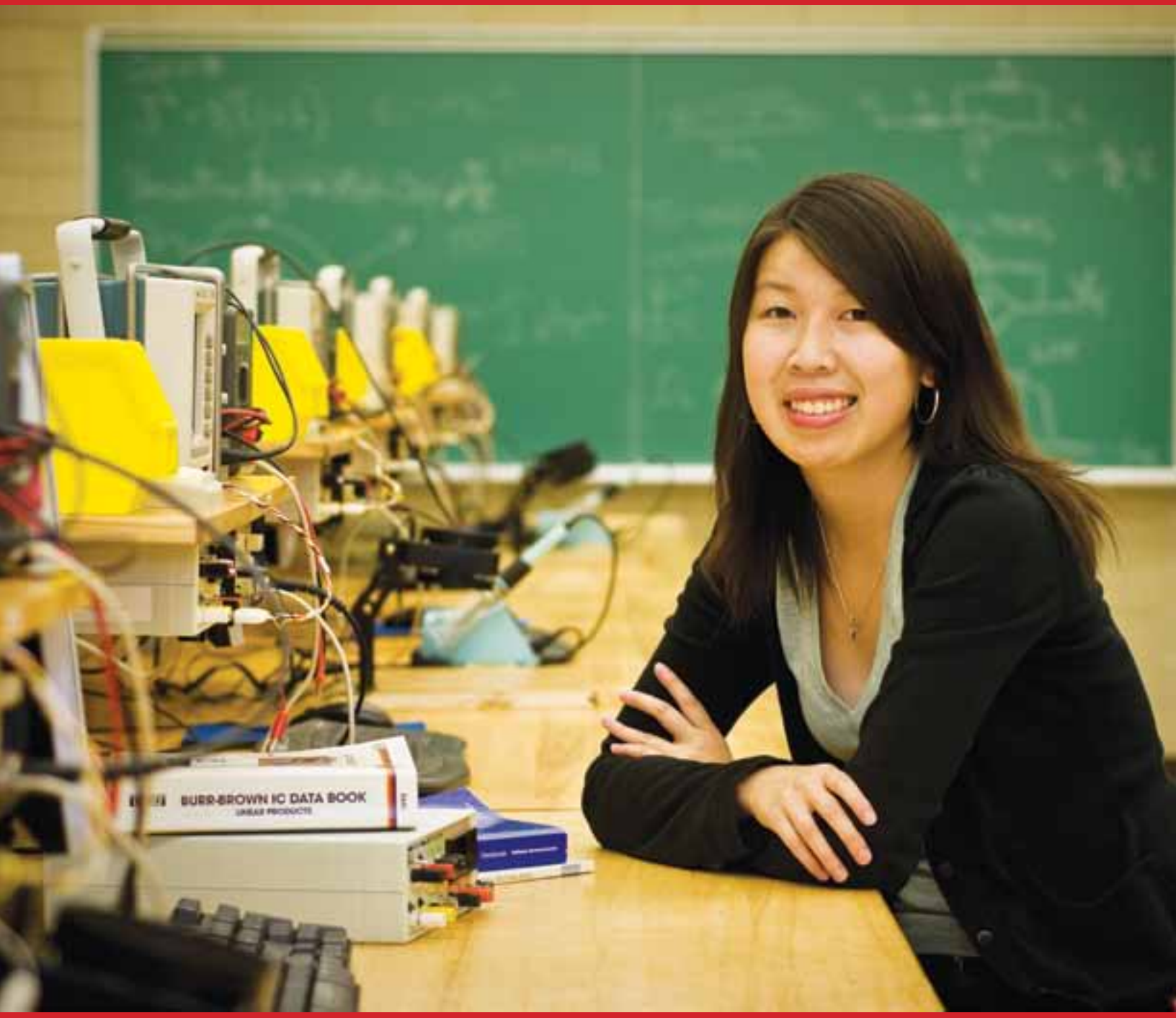
Engineering and Design

Carleton University



carleton.ca/engineering-design

Faculty of Engineering and Design

Areas of Study

Bachelor of Engineering

Co-operative education is available in all programs.

