined. The course will be a non-technical look at the Canadian and world economies. (May not be taken for credit in any program within the School of Business, or Faculty of Engineering. Science students may take the course only as a Social Sciences option.) (Antirequisite: ECON-1110.)

ECON-2100. Games and Behaviour

The course is designed for Arts, Social Science and Business students. It is intended to introduce them to key concepts and methods in game theory. The application and understanding of behavioral analysis as applied to individual decision making and public policy will be emphasized. The course provides a non-technical and intuitive way for students to master an understanding of real world problems and decision making. Students will learn about strategies for conflict resolutions, co-operation, social interaction, voting strategies, individual and

business behaviour. (May not be taken for credit in Economics or joint programs with Economics, Science or the Faculty of Engineering.)

ECON-2210. Intermediate Microeconomics I

The theory of markets, the theory of consumer behaviour and demand; the firm, production, cost, and supply.

(Prerequisite: ECON-1100.)

ECON-2220. Intermediate Microeconomics II

Extensions of the theory of consumer and firm behaviour; pricing under different market structures;

distribution; general equilibrium and economic welfare. (Prerequisite: ECON-2210.)

ECON-2310. Intermediate Macroeconomics I

A theoretical and policy oriented treatment of the determination of employment, output, interest rates, and the price level; stabilization policies and their effectiveness. (Prerequisites: ECON-1110.)

ECON-2410. Microeconomics for the Real World

This course will focus on the application of techniques of economics to the analysis of practical problems in a variety of fields (public health, natural resources, political science, industrial relations, business administration, and others). The course will emphasize more applied, as opposed to theoretical, aspects of microeconomics.

(May not be taken for credit in Economics programs or Combined Major Programs with Economics.)

(Prerequisites: ECON-1100 or ECON-2000) (Antirequisite: ECON-2210)

ECON-2510. Macroeconomics for the Real World

This course will focus on the application of techniques of economics to the analysis of practical problems in areas of current interest like globalization, inequality, protectionism and government spending and taxes. The course will emphasize more policy, as opposed to theoretical, aspects of macroeconomics. (May not be taken for credit in Economics or combined major programs with Economics).

(Prerequisite ECON-1110 or ECON-2010)

(Anti-requisite: ECON-2310).

ECON-2660. Selected Issues in Economics

(Prerequisites: ECON-1100 and ECON-1110.)

ECON-2900. Health Economics

This course will explore the unique economic features of health care with emphasis on international models of delivery, determinants of the demand and supply of health services, and public *versus* private health care systems. The Canadian experience will be considered with a focus on demographic patterns and

legislation. (Pre-requisites: ECON-1100, ECON-1110; plus any university-level course in statistics.)

FORENSIC SCIENCE:

FRSC-2007. Introduction to Forensic Science

This course will survey the many specialties of Forensic Science, including forensic pathology, entomology, anthropology, biology, botany, geology, etc. Special guest lectures by practicing forensic scientists will give students direct contact with the role they play in the extraction and meaning of evidence.

FRSC-2100. Crime Scene Evidence Analysis

This course builds upon the protocols developed in the Introductory Crime Scene Investigation (FRSC-1107) and it is designed to familiarize students with the diverse scientific techniques utilized by Forensic professionals. The techniques for analyses of forensic evidence span natural sciences, social sciences and computer sciences.

(Pre-requisite: (FRSC-1107 or FRSC-2007 or permission by course instructor).

MATHEMATICS COURSES

MATH-2250. Linear Algebra II

This course is a rigorous and proof-based study of linear systems, vector spaces, linear transformations, projections, pseudo-inverses, determinants, inner product spaces and applications. (Prerequisites: MATH-1020 and one of MATH-1250, MATH-1260 or MATH-1270.) (3 lecture hours, 1 tutorial hour per week.)

MATH-2251. Linear Algebra III

This course is a rigorous and proof-based study of eigenvalues and eigenvectors, diagonalization, similarity problem, canonical form for real and complex matrices, positive definite matrices, computational methods for approximating solutions to systems of linear equations and eigenvalues. (Prerequisite: MATH-2250.) (3 lecture hours, 1 tutorial hour per week.)

MATH-2780. Vector Calculus

This course will cover quadric surfaces, vector differential calculus, functions of several variables, maximum and minimum problems, multiple integrals, vector differential operators, line and surface integrals, Green's theorem, Stokes' theorem and Gauss' theorem. (Prerequisites: MATH-1730, and one of MATH-1250, MATH-1260 or MATH-1270.) (3 lecture hours, 1 tutorial hour per week.)

MATH-2790. Differential Equations

This course will cover first-order ordinary differential equations (ODEs), higher-order ODEs with constant coefficients, Cauchy-Euler equations, systems of linear ODEs, Laplace transforms, and applications to science and engineering. (Prerequisites: MATH-1730, and one of MATH-1250, MATH-1260 or MATH-1270.) (3 lecture hours, 1 tutorial hour per week.)