

UNIVERSITY OF ONTARIO- INSTITUTE OF TECHNOLOGY

Bachelor of Engineering (Honours) - Automotive Engineering

General information

UOIT's automotive engineering program is unique in Canada. The automotive engineering curriculum provides an understanding of the principles and application of automotive engineering, while strengthening each student's ability to think independently and take a systematic approach to problem solving.

Courses such as automotive systems design, vehicle dynamics and control, and automotive materials selection, prepare graduates for employment directly within the automotive industry, or within the many related automotive fields.

Work placement/internship/co-op opportunities

The university's proximity to some of the largest automotive and manufacturing companies in Canada provides many opportunities for work placements. In addition, a 12 to 16 month optional Engineering Internship Program is available for students completing third year, and students may participate in two to four month work placements through the Engineering Co-op Program. See course descriptions for ENGR 0998U Engineering Internship Program and ENGR 0999U Engineering Co-op Program for details.

Careers

Graduates are prepared to work in automotive companies, as well as in many other industries that service the automotive sector and require specialized mechanical, electrical, automotive, software and manufacturing engineering skills. Automotive engineers may find employment at major automobile, truck, bus and motorcycle companies, as well as within racing teams, parts manufacturers and research and development organizations. Maintenance and repair are additional areas of employment for graduates. In addition, the program's mechanical engineering foundation provides graduates access to companies seeking mechanical engineers. Graduates may also choose to pursue further studies for higher degrees or start their own business.

Professional designation

The automotive engineering program is designed to meet the requirements of the Canadian Engineering Accreditation Board. Each graduate is eligible to apply for licensing as a professional engineer (PEng) in any province or territory in Canada.

Admission requirements

Current Ontario secondary school students must complete the Ontario Secondary School Diploma (OSSD) with a minimum overall average of 70 percent on six 12 U or M credits including English (ENG4U) with a minimum grade of 60 percent, calculus (MCB4U), algebra and geometry (MGA4U), chemistry (SCH4U) and physics (SPH4U). In addition, a combined minimum 70 percent average in math and science courses is required.

All other applicants should refer to section 4.5 of the Calendar for the requirements for their specific category of admission.

Degree requirements

To be eligible for the BEng (Hons) degree in automotive engineering, students must successfully complete 138 credit hours, including all courses outlined below. For elective options, see the list below. Click on the individual course titles for course descriptions.

All courses in year one, except EDUC 1470U, are prerequisites to all non-elective courses in year three. All courses in years one and two, except EDUC 1470U and BUSI 2000U, are prerequisites to all non-elective courses in year four.

Approved students may undertake a co-op work term at any time before completing the program, and do so by registering in the course ENGR 0999U Engineering Co-op Program.

Year 1 - Semester 1----- (15 credit hours)

EDUC 1050U - Technical Communications

This course will assist students in developing professional writing and presentation skills required for university assignments and for their professional work in the future. It will start with basic writing and speaking skills and will emphasize their application in the preparation of reports and other technical writing. Topics for the course include using correct grammar and punctuation, organizing ideas, formulating persuasive arguments, and preparing narrative and written technical reports. Part of the process will involve students in the critical analysis of the writing and speaking of others as a means of developing one's own skills. 3 cr.

ENGR 3200U - Engineering Graphics and Design

Engineering drawing techniques, dimensions and geometric tolerances, standard viewpoints and section planes, orthographic projections, use of 3-D solid modelling and CAD software (and possibly other design and graphics software); a case-based introduction to engineering design; use of graphics and illustrations in engineering design; design projects by individuals and groups; basics of project management, such as organizing, planning, scheduling and controlling; application of such computer tools as spreadsheets, project management software, computer-aided drafting and design tools. 3 cr, 3 lec, 1.5 lab, 1.5 tut.

MATH 1010U - Calculus I

Study of limits and continuity, the derivative, Rolle's theorem, the Mean-Value Theorem for Derivatives, Fermat's Theorem, the differential and anti-differentiation, the definite integral, area, the Mean-Value Theorem for Integrals, the Fundamental Theorem of Calculus, and other topics as time permits. Applications to science and engineering will be incorporated. 3 cr, 3 lec, 2 tut. Prerequisite: OAC Calculus or 12U Advanced Functions and Introductory Calculus. Credit restriction: MATH 1880U.