Welcome to Carleton

Welcome to Carleton University, where your program, your university experience and your future success are our priorities.

Carleton offers a comprehensive range of rigorous, innovative programs. You will have the flexibility to choose the degree most appropriate for your interests, aptitudes and career goals, and will be challenged to do your best. Many of our programs offer additional opportunities for specialization through concentrations and streams, and can be further enhanced with co-operative education (co-op) and other work-study choices that allow you to gain practical experience while working towards your degree in Ottawa, Canada's national capital.

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Message from the Dean

Carleton University's Faculty of Engineering and Design has an international, long-standing reputation for excellence in both education and research. Our engineering, architecture, industrial design and information technology programs engage our students to ensure they obtain the best possible education and prepare themselves for a successful and satisfying career.

Our research-intensive Faculty offers one of the most comprehensive platforms of engineering education in Canada at the undergraduate and graduate levels. This fall, we are pleased to introduce our new Bachelor of Engineering (BEng) in Architectural Conservation and Sustainability program. It provides a unique, innovative focus in a multidisciplinary program that blends both civil engineering and architectural studies. This is in addition to two recently launched programs that reflect the most up-to-date developments in science and technology: our BEng in Sustainable and Renewable Energy Engineering and BEng in Biomedical and Mechanical Engineering programs.

Carleton University is currently in the process of constructing a new building for January 2011 that includes state-of-the-art laboratories and facilities which will engage students in our new and existing programs across the faculty. We also offer co-operative education and internship options to allow you to enhance your academic studies with more practical experience.

The engineering and design professions have become the main engines of economic growth through the introduction of new products and technological innovations necessary to continue to improve our standard of living. I invite you to join us at Carleton University and realize your full potential in engineering and design in our beautiful campus located in the National Capital Region, overlooking the Rideau River and the Rideau Canal.

Dr. Rafik A. Goubran, PEng
Dean, Faculty of Engineering and Design

The Carleton Advantage

Carleton University provides a stimulating and supportive community for your studies in engineering and design. You will have the choice of a number of rigorous programs and several options for specialization in a particular area.

You will be taught by experienced professors who are renowned experts in their fields and engaged in research on the national and international stage. You will have access to world-class facilities—state-of-the-art wind tunnels and strong floors, microchip fabrication facilities and the very latest in laboratories, design studios and advanced computer and networking platforms. You will take part in stimulating team projects, be inspired by guest speakers and have many opportunities for hands-on learning through co-op, fieldwork and other work-study options.

carleton.ca/
engineering-design

Relevant and accredited

The Faculty of Engineering and Design

The capital advantage

Our location in Canada's capital provides access to some of the world's best technology companies and government laboratories for co-op and internship placements. Ottawa is considered a global technology leader with more than 1,800 technology companies including several multinational giants. Ottawa's key industries include telecommunications, security and defence, software, aerospace, environment, construction, semiconductors, wireless, software and life sciences—and employ nearly 79,000 people.

carleton.ca/
engineering-design

RELEVANT
Today, more than ever before, our world needs people with degrees and professional qualifications in the engineering and design disciplines. You will graduate from the Faculty of Engineering and Design with the knowledge to design such things as buildings, aircraft, software, telecommunications systems, medical devices and environmental solutions to pollution, depending on your program.

IN DEMAND
The Bachelor of Engineering, Bachelor of Architectural Studies, Bachelor of Industrial Design and Bachelor of Information Technology are highly desirable degrees in today's fast-paced technology-driven world.

WELL RECOGNIZED
We are recognized as a leading engineering and design faculty in Canada, with the most extensive range of programs in the country.

INNOVATIVE
Universities teach, but they are also the creators of new knowledge. Our links with some of the best-known companies and government departments/agencies mean that our programs are on the cutting-edge of advances in the field.

ADVANCED
You will be exposed to exciting technological advances in information storage, global communications networks, computer-aided design and 3D image manipulation technologies. Other examples include aircraft simulators, advanced water and waste water treatment methods, offshore structures, new transportation approaches and transistors that are smaller than most living cells.

