Sustainability-Related Courses

Department/Division	Course Name	Description
Ag & Bioresource Engineering	**ABE 212.3 Physical Principles of Plant Biosystems**	An introduction to physical concepts governing movement and storage of nutrients, energy, and water within the plant biosystem (soil-plant-atmosphere). Topics include: physical properties of soil, biogeochemical cycling, plant physiology, and water and energy transport within the plant biosystem. Subject material will provide the foundation for future engineering courses involving biosystems. *Includes 12 hours on: water balance and soil management practices that reduce leaching and runoff and conserve water; carbon, nitrogen, and phosphorus cycles and discussion of carbon sequestration principles; effect of land use changes, and land management practices, including carbon cycle and organic waste management).*
Ag & Bioresource Engineering	**ABE 295.3 Introductions to Biosystems Engineering**	Introduction to the discipline of Agricultural and Bioresource (Biosystems) Engineering and to design principles and practices. Students will develop logical problem-solving skills through solution of problems involving energy and mass balances, bioprocessing, instrumentation and machinery systems, water and soil resources and waste management. Extensive use is made of computer software for calculation and graphical presentation of results. *Includes 6 hours on: Environmental stewardship and sustainability -- discussed directly in one hour lecture and included in presentations and laboratory exercises for waste utilization, sustainable soil and water management and to a lesser extent in machinery design.*
Ag & Bioresource Engineering	**ABE 327.3 Transport Process in Biosystems**	A unified approach to transport of energy and mass in biological and environmental processes. Emphasis is placed on the formulation and solution of mathematical models to represent heat and mass transfer in indoor and outdoor environments, in plant and mammalian systems, and for industrial processing of food and biomaterials. Students will apply analytical and numerical techniques to solve heat transfer problems involving steady state and transient heat conduction, convection and radiation, heat transfer with phase change, and mass transfer problems involving steady state and transient diffusion/dispersion and convection. *Includes 4 hours on: Problems of heat and mass transfer; composting, energy conservation in building or process equipment, greenhouse gases and their effect on atmospheric heating, pollutant transport in soil, air and water, etc.*
Ag & Bioresource Engineering	**ABE 431. 3 Irrigation System Design**	Engineering and hydrologic principles are applied to design of modern irrigation and drainage systems. Soil-plant water relationships important to understanding water needs are emphasized. *Includes 3 hours on: Irrigation sustainability as it relates to design considerations, eg, low energy precision application, water conservation.*

Ag & Bioresource Engineering	**ABE 432.2 Soil and Water Conservation**	Land degradation and associated management practices within land bioresource systems are studied. Emphasis is placed upon prairie agricultural systems, with examples within other systems (e.g. forestry, wetlands) also considered. Major topics include wind and water erosion, soil compaction, soil carbon change, acidification, sodic soils, salinization, and desertification. *Includes 20 hours on: Agriculture issues of erosion, organic matter depletion, salinity, water conservation; land management; some lectures on wetlands, forestry.*
Ag & Bioresource Engineering	**ABE 432.3 Soil and Water Conservation**	Land degradation and associated management practices within land bioresource systems are studied. Emphasis is placed upon prairie agricultural systems, with examples within other systems (e.g. forestry, wetlands) also considered. Major topics include wind and water erosion, soil compaction, soil carbon change, acidification, sodic soils, salinization, and desertification.
Ag & Bioresource Engineering	**ABE 482.3 Environmental Engineering in Biosystems**	The design of systems for processing and utilization of by-products generated by the bioresource industries, including primary agriculture, food processing, and forestry. Pollution problems caused by these industries are examined and opportunities for recycling and utilization of by-products are identified. Emphasis is on land as opposed to surface water as a receptor of organic by-products. A comprehensive strategy is developed for approaching pollution control and by-product utilization problems. Students are expected to integrate sociological, regulatory, economic, biochemical and technological considerations in exploring waste treatment and utilization options. Students work in teams to conduct an industrial waste survey and a feasibility study of waste reduction and enhanced waste utilization for a specific local industry, farm, or processing plant. Natural treatment/processing systems are emphasized and topics may include site assessment, composting, cogeneration, and wetlands treatment. *Includes 12 hours on: Water and air quality issues from processing facilities and waste utilization projects. Surface and groundwater protection is a main focus of the class. Waste utilization technologies. This includes microbiological conversion of substances, nutrient loading, conversion and transport, and environmental regulator compliance. Site characterization for establishment of waste storage facilities or utilization programs is covered.*
Ag & Bioresource Engineering	**ABE 495.6 Design Capstone Conservation of Materials**	A continuation of ABE 395 in a self-directed course. Students perform the analysis associated with the design problem and are able to specify a design solution at the end of the course. Students must submit a comprehensive report, describing the design solution. The final design solution is also presented to the faculty and staff in the Department of Agricultural and Bioresource Engineering in the format of poster and oral presentations. *Includes 1 hour on recycling.*
Civil Engineering	**CE 212.3 Civil Engineering Materials**	An introduction to the physical and mechanical properties of materials and the phenomenological bases for these behaviours. Fundamental concepts of materials science and engineering are introduced and applied to materials commonly encountered in civil engineering applications, including Portland cement concrete, metals and alloys, ceramics, polymers and polymer composites, and other materials such as wood, asphalt concrete, and soils. *Includes .5 hours on: Durability issues for concrete and the engineer's responsibility to*

		consider the long term performance of materials and lifecycle costing.
Civil Engineering	**CE 295.3 Design Project**	A design course in which the principles of design are learned by application to a suitable civil engineering project. The course requires that the students work in groups to achieve the desired outcome. Group interaction and performance is monitored throughout. Guest lectures from various industrial and other representatives will be provided to enhance the student's design experience. *Includes 1 hour: Lecture by the University's sustainability officer. The design teams are also expected to factor in sustainability and environmental stewardship to their various design alternatives and decision analysis.*
Civil Engineering	**CE 319.3 Hydrology**	Basic hydrological processes such as precipitation, evapotranspiration, runoff, infiltration, interception, and depression storage are introduced. Engineering applications such as stream flow and storm hydrographs, flood routing, hydrologic analyses and design, and watershed simulation are covered.
Civil Engineering	**CE 327.3 Sanitary and Environmental Engineering I**	Fundamental topics in the discipline of sanitary/environmental engineering are introduced. Topics include the design of municipal water distribution and wastewater collection systems; an introduction to water chemistry and water quality assessment; and design of physical and chemical treatment processes as they apply to water and wastewater treatment. A brief overview of storm water collection systems is also presented.
Civil Engineering	**CE 329.3 Transportation Engineering**	This course introduces civil engineering students to the planning, design, operation, and safety of road transportation systems. Topics include: fundamentals of traffic flow theory, highway capacity analysis, geometric design, intelligent transportation systems, travel demand forecasting methods, and safety analysis. *Includes 3 hours on: Amount and impact of vehicle emissions resulting from traffic flow efficiency; green space road infrastructure geometric designs, including driver fatigue and road side aesthetics; vehicle emissions model discussed in the context of engineering design selection.*
Civil Engineering	**CE 414.3 Sanitary and Environmental Engineering II**	This course introduces additional topics in the discipline of sanitary/environmental engineering. It builds upon previously introduced principles of chemistry, fluid mechanics and fundamentals of sanitary/environmental engineering. Topics covered include design of lime soda ash softening in drinking water treatment; design of biological wastewater treatment systems; and sludge and residual solids management in water and wastewater treatment. An introduction to tertiary wastewater treatment and wastewater disposal issues is also presented.