MATH 1850U - Linear Algebra for Engineers

Develops the fundamental ideas of linear algebra and demonstrates their applications to other areas. Topics include the algebra of matrices; systems of linear equations; determinants and matrix inverses; real and complex vector spaces, linear independence, bases, dimension and coordinates; inner product spaces and the Gram-Schmidt process; least squares and regression;

linear maps and matrices, change of basis and similar matrices; eigenvalues, eigenvectors and matrix diagonalization; quadratic forms. 3 cr, 3 lec, 2 tut.

PHY 1010U - Physics I

Introduction to basic mechanics. Newton's laws of motion; kinematics and dynamics in one and two dimensions; work and energy; friction; momentum and collisions; angular momentum, torque and rotation of rigid bodies; planetary motion; simple harmonic motion; static equilibrium; fluid mechanics. 3 cr, 3 lec, 3 lab (biweekly), 2 tut (biweekly). Prerequisites: Advanced Functions and Introductory Calculus 4U or OAC Calculus (required); Physics 4U or OAC Physics (recommended). Notes: Students without the physics prerequisite require the permission of the instructor in charge of the course, and will be responsible for making up background material.

Year 1 - Semester 2-----

(18 credit hours)

CHEM 1800U - Chemistry for Engineers

Introduction to the four sub-disciplines of modern chemistry: analytical, inorganic, organic and physical. Atoms, molecules, stoichiometry and gas laws; reactions, chemical kinetics, thermochemistry, entropy and free energy; electronic structure of atoms, bonding and molecular structure with emphasis on organic molecules; intermolecular forces, liquids and solids; electrochemistry, fuel cells and electrolytic cells. 3 cr, 3 lec, 2 lab (biweekly), 2 tut (biweekly). Prerequisite: OAC or 12U Chemistry.

EDUC 1470U - Impact of Science and Technology on Society

In this course, students will engage in analyses of scientific and technological developments from the perspective of broad social impacts. Special attention will be paid to controversial issues currently receiving media attention, but the major emphasis will be on ways of thinking critically about both the remediation of already existing problems (e.g., toxic substance cleanup) and the prevention of future problems (e.g., environmental impact analyses and or economic impact analyses). Canadian examples will be of primary concern, but students will also learn to think about impact globally since large-scale problems do not respect political boundaries. 3 cr, 3 lec.

ENGR 1200U - Introduction to Programming

Personal computer hardware: CPU, memory, machine cycle; input and output devices; data representation; operating systems: DOS and Windows; application software: programs and files, text and document processing; spreadsheets; databases; networks and computer-computer communications; programming languages; structured programming; flowcharting; algorithm design; use of procedures, loops and arrays; principles of object oriented programming; programming in 'C': data declaration, arithmetic and logic operations, input and output. 3 cr, 3 lec, 2 tut.

ENVS 1000U - Environmental Science

This course will introduce the conceptual, interdisciplinary framework of environmental science by examining its physical, biological, economic and social components. Topics will include environmental problems and scientific principles; ecological principles (ecosystems, nutrient cycles, geographic ecology, climate and biodiversity); resources and sustainability (food, water, energy and minerals); climate change; pollution (indoor and outdoor air, water, effects on health and ecosystems); energy (renewable, non-renewable, management); agriculture and food production (pesticides and pest control, energy and chemical inputs, land, soil water resources, population and economic issues); waste management and remediation and prevention of

environmental degradation. Canadian examples will be used wherever possible but the underlying theme will include a more global approach. 3 cr, 3 lec, 2 tut.

MATH 1020U - Calculus II

A continuation of Calculus I that addresses techniques of integration, applications of integration to volumes, arc length and surface area, parametric equations, polar coordinates, functions of two or more variables, partial derivatives, differentials, Taylor and MacLauren series, double and triple integrals, and other topics as time permits. Applications to science and engineering will be incorporated. 3 cr, 3 lec, 2 tut. Prerequisite: MATH 1010U. Credit restriction: MATH 1880U.

PHY 1020U - Physics II

Introduction to electromagnetism and optics. Electric charge and Coulomb's law; electric field, electric flux, Gauss' law; electrostatic potential, capacitance; Kirchoff's laws in DC circuits. Magnetic forces and magnetic field; Biot-Savart law; Ampere's law; magnetic flux, Faraday's law, inductance; AC circuits. Electromagnetic waves; wave propagation; waves in matter. Geometrical and wave optics. 3 cr, 3 lec, 3 lab (biweekly), 2 tut (biweekly). Prerequisite: PHY 1010U. Credit restrictions: PHY 1040U, PHY 1810U.