HANDS-ON
A Carleton education will teach you to use both your mind and your hands. We emphasize problem solving through laboratory work. You then get the chance to test your theoretical knowledge in the real world in co-op placements and fourth-year projects.

CHALLENGING
If you enjoy competition and teamwork, you can test your knowledge and match wits with other university students by entering engineering and design competitions (departmental, provincial or national). You will not only hone your professional presentation skills but also be exposed to mentors and business contacts who will be important to your future.

COMMITTED
Teaching is a major focus at Carleton University. Our professors are known and respected both nationally and internationally. We make sure you benefit directly by having many senior professors teach first-year courses. In addition, we have one of the best professor-to-student ratios in the country.

Four areas of study

Carleton University is one of the nation's leading institutions in the study and research of engineering, architecture, industrial design and information technology. Our comprehensive programs provide an outstanding education in an environment that is challenging, diverse and flexible. We offer four broad areas in which you can study.

ARCHITECTURAL STUDIES
carleton.ca/architecture

As a student in the Azrieli School of Architecture and Urbanism, you are offered choices in architectural design, technology and practice. You will begin your studies with courses in drawing, multimedia applications, art history and the social sciences. As you progress, you will pursue your own research in workshops, gain exciting hands-on experience, visit local building sites, and have the option to study abroad in your third year. You may also take part in our own Student Design Clinic, where senior students serve real clients with design ideas and advice on proposed building renovations and additions.

ENGINEERING
carleton.ca/engineering-design

Carleton's Engineering program ranks among the best in the country. The general curriculum begins with a common foundation in mathematics, physical sciences and engineering principles. You will also have the choice of a number of specialized programs: Aerospace; Architectural Conservation and Sustainability; Biomedical and Electrical; Biomedical and Mechanical; Civil; Communications; Computer Systems; Electrical; Environmental; Mechanical; Software; Sustainable and Renewable Energy; and Engineering Physics. Each of these disciplines provides opportunities for you to specialize according to your individual interests and eventual career goals.

INDUSTRIAL DESIGN
id.carleton.ca

The field of industrial design bridges the gap between technological developments and the human users of these innovations. In this program, you will learn the many elements that contribute to making technology serve people better. Starting with a firm base in mathematics, economics, psychology and physical sciences, Carleton's School of Industrial Design will introduce you to the modern production and innovation that goes into the development of all new products. You will study the aspects of design that make such products successful—both technically and commercially—and have the opportunity to highlight your work in an annual exhibition that has become a showcase for the university's most promising graduates.

INFORMATION TECHNOLOGY
bitdegree.ca

Carleton's School of Information Technology offers innovative programs leading to a Bachelor of Information Technology degree. The school delivers two distinct programs jointly with Algonquin College—Interactive Multimedia and Design (IMD) and Network Technology (NET). You will graduate with a Bachelor of Information Technology degree from Carleton University and either an Advanced Diploma of Applied Art (for IMD students) or an Advanced Diploma in Technology (for NET students) from Algonquin College. The curriculum, with a strong mix of theoretical concepts and hands-on training, is designed to stay current with the fast pace of change in the high-tech industry. Both the IMD and NET programs offer a co-op option with high placement rates.

Aerospace Engineering

In the 20th century, humans finally realized the age-old dream of flying. Today, the modern aerospace industry in Canada is vigorous, innovative and highly competitive.

Generating over $20 billion in annual revenue and employing over 80,000 people, the Canadian aerospace industry has a worldwide reputation for leadership in a number of fields—including commuter and business aircraft, gas turbine power plants, aircraft simulators, communications satellites and guidance systems.

The Carleton advantage

Carleton University established the first Bachelor of Engineering (BEng) degree program in Aerospace Engineering in Canada. Carleton's program is recognized for:

- a wide range of topics offered within four streams of study;
- a unique final-year design project that emulates a design office setting at an aerospace firm;
- an emphasis on problem-solving skills, and hands-on laboratory and design work;
- a progressive co-operative education (co-op) option; and
- excellent scholarships for high-standing students.