Civil Engineering	**CE 415.3 Structures for Water Management**	A design course in which the basics of fluid mechanics (hydrostatics, continuity, energy and momentum) are applied to hydraulic design. The concrete gravity dam and spillway structures are used to introduce the basic aspects of hydraulic structure design with respect to forces and hydraulic analysis, including the important topic of energy dissipation. Other structures, such as those used for flood control, irrigation, hydropower, navigation, water supply, land and highway drainage, wildfowl habitat preservation, and water-based recreation, are also considered.
Civil Engineering	**CE 416.3 Geotechnical Engineering Practice**	Applications in geoengineering with an emphasis on practical design of earthworks, foundations, excavations, and earth-retaining structures. Design and construction of shallow foundations based on bearing capacity and settlement analysis. Design and installation of deep foundations including piles and caissons. Introduction to geosynthetics and soil reinforcement, ground improvement and special construction techniques. As a major component of the course mark, students carry out a "real world" field investigation in small groups, plan and implement an appropriate laboratory testing program and complete a Geotechnical Investigation and Design Report. Emphasis is on analysis and design as well as constructability and long term performance. A theme of construction site safety runs throughout the course. *Includes 2 hours on: Environmental impact case histories.*
Civil Engineering	**CE 464.3 Water Resources Engineering**	This course builds on and supplements various aspects of other hydrotechnical courses, especially those related to hydrology. The course focuses on three major parts of water resources engineering practice. Part ideals with watershed analysis and simulation, including use of state-of-the art software, and the effects of urbanization on watershed runoff, including the design of street drainage systems and detention ponds. It also covers determination of peak discharges for hydrologic design. Part II deals with water use and its associated analysis, including irrigation, drought management and hydropower. Part III deals with water excess management and flood damage mitigation. Several aspects of the course include consideration of economics as a decision-making tool, notably those aspects dealing with drought and flood management.
Civil Engineering	**CE 466.3 Geotehnical Modeling**	Analysis, design and construction of various earth structures, encompass virtually every aspect of geotechnical engineering. Topics for this course include embankments, geosynthetic reinforced steep slopes and retaining walls, earth and mine tailings dams, deep excavations and tunnels. The role of instrumentation to ensure the safety of earth structures and to determine their performance during their service life is also presented. Application of key concepts is emphasized during hands-on computer sessions based on the state-of-the-art geotechnical software. *Includes 2 hours on: Environmental impact case histories*.
Civil Engineering	**CE 468.3 Geoenvironmental Engineering**	Introduction to wastes, contaminants and contaminant transport processes in the subsurface. A review of the design elements of natural and engineered barriers and analytical tools for barrier systems and for remediation of subsurface contamination. Case studies of containment and remediation systems for municipal, mining and industrial wastes.

Civil Engineering	**CE 495.6 Capstone Design Project**	A final design course in which advanced principles of design are learned by application to a suitable civil engineering project. The course, which builds upon the foundation established in CE 295, focuses on approaches to be taken in defining complex problems (including the outlining of project objectives and scope), acquisition of suitable data resources, generation of alternative solutions, methods for selecting design alternatives and project implementation. Design philosophy and methods are discussed and explored in the context of the particular assignment given for the current year. The course requires that the students work in groups to achieve the desired outcome. Group interaction and performance is monitored throughout. Guest lectures from various industrial and other representatives will be provided to enhance the student's design experience. *Includes 4 hours on: Guest presentation on sustainability topics and on environmental regulations.*
Civil Engineering	**CE 821.3 Surface Water Quality**	Water quality aspects of rivers and lakes and implications of waste water input are discussed. Topics include surface water quality parameters, point and non point source input characteristics, water quality measurements, mixing and self-purification processes, water quality modeling methods.
Civil Engineering	**CE 822.3 Sanitary Engineering I**	Water chemistry fundamentals underlying water and waste water treatment methods and groundwater chemistry are discussed. Principles covered include kinetics, chemical equilibrium, acid-base systems, complexation, precipitation-dissolution and oxidation-reduction.
Civil Engineering	**CE 840.3 Surface Hydrology Prediction and Simulation**	Consists of two major parts; the first one focuses on modeling hydrologic processes and prediction of hydrologic events using artificial neural networks (ANNs). The second part of the course focuses on presenting the concept of system dynamics and its applications in the field of hydrologic modeling. Case studies of watershed modeling, water balance, and environmental analysis will be discussed within an object-oriented simulation environment. Although environment and water resources-related applications will be dominant, the scope of the methodologies and models introduced during the course will be broad enough to benefit other students from different disciplines across campus.
Civil Engineering	**CE 850.3 Geoenvironmental Engineering Fundamentals**	An introduction to contaminant transport processes in porous media with a focus on key processes and the related chemical, physical and hydraulic properties of soils. The transport and attenuation processes for the case of saturated, homogeneous and unsaturated soils are reviewed and the governing equations are derived. Special conditions such as fractured or structured soils, unsaturated soils, and multiphase transport and partitioning, are also discussed at length
Civil Engineering	**CE 851.3 Applications in Geoenvironmental Engineering**	The course will apply the fundamental chemical, hydraulic and physical properties of soils and contaminants with an emphasis on practical engineering significance. The application of these fundamentals to geoenvironmental practice and problems is illustrated through the use of case studies. Particular focus is on two broad areas; contaminant barriers/waste management and contaminated site remediation.