Year 2 - Semester 1----- (18 credit hours)

BUSI 2000U - Collaborative Leadership

This course intends to develop critical employability skills such as teamwork, leadership, project management, communication skills and intercultural understanding, and will focus students' learning on topics related to interactions with others in personal, educational and professional contexts. Students will engage in collaborative and dynamic learning activities involving direct and practical application of the content/skills critical to professional success. They will explore the practice and impact of leadership, negotiations and teamwork in organizations and communities. These practices will be examined in a variety of settings as described in both popular and academic writings. Learning activities will be directed toward developing leadership for exceptional performance, obtaining commitment to goals and standards, negotiating and resolving conflict, inter-cultural communications, ethical practice, and relating with others in team environments. 3 cr, 3 lec.

ENGR 2020U - Statics and Dynamics

This course provides fundamental engineering knowledge of static and dynamic force/moment equilibrium and time-varying performance of different systems. It also examines the work, energy, impact, force, and kinematics and dynamics of systems of particles and rigid bodies. The course description consists of: resultant and equilibrium of force systems; distributed loads; hydrostatics; conditions of equilibrium and application to particles and rigid bodies; analysis of statically determinate structures including beams, trusses and arches; friction; centroid; principle of virtual work; Cartesian, normal-tangential, and polar components of velocity and acceleration in two and three dimensions; rotating frames; kinematics of particles and rigid bodies; force/acceleration; work/energy; impulse/momentum; conservative and non-conservative systems; systems of streams of particles and rigid bodies; introduction to three dimensional problems of particles and rigid body dynamics. 3 cr, 4 lec, 2 tut. Prerequisites: MATH 1020U, MATH 1850U, and PHY 1010U.

ENGR 2220U - Structure and Properties of Materials

Atomic structure and atomic bonding in solids, structure of crystalline solids, solidification and defects, alloys and phase diagrams, mechanical properties of metals and alloys, semiconductors, organics, polymers, crystalline ceramics, glass and fibre optics, composites, biomaterials, magnetic materials. 3 cr, 3 lec. Prerequisite: CHEM 1800U or CHEM 1020U.

ENGR 2310U - Concurrent Engineering and Design

This course covers the modern integrated product development process. Unlike the traditional product development approach, concurrent (simultaneous) engineering and design reunites technical and non-technical disciplines and brings forward a philosophy of cross-functional cooperation in order to create products which meet pre-determined objectives, and are better, less expensive, and more quickly brought to market. It is a process in which appropriate disciplines are committed to work interactively to analyse market and customer requirements in order to improve the end-to-end process by which products are conceived, designed, manufactured, assembled, sold to the customer, serviced, and finally disposed of. The concept of design is presented. Brainstorming, creativity methods, design for manufacturing, design for assembly, design for cost, and design for quality, life cycle design, reverse engineering, and rapid prototyping are addressed. Teamwork and communication skills are developed. 3 cr, 3 lec, 2 lab. Prerequisite: ENGR 3200U.

ENGR 2640U - Thermodynamics and Heat Transfer

Nature of thermodynamics; First Law of Thermodynamics; Second Law of Thermodynamics. Control mass and control volume analyses. Properties and behaviour of pure substances. Ideal gases and mixtures; equation of state for a perfect gas. Maxwell's relations. Introduction to conduction, convection and radiation. Solutions to steady-state and transient conduction problems. Solutions to convection problems for laminar and for turbulent flows. Thermal radiation between black bodies. 3 cr, 3 lec, 2 lab (biweekly), 1 tut. Prerequisites: PHY 1010U, MATH 1020U.

MATH 2860U - Differential Equations for Engineers

A study of differential equations that arise as models of phenomena in engineering. Topics include: first-order equations; linear equations; second-order equations and their applications; systems of linear equations; series solutions; Laplace transforms; introduction to partial differential equations. 3 cr, 3 lec, 1 tut. Prerequisite: MATH 1020U. Credit restriction: MATH 2060U.

**Year 2 - Semester 2-----
(15 credit hours)****ENGR 2420U - Solid Mechanics**

Design of mechanical joints; elasto-plastic torsion of circular sections; elasto-plastic bending of beams; residual stresses, shearing stresses in beams, analysis of plane stress and plain strain problems; pressure vessels, design of members of strength criteria, deflection of beams; indeterminate structures. 3 cr, 3 lec, 2 lab (biweekly), 1 tut. Prerequisite: ENGR 2020U.