Civil Engineering	**CE 871.3 Advanced Physical Hydrogeology**	Aquifer characterization; Mapping flow in regional systems; Groundwater in the hydrologic cycle; Principles of hydraulic testing; Groundwater as a resource; Stress, strain and pore fluids; Heat transport in groundwater systems.
Chemical Engineering	**CHE 322.3 Mathematical Modeling II**	Ordinary and partial differential equations as they relate to chemical engineering processes. Laplace transforms for ordinary differential equations. Analytic and numerical solutions to partial differential equations. An emphasis will be placed on the development of mathematical models for chemical engineering systems. *Includes 1.5 hours on: Introduction to alternative energy biofuel production and research on wastewater treatment using biosorption.*
Chemical Engineering	**CHE 325.3 Process Engineering and Design 1**	The concepts of industrial chemical process design, industrial economics, process optimization, process simulation and plant safety. Encourages students to use their fundamental knowledge in science and mathematics to design practical chemical engineering facilities. Special emphasis will be placed on safety, hazards, sustainability and loss prevention issues in chemical plants. *Includes 2 hours on: A climate change seminar by a guest speaker; lectures on pollution, pollution prevention, environmental standards.*
Chemical Engineering	**CHE 411.3 Chemical Reaction Engineering**	An examination of the principles of applied chemical kinetics and their use in chemical reactor design and chemical plant operation. Both homogeneous and heterogeneous kinetics, including catalysis, are considered. *Includes 3 hours on: Efficient reactor design and design of catalysts for long life and how they impact catalytic chemical processes and environmental pollution.*
Chemical Engineering	**CHE 422.3 Process Engineering and Design**	Detailed design of an actual industrial chemical process including preparation of the engineering flow sheet, process simulation and optimization, plant energy and material balances, equipment sizing and design, plant layout, hazards, safety, environmental impacts, and economic analysis of the chemical process. Students will also employ project management skills to ensure timely completion of projects. *Includes 1 hour on: Impacts of the process which they are designing on sustainability and the environment.*
Chemical Engineering	**CHE 454.3 Design of Industrial Waste Treatment Systems**	Air pollution topics include causes and effects of air pollution, sampling and analysis of air and stack gas samples, stack gas dispersion models, and the design of industrial control measures for particulates. Water pollution topics include causes and effects of water pollution, biology of receiving waters and treatment systems, sampling and analysis of wastewaters, and industrial control measures including biological methods such as trickling filters, aeration basins and activated sludge systems. *Includes 3 hours on: Air and water pollutants; approaches to minimize the impacts of industrial activities on the environment; pollution problems of local, regional and global concern are discussed.*
Chemical Engineering	**CHE 460.3 Oil and Natural Gas Upgrading**	The application of chemical engineering principles to the petroleum refining and petrochemical industries. A refinery survey looks at key unit operations such as atmospheric distillation catalytic cracking, and reforming. Bitumen and heavy oil upgrading are also discussed. Processes for the production of petrochemicals from natural gas constituents are examined. *Includes 6 hours on: Impact on the environment of different alternatives for oil and gas upgrading processes; processes used to treat waste streams from the oil and gas*

		upgrading industry; processes to produce cleaner fuels.
Chemical Engineering	**CHE 461.3 Introduction to Biochemical Engineering**	To provide the engineering student with an understanding of the behaviour of microorganisms and their industrial application. The elements of organism structure, and enzyme and cell functions are discussed. Attention is given to the evaluation of batch and continuous fermentation processes and the operations of aeration, agitation and sterilization. Some industrial processes are considered.
Chemical Engineering	**CHE 464.3 Petroleum Production Engineering**	An introduction to the techniques used in the production of oil and natural gas. Topics include an introduction to petroleum geology, properties of reservoir rocks and petroleum fluids, inflow performance of vertical and horizontal wells. Wellbore hydraulics, well testing and well stimulation. *Includes: Sustainability and environmental issues in exploration (effect on marine and land wildlife); sustainability and environment issues in drilling (effect of drilling fluids, acids on environment); contamination of soil and water by drilling processes; sustainability and environmental issues in transportation and storage (emission of VOC, spills in land and sea...).*
Chemical Engineering	**CHE 470 Field Trip**	Visits to industrial plants. *Students are exposed to the initiatives taken by the industry to protect and maintain a sustainable environment.*
Chemical Engineering	**CHE 495.6 Capstone Design Project**	Emphasizes the application of a formal design process. Students, working in small groups, apply top-down design principles to a year-long project starting with a basic description of the product or system and culminating with an oral presentation of the final working design. *Sustainability and environmental impact are important criteria in some design projects.*
Chemical Engineering	**CHE 861.3 Fundamental Biochemical Engineering**	Chemical engineering students learn the fundamentals regarding the microorganisms and their industrial applications. Metabolic regulations, enzymatic and biochemical reaction are covered. Batch and continuous fermentations, design of bioreactors, aeration, mixing, sterilization and down stream processing are discussed.
Chemical Engineering	**CHE 862.3 Advanced Biochemical Engineering**	Covers the most recent areas of research progress in biochemical engineering. Topics include novel bioreactors, large-scale cultivation of plant or mammalian cells, recombinant cell fermentations, novel systems and downstream processing techniques.
Chemical Engineering	**CHE 888.3 Chemicals and Energy from Renewable Resources**	Focuses on the processes that produce chemicals and/or energy from renewable resources and the associated environmental issues. The fundamental principles and the highlights of research frontiers are introduced. Students will study the basic processes such as gasification, pyrolysis, catalytic conversions and synthesis, and chemical energy production using renewable feedstock.

Electrical Engineering	**EE 212.3 Passive AC Circuits**	Basic concepts in AC circuits, power factor, real, reactive and complex power. Loop and nodal analysis, circuit theorems and their application in AC circuits. Wye-delta transformation, series and parallel resonance, circuit response to variable frequencies. Circuit representation of transformers, utilization of the per unit system, Polyphase system, three phase 3-wire and 4-wire systems, star and wye connections, balanced and unbalanced three phase systems, power measurement in three phase systems. *Includes 5 hours on: Efficiency of power transformers and electrical motors; maximum power transfer theorem; increase of the power factor to reduce losses in the network.*
Electrical Engineering	**EE 323.3 Electronic**	Topics include operational amplifier circuits such as instrumentation amplifiers and waveform generation circuits, passive and active filter design, transducers, noise sources and noise reduction techniques, analog and digital interfacing such as A/D converters, D/A converters, sample and hold circuits, and digital instrumentation buses. *Includes 1 hour on: Instrumentation. Low power design is considered in the design is considered in the design project.*
Electrical Engineering	**EE 395.3 Electrical Engineering Design**	Covers the top down approach applied to engineering design. The students will exercise the approach by designing, building and testing one or two projects. The course also includes aspects of manufacturing engineering, project organization and control. *Low power design is considered in all of the design projects.*
Electrical Engineering	**EE 432.3 VLSI Circuit Design**	A general introduction to VLSI design, analysis and simulation. Topics include CMOS cell design, logical effort, circuit simulation and system design. *Includes .5 hour on: IC fabrication toxic chemical removal.*
Electrical Engineering	**EE 417.3 Introduction to Micro and Nanotechnology**	A multidisciplinary introduction to the processing of micro and nano scale structures that are applied in emerging fields of high resolution patterning such as micro/nano electronics, photonics and fluidics. Fundamental technology issues including materials, equipment, fabrication, and inspection are discussed. *Includes 1 hour on: Impact of miniaturization on energy consumption during device fabrication and operation/low-loss/high efficiency micro- and nano devices (e.g. improved catalysts in fuel cells).*
Electrical Engineering	**EE 495.6 Senior Design Project**	Emphasizes the application of a formal design process. Students are divided into working groups of two or three to design, in a top down fashion, a product or system. The students start from a layman's statement of what is needed and produce a requirement specification, system analysis and specification, block level design and a working unit. The students are required to give a formal oral presentation of their year's work to a group of their peers. *Environmental impact is important criteria in some design projects.*
Engineering Physics	**EP 271.3 Heat Kinetic Theory and Thermodynamics**	Calorimetry, thermal expansion, heat transfer and the empirical gas laws. Kinetic theory of gases: specific heats, Boltzmann distribution. Mean free path and transport phenomena. Zeroth, first and second laws of thermodynamics. Entropy and heat engines. *Includes 4 hours on: Energy conservation and heat engines.*

Engineering Physics	**EP 311.3 Electronics 1**	Introduces analogue electronics. The course covers network analysis, AC circuits, the physics and operation of semiconductors, junction diodes, transistors, the design of amplifier circuits, small signal analysis, and operational amplifiers (op-amps). *Includes .5 hour on: Lab on solar energy; discussion of inverter design for wind power systems.*
Engineering Physics	**EP 317.3 Applied Physics of Materials**	Introduction to atomic structure, bonding, types of solids, crystalline states, and types of crystals. Solid solutions. Mechanical properties strain and thermal expansion. Thermal fluctuations, noise and thermally activated processes. Heat capacity of solids. Electrical conductivity of pure metals and solid solutions. Temperature dependence. Hall effect. Energy band structure in solids. Semiconductors. Classical and Fermi-Dirac statistics. Conduction in metals. Contact potential. Seeback effect, thermocouple. Thermionic emission and vacuum tube devices. Phonons. Debye heat capacity and heat conductivity. Extrinsic, p- and n-semiconductors. Conductivity and temperature dependence. Optical absorption. Luminescence. Shottky diode. Ohmic contract and thermoelectric effect. *Includes 1 hour on: Applied Physics of materials pollution.*
Engineering Physics	**EP 321. 3 Electronics II**	Introduces digital electronics and completes some analogure electronic topics not covered in EP 311. Analogue topics include transducers, feedback systems, modulators, frequency converters, amplifier configurations and design. The majority of the course covers digital electronics, including logic operation and implementation (AND, OR, NOT), binary numbers, Boolean algebra, memory elements, ROM, RAM, logic circuits (adders, counter, etc.), A/D and D/A converters, and simple microprocessors. Circuit design principles are emphasized and a major design project is undertaken. *Includes 2 hours on: Detectors and transducers, environmental monitoring systems.*
Engineering Physics	**EP 324.3 Mechanics IV**	Covers three-dimensional rigid body dynamics and introduces fluid mechanics concepts such as the control-volume approach, the continuity equation, derivation of Bernoulli's equation, and conservation of momentum and energy in a fluid system. I*ncludes .5 hour on: Control volume analysis used to gain insight into numerical simulation of dust(and gas) ventilation in work places; public and worker health safety.*
Engineering Physics	**EP 431.3 Optical Systems and Materials II**	Diffraction of light - Fraunhofer and Fresnel. Anisotropic effects on the polarization of electromagnetic waves, particularly by reflection and refraction, by birefringent materials (prisms, Fresnel rhombs), and by electro-optic and magneto-optic systems; application of these effects to modulation of light. Circular birefringence as the cause of Faraday rotation and optical activity. Dielectric waveguides and fiber optics. Light-emitting diodes. Fundamentals of stimulated emission and lasers; types of lasers. Optical amplifiers, optical detectors, and optical communication systems. *Includes 1 hour on: Spectral analysis for solar power systems*.
General Engineering	**GE 101.3 Introduction to Professional Engineering**	An introduction to the engineering profession: study skills and time management, engineering disciplines, experiential learning through internships, the engineer's role in public health and safety, sustainability, academic and professional ethics, engineering and society, and communication skills. *Includes 1 hour on: Introduction to sustainability and environmental issues.*

General Engineering	**GE 348.3 Engineering Economics**	An introduction to engineering economics and decision analysis. Topics include: fundamental economic concepts, cost concepts, time value of money operations, comparison of alternatives, depreciation and income tax, economic analysis of projects in the public and private sectors; break-even analysis, sensitivity and risk analysis, decision models. *Throughout much of the course, life cycle performance and the effect on life cycle costs are discussed in the context of our ability to sustain things throughout the service life.*
General Engineering	**GE 449.3 Engineering in Society**	Designed to create an awareness of the diverse and often-contradictory impacts of science and technology on society. The consequences of current technological changes and those of the recent past are explored from a professional ethics point of view to illustrate the complexities of technological-societal interrelationships. *Includes 3 hours on: Sustainability and environmental issues explored through class discussions and case histories.*
Geological Engineering	**GEOE 412.3 Reservoir Mechanics**	Fluid flow in hydrocarbon reservoirs; material balance equations; oil and gas well testing; waterflooding and EOR methods; fractional and segregated flow of immiscible fluids. *Includes: CO2 enhanced recovery and storage; reducing oilfield use of water by improving waterflood efficiency; methane emissions reduction by gas-injection*
Geological Engineering	**GEOE 466.3 Petroleum Geomechanics**	Geomechanical, geotechnical and petrophysical problems of interest to the petroleum industry: petroleum well drilling, borehole breakouts, wellbore stability, hydraulic fracturing, subsidence and compaction due to oil and gas withdrawal. *Includes 1 hour on: CO2 enhanced recovery and storage and the associated reduction in greenhouse gas emissions.*
Geological Engineering	**GEOE 475.3 Advanced Hydrogeology**	Contaminant transport; regional groundwater flow; petroleum hydrogeology; fluid migration in basins; surface-water groundwater interaction; introduction to groundwater modeling. *Includes 6 hours on: Impact on the environment of groundwater contamination; remediation methodologies.*
Geological Engineering	**GEO 495.6 Capstone Design Project**	A final design course in which advanced principles of design are learned by application to a suitable geological engineering project. The course, which builds upon the foundation established in CE 295, focuses on approaches to be taken in defining complex problems (including the outlining of project objectives and scope), acquisition of suitable data resources, generation of alternative solutions, methods for selecting design alternatives and project implementation. Design philosophy and methods are discussed and explored in the context of the particular assignment given for the current year. The course requires that the students work in groups to achieve the desired outcome. Group interaction and performance is monitored throughout. *Guest lectures from various industrial and other representatives will be provided to enhance the student's design experience. Includes 4 hours on: Guest presentation are given on sustainability topics and environmental regulations.*
Mechanical Engineering	**ME 214.3 Introduction to Materials and Manufacturing**	Provides an introduction to the relations between the structure and properties in engineering materials. It deals with the basics of structure, strengthening and deformation mechanisms of steels. *Includes 2 hours on: Recyclability considerations in the material selection; extraction of materials from earth; resource depletion.*