ENGR 2790U - Electric Circuits

Basic concepts of electricity, magnetism and electric circuits; DC and AC driven circuits; series and parallel circuits; Ohm's Law, Kirchhoff's Laws, Thevenin's Theorem, Norton's Theorem, operation of electrical equipment such as instruments, motors, generators, solid-state transistors

and microcircuits; electrical measuring equipment and circuit measurements; response to step functions; response to sinusoids, steady-state AC, resonance, parallel resonance, AC power, power factor, power factor correction; graphical and analytical analysis of single-stage amplifier; magnetic circuits and devices: coils, solenoids, transformers; mutual inductance; fundamentals of electro-mechanical energy conversion; elementary rotating machines; single and three phase circuits. 3 cr, 3 lec, 2 lab. Prerequisites: PHY 1020U, MATH 1020U.

ENGR 2860U - Fluid Mechanics

Properties of fluids and their units; fluid static. Kinematics of fluids, conservation of mass and the continuity equation. Dynamics of fluids; Euler's equation; Bernoulli's equation. The energy equation; energy grade lines. Flow of viscous fluids; laminar and turbulent flows; flow in pipes and fittings; the Moody diagram. Flows around immersed bodies; lift and drag on bodies. Boundary layers; flow separation. Flow measurement techniques. 3 cr, 3 lec, 2 lab (biweekly), 1 tut. Prerequisites: PHY 1010U, MATH 1020U.

MATH 2070U - Numerical Methods

Provides an overview of and practical experience in utilizing algorithms for solving numerical problems arising in applied sciences. Topics include: computer arithmetic, solution of a single nonlinear equation, interpolation, numerical differentiation and integration, solution of differential equations, and solution of systems of linear equations. Students will use computer programs in the solution of problems. 3 cr, 3 lec, 1 tut. Prerequisite: MATH 1020U. Credit restrictions: MATH 2072U.

STAT 2800U - Statistics and Probability for Engineers

Sample spaces, probability, conditional probability, independence. Bayes' theorem, probability distributions, algebra of expected values, descriptive statistics. Inferences concerning means, variances, and proportions. Parameter estimation, correlation. Introduction to quality control and reliability. 3 cr, 3 lec, 1 tut. Prerequisite: MATH 1020U. Credit restrictions: BUSI 1450U, SSCI 2910U, STAT 2010U, STAT 2020U, HLSC 3800U.

Year 3 - Semester 1----- (18 credit hours)

ENGR 3030U - Computer-Aided Design

Geometric/solid modelling, computer graphics and feature modelling. Finite element analysis, discretization and modelling, selection of elements, treatment of boundary conditions, checking for accuracy. Design optimization, optimization models, algorithms for optimization. State-of-the-art software packages will be introduced and case studies will be employed. 3 cr, 4 lec, 2 lab. Prerequisite: ENGR 2310U, ENGR 2420U.

ENGR 3190U - Manufacturing and Production Processes

The role and characterization of manufacturing technology within the manufacturing enterprise is studied. Topics include an overview of the deformation process, joining processes, consolidation processes, material removal processes, and material alteration processes; process selection and planning; just-in-time production; computer control of manufacturing systems. 3 cr, 3 lec, 3 lab (biweekly). Prerequisites: ENGR 2220U, ENGR 2310U.

ENGR 3270U - Kinematics and Dynamics of Machines

Classification of mechanisms; velocity, acceleration and force analyses; graphical and computer-oriented methods of analyses; balancing, flywheels, gears, gear trains, and cams. Introduction to Lagrangian dynamics; Lagrange's equations of motion; Hamilton's equations, and Hamilton's principle. 3 cr, 3 lec, 2 lab (biweekly), 1 tut. Prerequisite: ENGR 2020U.

ENGR 3350U - Control Systems

Analysis and synthesis of linear feedback systems by classical state space techniques. Nonlinear and optimal control systems. Modelling of dynamic systems; analysis of stability, transient and steady state characteristics of dynamic systems; characteristics of feedback systems; design of PID control laws using frequent response methods and the root locus technique. 3 cr, 3 lec, 2 lab (biweekly), 1 tut. Prerequisites: ENGR 2790U, MATH 2860U.

ENGR 4260U - Automotive Engineering

This course covers technical systems and related engineering aspects of vehicles, with a focus on how they pertain to vehicle design, analysis, and performance development. Topics covered include: introduction to automotive engineering, fundamentals of vehicle mechanics, design layout of different parts of powertrain, traction and engine torque. Mechanics and properties of road-tires and concepts of the camber and caster, cornering, steady-state handling. Static and dynamic weights, dynamic load shift. Vehicles traveling on graded and banked roads. Accelerating and braking of road vehicles. Air, gradient, and rolling resistances, Determination of the centre of mass, suspension and steering systems, ride, handling performance, issues in proving ground testing of vehicles. 3 cr, 3 lec, 1 tut. Prerequisites: ENGR 2020U, ENGR 3350U.