Mechanical Engineering	**ME 229.3 Introduction to Engineering Design**	Introduces the mechanical engineering student to the concepts behind engineering design. Special seminars by practicing professionals supplement the course materials. Specific topics to be covered are: historical background, log books, scheduling, literature search, cost analysis, project management, CAD techniques, report writing, design ethics, safety in design, sustainability and legal responsibilities. Students are responsible for participating in and completing an applied design project as well as complete WHMIS basic training. *Students must demonstrate sustainability and environmental stewarding in all designs.*
Mechanical Engineering	**ME 327.3 Heat Transfer**	The basic concepts of the three major fields of heat transfer; conduction - basic laws and applications; convection - free and forced convection, internal and external flows, heat exchangers; radiation - laws of generation and exchange. *Includes 2 hours on: Building heat loss calculations (energy conservation).*
Mechanical Engineering	**ME 330.3 Manufacturing Process**	Introduction to the processes in which physical objects are manufactured. Topics include casting, machining, powder metallurgy, special treatment of steels, joining, molding of plastics and superplastics forming of non-ferrous alloys. *Includes 2 hours on: Permanent versus disposable moulds; energy versus manufacturing costs: subcontracting versus in-plant manufacturing; social and moral issues of out-sources.*
Mechanical Engineering	**ME 417.3 Thermodynamics II**	A second course in equilibrium thermodynamics. It focuses on the second law and the concept of entropy, which are used to study the conditions of thermal, mechanical and chemical equilibrium, with applications to power cycles, refrigeration cycles and reacting mixtures. The second law is next used to develop the concept of availability or exergy. Finally, both the first and second laws are used to study one-dimensional compressible duct flow. *Includes 9 hours on: Thermal efficiency of internal combustion engines and gas turbines; fuel cells (alternate energy sources).*
Mechanical Engineering	**ME 477.4 Engineering Materials II**	Provides students with an exposure to advanced engineering materials not covered in the core ME materials courses. It covers broad classes of materials and their applications with emphases on topics related to materials used in high temperature and other hostile environments. Failure of engineering materials and surface engineering are also covered. *Includes 1.5 hours on: Advanced Engineering; materials recyclability; consideration of materials; resource depletion.*
Mechanical Engineering	**ME 490.3 Design of Fluid Power Circuits**	An introduction to the design of industrial and Fluid Power circuits. The operation and design of basic components are considered. A methodology to the design of industrial circuits is introduced and applied to industrial applications. Design criteria for open loop applications are introduced. *Includes 5 hours on: Maximizing energy efficiency of fluid power circuits; use of bio-degradable fluids; filtering for maximum fluid life leakage of fluids.*
Mechanical Engineering	**ME 491.3 Thermal System Design**	A design course involving the application of the fundamentals of thermodynamics. Topics may vary depending on the choice of design project, but would typically include psychrometrics, internal and external energy gains, heating and cooling loads, duct and piping design, overall thermal design specifications and system component design and selection. *Includes 10 hours on: Energy efficient building design; state-of-the-art energy recovery devices in buildings;*

		indoor air quality; off-gassing problems with building materials; life cycle cost evaluation.
Mechanical Engineering	**ME 492.3 Materials in Engineering**	Emphasizes materials engineering in the design process. It covers an overview of available engineering materials and their selection based on mechanical properties, surface durability and cost. *Includes .5 hour on: DesigniImpact of material selection on environment; problems with plastic stability; third world problems with recycling; poor recyclability of composites.*
Mechanical Engineering	**ME 493.3 Machine Design II**	Deals with advanced mechanical design topics. It is considered as a continuation of Machine Design I, but with an emphasis on the use of integrated design software. The course includes use of finite element and other software, such as ANSYS, SolidWorks, and MATLAB in design. One portion of the course discusses the design process and introduces the design optimization methodology and integrated design optimization software, which will be used for solving unconstrained, constrained, and multi-objective optimal design problems. T*he course also includes design of systems under shock and impact loading, vibration isolation and control. Includes 3 hours on: Ergonomics in safe designs; maintenance, recycling, quality control for extended life.*
Mechanical Engineering	**ME 495.6 Industrial Design Project**	The synthesis and design of mechanical engineering components and systems. Students work in groups as a design team on selected projects submitted by industry. Oral and written presentations are made by students during the term with a formal oral presentation and final written report at the end of the course. Evaluations of oral and written presentations are made by supervisors as well as other outside examiners. Lecture material covers design processes and methodologies as well as design aspects related to occupational health and safety. This material is augmented through seminars given by industrial design specialists based on their design experiences. *Includes 3 hours on: Special lectures on sustainability; guest speakers on environmental issues.*
Agriculture	**AGRC 111.3 Agricultural Science I**	An introduction to agricultural systems illustrating the interactions between plant, animal, microbial, human and environment components. The soil/plant/environment interface is emphasized. Management decisions affecting cropping and land use are examined.
Agriculture	**AGRC 112.3 Agricultural Science II**	An introduction to agricultural systems and the interactions between microbial plant, animal, and human components. The emphasis is on issues and problems associated with animal production, value-added processing, marketing and the consumption of food.

Agriculture	**AGRC 113.3 Agri Food Issues and Institutions**	Examines the institutional setting within which the agri-food sector operates, as well as the drivers that affect this setting. Attention is paid to changes in the demand for food and bio-based products, the changing nature of production, and long-term trends in productivity, prices, employment and trade. The course examines the manner in which decisions about technology adoption, employment, diversification, R&D expenditures, and government policy are made; the institutions (e.g., laws, contracts, social norms, markets) that govern this decision making; the social, legal, political and economic factors that affect these institutions; as well as the implications for the agri-food sector of decisions made.
Bioresource Policy, Business and Economics	**BPBE 330.3 Land Resource Economics**	A study of natural resource economics with emphasis on environmental economics, measurement of non-market goods, project evaluation, issues in urban and rural land use, and conservation. Policy problems related to the foregoing will be examined.
Bioresource Policy, Business and Economics	**BPBE 430.3 Natural Resource Economics**	Management and allocation of natural resources requires an understanding of the biophysical characteristics of resources, and the economics underlying decisions of resource users and society. This course will develop a series of tools to evaluate natural resource use from the management and policy perspective. The course will focus on renewable resources with some consideration of nonrenewable resources. Students will become familiar with dynamic mathematical and simulation models to evaluate the use of natural resources over time.
Food and Bioproduct Sciences	**FABS 211.3 Introductory Bioproduct Science**	Provides a general overview of the current science of bioproducts, i.e. industrial products made from renewable biomass. The course focuses on the structure, properties and processing of bioproducts arising from the value-chain of agricultural bioresources.
Food and Bioproduct Sciences	**FABS 212.3 Agrifood and Resources Microbiology**	An introduction to the general biology of microorganisms with emphasis on those of agrifood, economic and environmental importance. Microbial morphology, metabolism, growth and genetics; infectious disease and immunity; environmental microbiology and waste water treatment; agricultural microbiology; food and industrial microbiology. Laboratory practice in basic microbiological techniques and their application to the study of microbial activities.
Food and Bioproduct Sciences	**FABS 360.3 Water Microbiology and Safety**	An introduction to the principles, vocabulary and concepts associated with the provision of safe drinking water. Examination of the relationship between microbial health threats and water resources and governance, quality assessment, treatment, risk assessment and decision-making, and security and global issues. There will be in-class discussion, student presentations and lectures.
Food and Bioproduct Sciences	**FABS 371.3 Food Biotechnology**	Presents principles, concepts, and application of methods and process design of biotechnology related to foods and ingredients for product quality and yield. New food development from plants, animals, microorganisms and related issues of governance, regulation, safety, health, consumer and market challenges will be presented.
Food and Bioproduct Sciences	**FABS 430.3 Environmental Microbiology**	Includes fundamentals of microbial ecology and explains basic concepts of microbial diversity and function within the environment. Covers principal biological properties and interactions of prokaryotic and eukaryotic microorganisms and highlights their practical value to the environment, agriculture, soil, plants, invertebrates, public health, industry and biotechnology.

Food and Bioproduct Sciences	**FABS 436.3 Biofuels Production**	Students are provided with comprehensive theoretical and practical knowledge of the multi-disciplinary production steps leading to fuel and industrial alcohol. One four hour field trip to an industry location. Excursion fees may apply.
Indigenous Peoples Resource Management	**IPRM 102.3 Environmental Studies I Economics and Law**	Introduces students to basic biophysical and economic theory underlying natural resource management and legal rules enabling or constraining management decisions. Instruction will focus on case studies and will involve a field trip component. Economic and legal theory will be integrated with the study of physical, biological and ecological components of resources studied.
Plant Science	**PLSC 213.3 Principles of Plant Ecology**	Designed for students in the College of Agriculture. It considers the nature of ecosystems and of processes associated with energy flow and material cycling within them. Particular attention is given to ecosystems of Western Canada and the effect that man exerts on them, especially through agricultural practices.
Plant Science	**PLSC 418.3 Management of Arable Grassland**	Will familiarize students with the ecology, quality, physiology and production of temperate forage species used in arable grassland production, focusing on those adapted to semi-arid climate. The scientific basis of modern management and utilization practices will be examined, particularly as it relates to the Saskatchewan forage industry.
Plant Science	**PLSC 423.3 Landscape Ecology and Vegetation Management**	Current theories relating to structure, functioning, and composition of landscapes and human impacts on natural ecosystems, landscape-level processes and patterns, and succession. Developing management plans for natural and remnant landscape elements, and inducing successional changes, and monitoring impacts will be covered. Field trips will be required.
Plant Science	**PLSC 425.3 Forest Ecology**	Study of tree physiology, the forest environment, dynamics of the composition, structure and functioning of forest ecosystems at multiple spatial and temporal scales. Emphasis is placed on forest ecosystems of Canada
Plant Science	**PLSC 823.3 Landscape Ecology and Vegetation Management**	Current theories relating to structure, functioning and composition of landscapes and human impacts on natural ecosystems, landscape-level processes and patterns, and succession. Developing management plans for natural and remnant landscape elements, and inducing successional changes, and monitoring impacts will be covered.
Renewable Resource Management	**RRM 212.3 Introductory Resource Economics and Policy**	Provides students with an introduction to the economic tools and theory used to address the management and governance of renewable resources. The application of these tools and theory in renewable resource policy will be demonstrated using examples of policy initiatives for renewable resources in Canada and in other countries. Students will learn the role of economics in natural resource policy and will gain understanding of the strengths and weaknesses of policy instruments in a range of applications. Emphasis is on beginning to develop students' skill in applying an economic lens to renewable resource management and governance.
Soil Science	**SLSC 240.3 Agricultural Soil Science**	Students are introduced to the major physical, chemical and biological properties of soil and the influence of those properties on soil productivity. The relationship of soil to its environment will be investigated as it relates to soil genesis, soil classification and cropping systems. The principles of soil fertility and fertilizer management will be explored with

		emphasis on cropping systems of Western Canada.
	SLSC 480.3 Soils and Boreal Landscapes	A four day field course with a follow-up tutorial to study boreal soils and landscapes the week prior to the fall term. Focus will be on the examination, description and classification of northern soils within various landscapes. This course also provides an introduction to basic air photo interpretation, ecological classification and forest measurements, as well as an artistic interpretation of landscapes.
Anthropology	**ANTH 329.3 Environmental Anthropology**	Examines the variety of cultural adaptations that societies make to local environments, dealing with such adaptations as hunting and gathering, pastoralism, horticulture and intensive agriculture. It also attempts to illustrate how the principles of general ecology apply to the study of man in his environmental relationships.
Biology	**BIOL 107.6 The Living Earth**	Includes geological, biological and ecological studies. It considers the history of the earth and the forces which shape its changing surface, the nature of life and the requirements for life on the earth, heredity and evolution including the record of life preserved in the rocks, organism diversity, and the effects of people on the environment. The lectures will be supplemented by outside reading and by small-group tutorial and demonstration sessions.
Biology	**BIOL 108.6 The Living Earth**	Follows the same lectures as BIOL 107 but has a three-hour laboratory each week. Designed for College of Education students in the Elementary Program. There will be a Physical Sciences/ Biological Sciences laboratory devoted to an integrated approach to the environment, using techniques from Physics, Chemistry, Biology and Geology. This laboratory is equivalent to a three-hour practicum.
Biology	**BIOL 120.3 The Nature of Life**	An introduction to the underlying fundamental aspects of living systems: covering cell biology, genetics and the evolutionary processes which lead to complex, multi-cellular life forms.
Biology	**BIOL 121.3 The Diversity of Life**	Our world has at least 15 million species, all of which have adapted to particular environments and lifestyles and use energy to grow and reproduce. We examine these processes in representative organisms from all the major groups, and discuss factors influencing changes in biodiversity over time and space.
Biology	**BIOL 228.3 An Introduction to Ecology and Ecosystems**	An introduction to population, community and ecosystem ecology. The structure and dynamics of communities will be considered along with energy flow and biogeochemical cycles in ecosystems. Effects of human activities on community and ecosystem processes will be reviewed.
Biology	**BIOL 324.3 Plants and Human Affairs**	A consideration of economically important vascular plants, plant families, plant parts and products used as food, textiles and medicines. The origin, history and domestication of plants and major crops, diversification of crops and major centers of agriculture in the world and fundamental roles of plants in human societies are discussed.