Liberal Studies

Courses selected for the liberal studies elective must be approved by the Faculty of Engineering and Applied Science. The following are approved as general liberal studies electives:

- EDUC 1200U History of Science and Technology
- JSTS 1000U Introduction to Criminal Justice
- PHIL 1040U Philosophy: Social and Political Issues
- POSC 1010U Political Science
- PSYC 1000U Introductory Psychology
- SOCI 1000U Introductory Sociology
- ANTH 0100T Introductory Anthropology*
- CLLI 0100T Greek Drama in Translation*
- CLST 0100T Introduction to the Study of Modern Culture*
- ENGL 0100T Introduction to English Literature*
- GEOG 0103T Human Geographies in Global Context*
- HIST 0102T Nation and Citizenship: Interpreting Canada*
- HIST 0102T Western European History from the Middle Ages to the Present*
- HIST 1001T Themes in Canadian History I*
- HIST 1002T Themes in Canadian History II*
- NAST 0100T Introduction to Native Studies*
- PHIL 0102T Introduction to Philosophical Inquiry*
- PHIL 0103T Introduction to Philosophical Inquiry*
- POSC 0100T Governance and Globalization - Politics in the 21st Century*
- PSYC 0101T Introduction to Psychology*

- SOCI 0100T Introduction to Sociology*

The following are approved as advanced liberal studies electives:

- JSTS 2190U Issues in Diversity
- JSTS 2550U Psychological Explanations of Criminal Behaviour
- JSTS 2710U Sociological Theories of Crime
- PSYC 2010U Developmental Psychology
- ANTH 0200T Sociocultural Anthropology*
- ANTH 0203T Technologies across Time and Cultures*
- ANTH 0204T Law and Justice across Time and Cultures*
- ANTH 0253T Aboriginal Art in North America*
- ENGL 0212T Early Romantics*
- ENGL 0220T Studies in Shakespeare*
- ENGL 0253T The Age of Elizabeth*
- HIST 0208T The Social History of Europe*
- HIST 0211T The United States from 1775-1880*
- HIST 0221T "Empire Ontario" 1867-1945*
- HIST 0222T Ontario Since 1945: From the "Common Good" to "Common Sense"*
- PHIL 0214T Introduction to Existential Philosophy*
- PHIL 0275T Philosophy of Religion*
- PHIL 0279T Philosophy of Art*
- WMST 0237T Women and the Law*
- WMST 0238T Women and the Criminal Justice System*

*Offered through Trent University at the University of Ontario Institute of Technology

Other liberal studies electives will be identified in the future.

Year 3 - Semester 2----- (18 credit hours)

BUSI 2050U - Economics for Professionals

Aspects of theoretical and applied economics relevant to professionals. Fundamental principles in both micro- and macroeconomics are introduced. Microeconomics topics include scarcity, opportunity cost, diminishing returns, elasticity, industrial organization, economies of scale and concentration. Macroeconomics topics include unemployment, inflation, economic growth, the multiplier, equilibrium, fiscal policy and monetary policy. The principle of money and banking are introduced along with the role of the Bank of Canada. Applied economics topics covered include cost concepts, time value of money, comparison of alternatives, depreciation, tax considerations, economic analysis of projects, break-even, sensitivity and risk, and decision models. 3 cr. 3 lec.

ENGR 3000U - Automotive Component Design

Component design of powertrain: manual and automatic transmissions, transfer case, planetary gears, final drive including differential lock system, propshaft, synchronising element, helical and bevel gears. Design of transmission systems; need for an automatic transmission, function of manual and automatic transmission system; design of planetary gear train transmissions, and peripheral components; Hydraulic power supply, electronic and hydraulic controls in automatic transmissions; transmission arrangements and performance characteristics; chassis design.

Heating and cooling systems design for passenger comfort; design of engine cooling and exhaust systems. 3 cr, 3 lec, 2 lab (bi-weekly), 1 tut. Prerequisites: ENGR 3030U, ENGR 4260U.

ENGR 3210U - Mechanical Vibrations

Fundamental concepts of vibrations of mechanical systems; free vibrations of single degree of freedom systems; various types of damping and vibration absorption; forced vibrations; vibration measuring instruments; steady state and transient vibrations; vibrations of multi-degree of freedom systems; vibration isolation; modal analysis; vibrations of continuous systems; introduction to non-linear vibrations, including non-linear springs and non-linear damping. 3 cr, 3 lec, 2 lab (biweekly), 1 tut. Prerequisite: ENGR 2020U.

ENGR 3220U - Machine Design

Theory and methodology related to conceptual design; review of the methods used in stress analysis; simple design factor approach; variable loads; stress concentrations; bolts and bolted joints; welded joints; springs; shaft and bearing design; brakes and braking systems; design for recycling; reliability, maintenance and cost considerations. 3 cr, 3 lec, 2 lab (biweekly), 1 tut. Prerequisites: ENGR 3270U, ENGR 2310U, ENGR 2420U.

ENGR 3320U - Fluid Power Systems

The course reviews relevant fluid mechanics principles and proceeds with treatments of individual components. Components analysed include: pumps, actuators, lines, valves and other related components. Discussions of individual components include: principles of operation, mathematical models, and design considerations. Analysis and design of fluid power systems used in industrial and processing equipment. Selected topics to include: positive displacement components, control devices, actuators, fluid transmission and system dynamics. 3 cr, 3 lec, 2 lab (biweekly). Prerequisites: ENGR 2860U, ENGR 3350U

ENGR 3450U - Combustion and Engines

Combustion fundamentals, including flame stoichiometry, chemical kinetics, flame temperature, pre-mixed and diffusion flames. Applications to engineered combustion systems such as furnaces and fossil-fuelled engines. Continuous and unsteady combustion systems. Internal combustion engines, including cycles, fuels and lubricants, supercharging, carburetion, valving, manifolding, combustion chamber ignition and fuel injection; engine performance and testing. Design of combustors and engines. Methods for increasing combustion efficiency and reducing pollutant formation. Pollution reduction techniques. Safety issues. 3 cr, 3 lec, 2 lab (biweekly), 1 tut. Prerequisites: CHEM 1800U, ENGR 2320U.

Year 4 - Semester 1----- (18 credit hours)

ENGR 4010U - Vehicle Dynamics and Control

Total vehicle dynamics; dynamical properties of vehicle parts; the longitudinal, lateral and vertical dynamics; mathematical models of vehicles to predict their road performance; suppression of forces, moments, and movements under external road disturbances; steady-state handling and vehicle directional behaviour; transient response and stability in small disturbance manoeuvres; nonlinear effects in tire modelling, classification and analysis of suspension systems; ride quality; driving stability; vehicle control factors such as driver modelling, occupant

comfort and driver interfaces; introduction to active suspension systems, traction control, and yaw-moment control; introduction to advanced vehicle control systems for intelligent vehicle-highway systems. 3 cr, 3 lec, 1 tut. Prerequisites: ENGR 3210U, ENGR 4260U.

ENGR 4060U - Automotive Structural Design and Materials Selection

The course covers the theory and design of automotive body structures and chassis systems in addition to the evaluation of such designs and material selection strategies. An emphasis is placed on the relationships between microstructures, processing, properties and design. The chassis dynamometer as a research and certification tool is introduced, as well as determination of load, road load testing, and power testing. Among other materials, reinforced fibre and cellular plastic composite materials are examined in order to identify their properties and applications. The fundamentals of crash mechanics, manufacturing methods, fabrication, assembly techniques, testing, repair, and design of composite products are also covered. Selected current automotive research and advances are examined. 3 cr, 3 lec, 1 tut. Prerequisite: ENGR 3000U.

ENGR 4080U - Automotive Systems Design

The increasing complexity of automotive systems and the pressure to deliver these systems to market faster is driving the need for better engineering design approaches to product development. This course covers design theory, operation, and testing of systems found in modern automobiles, as well as the impact of automotive design on society. Students work in small groups of three or four and complete a series of projects in which they integrate efficient production methods, cost effectiveness, modern materials utilization, etc. Their work includes a comprehensive presentation of the latest systems and technologies and covers the fundamentals of design of passenger cars, trucks, etc.; layout of major vehicle subsystems to arrive at a preliminary vehicle design; use of systems engineering to define requirements, generate design concept and predict performance; design for vehicle safety. The "best" solutions are chosen from a group of solutions presented to them, based on specified criteria. Modelling and design validation is performed, in some instances, using a computational design and simulation environment. A special requirement for students in engineering and management programs is that, because of the dual orientation of such programs, some of the design projects must be of an engineering-management type and involve business and/or management factors. 3 cr, 3 lec, 2 lab.