Biology	**BIOL 373.3 Community Ecology**	Examines physical and biotic factors shaping species assemblages over space and time, especially processes controlling plant communities (e.g. environmental factors, disturbance, and biotic interactions). Explores current issues in community ecology, such as impacts of diversity loss, invasive species, and environmental change. Laboratories focus on experimental design, data collection and analysis.
Biology	**BIOL 410.3 Current Perspectives in Environmental Biology**	Consists of modules taught by faculty in the environmental sciences. Students will participate together in weekly seminars, assigned readings, essays and oral presentations to learn about current issues in the environment and cutting-edge research with an environmental focus.
Biology	**BIOL 470.3 Conservation Biology**	An introduction to the theoretical and scientific foundation of conservation biology as applied to animals and plants. Course material will cover elements of population, community and landscape ecology as they apply to conservation challenges. Labs will include measuring biodiversity and analysis of current conservation issues. Field trips are compulsory.
Biology	**BIOL 475.3 Ecological Toxicology**	An introduction to the principles of ecological toxicology, including: population modeling, experimental design and interpretation of field studies, and contaminant impact assessment on populations, communities and ecosystems. Computer laboratory exercises will be used to model populations and ecosystems and analyze changes in populations and communities resulting from contaminant impacts.
Chemistry	**CHEM 375.3 Pollution Waste Disposal and Environment**	The disposal and treatment of waste materials will be discussed in terms of their effect on the gaseous and aqueous environments. A series of problems designed to illustrate the material covered in each topic will be assigned. The laboratory sessions are designed to give some understanding of how tests for environmental quality are carried out in the field and in the laboratory.
Economics	**ECON 231.3 Co operatives**	The historical background, philosophy and development of co-operatives are studied with special reference to the experience and problems of the prairie economy. Economic problems peculiar to co-operative organization are analyzed.
Economics	**ECON 270.3 Development in Non Industrialized Countries**	A review of the economic development of selected countries. The relevance of resources, financial institutions, government action and regional differences to problems of industrialization in these countries will be studied in the light of past and current theories of economic development.
Economics	**ECON 277.3 Economics of the Environment**	An introduction to the economic analysis of environmental issues. It will include analysis of environmental quality, benefit-cost analysis, and evaluation of different environmental policies and their application in Canada and Saskatchewan. It will conclude with analysis of global environmental issues.
Economics	**ECON 817.3 Economics of Developing Countries**	Deals with the theories and policies of economic development primarily in developing countries of the Third World since 1945. Topics include agricultural development, industrial development, international trade, the financing of economic development, and income distribution.

Geography	**GEOG 120.3 Introduction to Global Environmental Systems**	An introduction to the principles, processes and interactions in the earth's physical environment with a particular emphasis on the flow of energy and matter within global environmental systems. Topics include global radiation and energy balances, atmospheric and oceanic processes, the hydrological cycle, earth surface processes and biogeochemical cycling. Case studies are introduced to illustrate the interaction between human activity and the natural environment.
Geography	**GEOG 125.3 Environmental Science and Society**	Studies the Earth's life-support systems and explores the consequences of human activity. Key themes include examining global ecosystem processes, human interconnections, as well as applications of information from the Earth Sciences.
Geography	**GEOG 130.3 Space Place and Society An Introduction to Human Geography**	Exposes students to human geography using a thematic approach. It is designed to stimulate a geographical imagination among students who are interested in understanding "how the world turns" by focusing on how nature, culture, and human actions shape places, regions, and the relationships and interactions among them.
Geography	**GEOG 208.3 World Regional Development**	The regions of the world face a series of development problems. These problems are examined in terms of development theory and their spatial consequence. Their implications for global, national and regional planning are discussed.
Geography	**GEOG 280.3 Environmental Geography**	An introduction to the geographic perspectives on resources and the environment. This course introduces environmental geography as an integrative science to explore the relationships between human and physical systems.
Geography	**GEOG 329.3 Watershed Planning and Management**	The process and practice of planning and management for watersheds in a North American context. A focus on water and land use policy and watershed governance structures. Institutional arrangements affecting water management in Canada will be investigated. Topics will include integrated watershed management, watershed plan preparation, and barriers to source water protection.
Geography	**GEOG 341.3 Urban Planning and Geography**	Examines the history of cities and the future of urban places and planning, contemporary trends affecting the work of urban planners and how communities envision and influence their own development. Focuses student thinking on critical frameworks for understanding contemporary urban planning and geography. A field trip will be incorporated into this course.
Geography	**GEOG 350.3 Transportation Planning and Urban Geography**	Introduces the geographical aspects of transportation theory and planning. Major topical areas that are emphasized are: travel, behaviour, network design, and planning and policy for the future.
Geography	**GEOG 351.3 Northern Environments**	A multidisciplinary study of the physical environment of the circumpolar region. Examines the processes operating at the Earth's surface and within the atmosphere and oceans and their role in structuring northern ecosystems. Research projects will permit students with background preparation in the humanities, social sciences and natural sciences to assess the impact of human activity on northern environments
Geography	**GEOG 364.3 Geography of Environment and Health**	Explores the ways in which human-environment interactions impact on human health and disease. The goal of this course is to help students understand and assess the nature and variation across space of major environmental risks to health, and to learn how such risks may