ENGR 4210U - Advanced Solid Mechanics and Stress Analysis

Three-dimensional stress analysis; strain energy; energy methods; finite element method; asymmetric and curved beams, superposition of beam solutions, beams on elastic foundations; plate bending; buckling, including Euler's formulae for buckling; eccentric loading; fracture mechanics; fatigue. 3 cr, 4 lec, 2 lab (biweekly), 1 tut. Prerequisite: ENGR 2420U.

Liberal Studies

Courses selected for the liberal studies elective must be approved by the Faculty of Engineering and Applied Science. The following are approved as general liberal studies electives:

- EDUC 1200U History of Science and Technology
- JSTS 1000U Introduction to Criminal Justice
- PHIL 1040U Philosophy: Social and Political Issues
- POSC 1010U Political Science
- PSYC 1000U Introductory Psychology
- SOCI 1000U Introductory Sociology
- ANTH 0100T Introductory Anthropology*
- CLLI 0100T Greek Drama in Translation*
- CLST 0100T Introduction to the Study of Modern Culture*
- ENGL 0100T Introduction to English Literature*
- GEOG 0103T Human Geographies in Global Context*
- HIST 0102T Nation and Citizenship: Interpreting Canada*
- HIST 0102T Western European History from the Middle Ages to the Present*
- HIST 1001T Themes in Canadian History I*
- HIST 1002T Themes in Canadian History II*
- NAST 0100T Introduction to Native Studies*
- PHIL 0102T Introduction to Philosophical Inquiry*
- PHIL 0103T Introduction to Philosophical Inquiry*
- POSC 0100T Governance and Globalization - Politics in the 21st Century*
- PSYC 0101T Introduction to Psychology*
- SOCI 0100T Introduction to Sociology*

The following are approved as advanced liberal studies electives:

- JSTS 2190U Issues in Diversity
- JSTS 2550U Psychological Explanations of Criminal Behaviour
- JSTS 2710U Sociological Theories of Crime
- PSYC 2010U Developmental Psychology
- ANTH 0200T Sociocultural Anthropology*
- ANTH 0203T Technologies across Time and Cultures*
- ANTH 0204T Law and Justice across Time and Cultures*
- ANTH 0253T Aboriginal Art in North America*
- ENGL 0212T Early Romantics*
- ENGL 0220T Studies in Shakespeare*
- ENGL 0253T The Age of Elizabeth*
- HIST 0208T The Social History of Europe*
- HIST 0211T The United States from 1775-1880*
- HIST 0221T "Empire Ontario" 1867-1945*
- HIST 0222T Ontario Since 1945: From the "Common Good" to "Common Sense"*
- PHIL 0214T Introduction to Existential Philosophy*
- PHIL 0275T Philosophy of Religion*
- PHIL 0279T Philosophy of Art*
- WMST 0237T Women and the Law*
- WMST 0238T Women and the Criminal Justice System*

*Offered through Trent University at the University of Ontario Institute of Technology

Other liberal studies electives will be identified in the future.

Engineering Elective

Courses selected for the engineering elective must be approved by the faculty of engineering and applied science. Engineering courses from other engineering programs may be allowed as engineering electives provided students have the prerequisites and the courses extend the students' knowledge through greater depth in an advanced area, or greater breadth in a complementary field.

The following are approved courses as engineering electives:

- ENGR 4160U Artificial Intelligence in Engineering
- ENGR 4380U Life Cycle Engineering
- ENGR 4540U Energy Efficiency, Management and Simulation

Note: Not all of the listed engineering electives will necessarily be offered each year.

Year 4 - Semester 2----- (18 credit hours)

ENGR 3390U – Mechatronics

This course provides students with the tools required to design, model, analyse and control mechatronic systems; i.e. smart systems comprising electronic, mechanical, fluid and thermal components. The techniques for modelling various system components will be studied in a unified approach developing tools for the simulation of the performance of these systems. Analysis will also be made of the various components needed to design and control mechatronic systems including sensing, actuating, and I/O interfacing components. 3 cr, 3 lec, 2 lab (biweekly), 1 tut. Prerequisites: ENGR 3270U, ENGR 3350U.

ENGR 3460U - Industrial Ergonomics

The biology of work; anatomical and physiological factors underlying the design of equipment and work places; biomechanical factors governing physical workload and motor performance; Circadian rhythms and shift work; measurement and specification of heat, light and sound levels with respect to the design of workplaces. Detailed analyses will be made of several cases in which human factors methods have been applied to improve the efficiency with which human/machine systems operate. 3 cr, 3 lec, 1 tut.

ENGR 3460U - Industrial Ergonomics

The biology of work; anatomical and physiological factors underlying the design of equipment and work places; biomechanical factors governing physical workload and motor performance; Circadian rhythms and shift work; measurement and specification of heat, light and sound levels with respect to the design of workplaces. Detailed analyses will be made of several cases in which human factors methods have been applied to improve the efficiency with which human/machine systems operate. 3 cr, 3 lec, 1 tut.

ENGR 4045U - Quality Control

Quality improvement and productivity; quality costs, total quality management; statistical process control; control of incoming material, control charts for attribute and variable data, process capability. Process optimization and design of experiments; screening methods, fractional

factorial experiments, Taguchi methods, empirical regression models; acceptance sampling. 3 cr, 3 lec, 1 tut. Prerequisite: STAT 2800U.

ENGR 4999U - Design Thesis

An engineering thesis project relating to design, on a topic relevant to the student's program, will be carried out under the supervision of a faculty advisor. The course stresses independent work skills and the synthesis of knowledge acquired from previously studied courses. A wide range of topics may be covered, including research and development, testing and/or evaluation of a system, process or device. Each student will prepare a formal technical report and will make an oral presentation. Prerequisite: Successful completion of all third year non-elective courses. A special requirement for students in engineering and management programs is that, because of the dual orientation of such programs, the thesis topic be selected so as to allow the student to investigate, integrate and apply engineering and management principles, objectives and practices. 3 cr, 6 tut.

SSCI 4090U - Ethics and Law for Professionals

Ethical and legal aspects of the engineering profession; business organizations and corporations; intellectual and industrial property; conflict resolution; contract law; employment and labour law; occupational health and safety; Canadian and international engineering standards and commercial practices; international trade; environmental laws and regulations. 3 cr, 3 lec/sem. Not for students in the faculty of social science.

Liberal Studies

Courses selected for the liberal studies elective must be approved by the Faculty of Engineering and Applied Science. The following are approved as general liberal studies electives:

- EDUC 1200U History of Science and Technology
- JSTS 1000U Introduction to Criminal Justice
- PHIL 1040U Philosophy: Social and Political Issues
- POSC 1010U Political Science
- PSYC 1000U Introductory Psychology
- SOCI 1000U Introductory Sociology
- ANTH 0100T Introductory Anthropology*
- CLLI 0100T Greek Drama in Translation*
- CLST 0100T Introduction to the Study of Modern Culture*
- ENGL 0100T Introduction to English Literature*
- GEOG 0103T Human Geographies in Global Context*
- HIST 0102T Nation and Citizenship: Interpreting Canada*
- HIST 0102T Western European History from the Middle Ages to the Present*
- HIST 1001T Themes in Canadian History I*
- HIST 1002T Themes in Canadian History II*
- NAST 0100T Introduction to Native Studies*
- PHIL 0102T Introduction to Philosophical Inquiry*
- PHIL 0103T Introduction to Philosophical Inquiry*
- POSC 0100T Governance and Globalization - Politics in the 21st Century*
- PSYC 0101T Introduction to Psychology*
- SOCI 0100T Introduction to Sociology*

The following are approved as advanced liberal studies electives:

- JSTS 2190U Issues in Diversity
- JSTS 2550U Psychological Explanations of Criminal Behaviour
- JSTS 2710U Sociological Theories of Crime
- PSYC 2010U Developmental Psychology
- ANTH 0200T Sociocultural Anthropology*
- ANTH 0203T Technologies across Time and Cultures*
- ANTH 0204T Law and Justice across Time and Cultures*
- ANTH 0253T Aboriginal Art in North America*
- ENGL 0212T Early Romantics*
- ENGL 0220T Studies in Shakespeare*
- ENGL 0253T The Age of Elizabeth*
- HIST 0208T The Social History of Europe*
- HIST 0211T The United States from 1775-1880*
- HIST 0221T "Empire Ontario" 1867-1945*
- HIST 0222T Ontario Since 1945: From the "Common Good" to "Common Sense"*
- PHIL 0214T Introduction to Existential Philosophy*
- PHIL 0275T Philosophy of Religion*
- PHIL 0279T Philosophy of Art*
- WMST 0237T Women and the Law*
- WMST 0238T Women and the Criminal Justice System*

*Offered through Trent University at the University of Ontario Institute of Technology

Other liberal studies electives will be identified in the future.