		be prevented or managed
Geography	**GEOG 381.3 Geography of Northern Development**	Explores the question of development in northern Canada. The framework for this geographical analysis is provided by the Core/Hinterland Theory. Within this theoretical framework, major resource development will be examined and the regional impact analyzed. Special attention will be placed upon resource development conflicts.
Geography	**GEOG 385.3 Analysis of Environmental Management and Policy Making**	An examination of various approaches to environmental management. Emphasis is placed on environmental policy making and management strategies pertinent in a western context. Analytical frameworks used to understand how policies are developed and implemented are also introduced.
Geography	**GEOG 386.3 Environmental Impact Assessment**	A practical and theoretical introduction to environmental and socioeconomic impact assessment. Emphasis is placed on the principles and characteristics of impact assessment as set out under Canadian and Saskatchewan guidelines and legislation, and on the lessons learned from selected case studies.
Geography	**GEOG 464.3 Geography of Health**	Provides students with an introduction to health geography, examining the development of the sub discipline and its potential contributions as an approach for health-related research. It considers the ecological relationship between humans and disease, as well as the spatial patterns of health and health care. Additionally, lectures and readings will explore the use of geographic techniques and tools, including cartography, GIS and remote sensing, in health studies. In addition to the lectures and in-class discussions, a variety of supplemental readings will be assigned.
Geography	**GEOG 486.3 Research Seminar in Environmental Impact Assessment**	A project-based course focusing on emerging concepts and broader applications of environmental assessment principles and practices. Course topics varying from year to year following developments in the field, and may include such topics as cumulative effects assessment, strategic environmental assessment, project scoping, assessment methods and techniques, monitoring and follow-up.
Geography	**GEOG 880.3 Environmental Geographies**	Introduces a range of philosophical perspectives, topical issues, and methodological approaches to studies in environmental geography. Considers research focused on applied research about management strategies and policy making as well as theoretical work focused on politics associated with environmental problems. Also examines possible synergies between the two.
Geography	**GEOG 885.3 Advanced Applications of Environmental Management**	Using a collaborative learning model, this course will analyze theoretical and practical problems associated with defining and evaluating resource and environmental management and its associated strategies.
Geography	**GEOG 886.3 Advanced Environmental Impact Assessment**	A project-based course focusing on emerging concepts and broader applications of environmental assessment principles and practices. Course topics varying from year to year following developments in the field, and may include such topics as cumulative effects assessment, strategic environmental assessment, project scooping, assessment methods and

		techniques, monitoring and follow-up.
Geological Sciences	**GEOL 108.3 The Earth and How It Works**	Exploration of the global and local-scale physical processes that have shaped our planet. Strong emphasis is on interrelationships of geological processes and humans. Topics for discussion include volcanoes, earthquakes, pollution, and the origin and exploitation of energy, mineral and water resources.
Geological Sciences	**GEOL 121.3 Earth Processes**	Follows the same lectures as GEOL 108. The laboratory component satisfies the requirements of students in Program Type C (B.Sc. programs). Students in the College of Education who wish to take a course in Earth Science and require a laboratory component are advised take this course.
Geological Sciences	**GEOL 206.3 Earth Systems**	An introduction to Earth System Science, a concept that demonstrates the interrelationships between the Earth's landmasses, atmosphere, oceans and biosphere, and the role of humans in their interaction. Topics discussed will include geochemical cycles and environmental change, both natural and anthropogenic.
Geological Sciences	**GEOL 330.3 Climate History**	Explores the record of climate variations preserved in recent earth materials, and the influence of these variations on contemporary societies. The focus will be on extreme periods, e.g., Pleistocene deglaciation, the Younger Dryas, 8.2ka event, Piorra Oscillation, Roman Warm Period, Dark Ages, Medieval Optimum, Little Ice Age, and 20th century warming.
History	**HIST 289.6 The Menace of Progress A History of Colonialism and the Failures of Development**	Poverty, stagnant economies, environmental degradation! The images of the "south" are routinely depressing and alarming. This course examines the roots of these images and suggests how they reflect ideas of civilization and progress held by those who colonized, and those who subsequently imposed "development" on Latin America, Africa and Asia.
History	**HIST 290.3 Topics in Environmental History**	Explores various topics in environmental history. The focus of the course in any academic term will vary. Students may take more than one section of HIST 290 for credit, provided the subject matter of each course taken differs substantially. Topics covered might be as broad as an environmental history of the world or as specific as nuclear testing and environmental destruction. Students are encouraged to check with the department for more information.
International Studies	**IS 402.3 International Development**	This seminar explores the contribution which interdisciplinary theory and research make toward understanding international issues, particularly international development. Topics will include theoretical conceptualization of development and sustainability, global poverty and inequality, the globalization debate, foreign aid and structural instabilities.
Land Use and Environmental Studies	**LUES 400.3 Field Training in Environmental Management**	Land Use and Environmental Studies students will analyze, research and propose solutions to actual problems in environmental management under the direction of professional management personnel and of instructors in the LUES program. The course will also provide training in field research techniques and report preparation

Physics	**PHYS 404**	Intended to make the student familiar with a variety of modern techniques in Experimental Physics including physical properties of materials and their use in the laboratory, radiation sources and radiation detection, vacuum techniques and cryogenics. *Includes 3 hours on: Nuclear energy and environmental radiation; solar energy (2 projects); photovoltaic device characteristics and design of mini solar-thermal system for small building.*
Educational Foundations	**EFDT 885.3 Investigations in Culture and the Environment**	Course participants will individually and collectively engage in inquiry into various fields and discourses of culture and environment, drawing implications for their own life and work contexts.
Educational Foundations	**EFDT 880.3 Ecological Education for Regeneration: Process Perspectives**	Utilizes process thought as a theoretical approach to ecological education; analyzes ideas such as integral development, emergence, and transformation in ecological education; and investigates critical pedagogies, educational policy and leadership, and curriculum development.
Educational Foundations	**EFDT 881.3 Education Wisdom Nature**	Traces the concept of wisdom from earliest times through a decline in interest during the Enlightenment to its present-day resurgence among feminist theologians, deep ecologists, and First Nations peoples. Conceptions of wisdom and their emotional and cognitive preconditions are explored. Educational implications are considered.
Indian and Northern Education	**EIND 852.3 Theory and Practice of Anti-Racist Education**	Examines the historical, economic and political processes and practices of racialization, and the ways in which these processes and their effects become entrenched in our social and educational institutions. Theories and practices of integrative anti-racist education will be explored, including its applications in a variety of work places.
Indian and Northern Education	**EIND 850.3 Decolonizing Aboriginal Education**	Intended to address colonization and imperialism among Aboriginal peoples, focusing specifically on the role education has played in achieving cognitive imperialism, critique the tenets of cognitive imperialism in English language, and education policy, politics, and practice, and evaluate international options for restoring Aboriginal communities