Unparalleled resources

Carleton's laboratory and computer facilities available to aerospace engineering students are unparalleled. Laboratory facilities include multiple wind tunnels ranging from an atmospheric boundary-layer tunnel to a supersonic tunnel; a large-scale water channel; model satellites; test facilities for thermal and vibration testing of satellite sub-structures; systems for structural testing of aircraft components; material processing equipment including furnaces and a plasma spray coating facility; equipment for the study of heat transfer phenomena; and facilities for training on avionics systems. In addition, students benefit from Carleton's proximity to, and close association with, government research organizations such as the National Research Council Canada.

Program of study

The BEng program in Aerospace Engineering is fully accredited by the Canadian Engineering Accreditation Board. The program's four streams consist of:

Jeff Teutsch, Aerospace Engineering

As a Aerospace Engineeering student, Jeff Teutsch has taken on strong leadership roles in Carleton's Mechanical and Aerospace Society. However, his biggest challenge is yet to come as he launches into a challenging final-year project.

This year, Jeff will be building an Unmanned Aerial Vehicle (UAV). The vehicle, aptly named The Rook, will be a mini, 35 kg modular UAV designed to fly missions for universities and small enterprises. The project parameters include safety, ease of assembly and an ability to follow ground relief.

- Aerodynamics, Propulsion and Vehicle Performance
- Aerospace Structures, Systems and Vehicle Design
- Aerospace Electronics and Systems
- Space Systems Design

The four streams provide a foundation in the key disciplines of dynamics/controls, thermofluids, solid mechanics, materials and avionics electronics/systems, all of which are essential to the design of airframes, space platforms, propulsion systems, and control and navigation systems. Each stream begins with a common set of courses in engineering and science. These are followed by increasingly specialized courses throughout the remainder of the four-year program.

Please refer to the *Carleton University Undergraduate Calendar* at carleton.ca/cuuc for more information on courses as well as details on the co-operative education option for this program.

After graduation

As graduates of the Aerospace Engineering degree program, students are well prepared for challenging careers within the aerospace design and manufacturing industry, airline and space operations, government research laboratories, and aircraft certification and accident investigation authorities.

The Carleton Moonbuggy in action at NASA's Marshall Space Flight Center. The course simulates a lunar landscape and includes hills, craters, sand traps and serpentines.

New Architectural Conservation and Sustainability

Architectural Conservation and Sustainability

Sustainable development and heritage conservation have become guiding principles for our modern industrial society. With increased awareness of the importance of economic, social and environmental sustainability, expertise in sustainable green building design and heritage conservation is now in high demand.

Skilled civil and environmental engineers apply their knowledge in sustainability to the design and retrofit of both new and existing buildings and other structures, considering areas such as life cycle costs, impacts of selected materials, and energy needs and consumption. They also bring their expertise to the burgeoning field of conservation, as more structures receive various levels of heritage designation and are in need of repair and adaptation.

The Carleton advantage

Carleton's Bachelor of Engineering (BEng) in Architectural Conservation and Sustainability is a multidisciplinary program

Students learn how to analyze unique structural components (e.g., arches) and how to design and implement rehabilitation strategies for our heritage buildings.

that blends both engineering and architectural studies. You will have the opportunity to study within a top-notch engineering faculty as well as be enriched by the program's close association with Carleton's well-known architecture program. The program offers:

- the opportunity to follow one of two study streams suited to your background and interests;
- a challenging and hands-on final-year project that brings together knowledge, skills and expertise gained in the program;
- a progressive co-operative education (co-op) option;
- integrated and collaborative approaches to projects with architecture students; and
- generous scholarships to high-standing applicants.

Unparalleled resources

At Carleton, you will benefit from:

- well-equipped engineering laboratories and computer rooms on campus;
- state-of-the-art architecture facilities, considered among the finest in North America;
- proximity to key industry and government partners such as the Heritage Conservation Directorate, Public Works and Government Services Canada, the Canada Green Building Council, and Canada Mortgage and Housing Corporation; and
- association with advanced research institutions such as the National Research Council Canada, Natural Resources Canada and Environment Canada.

Program of study

The BEng in Architectural Conservation and Sustainability has been designed to meet the strict professional and academic requirements of the Canadian Engineering Accreditation Board.

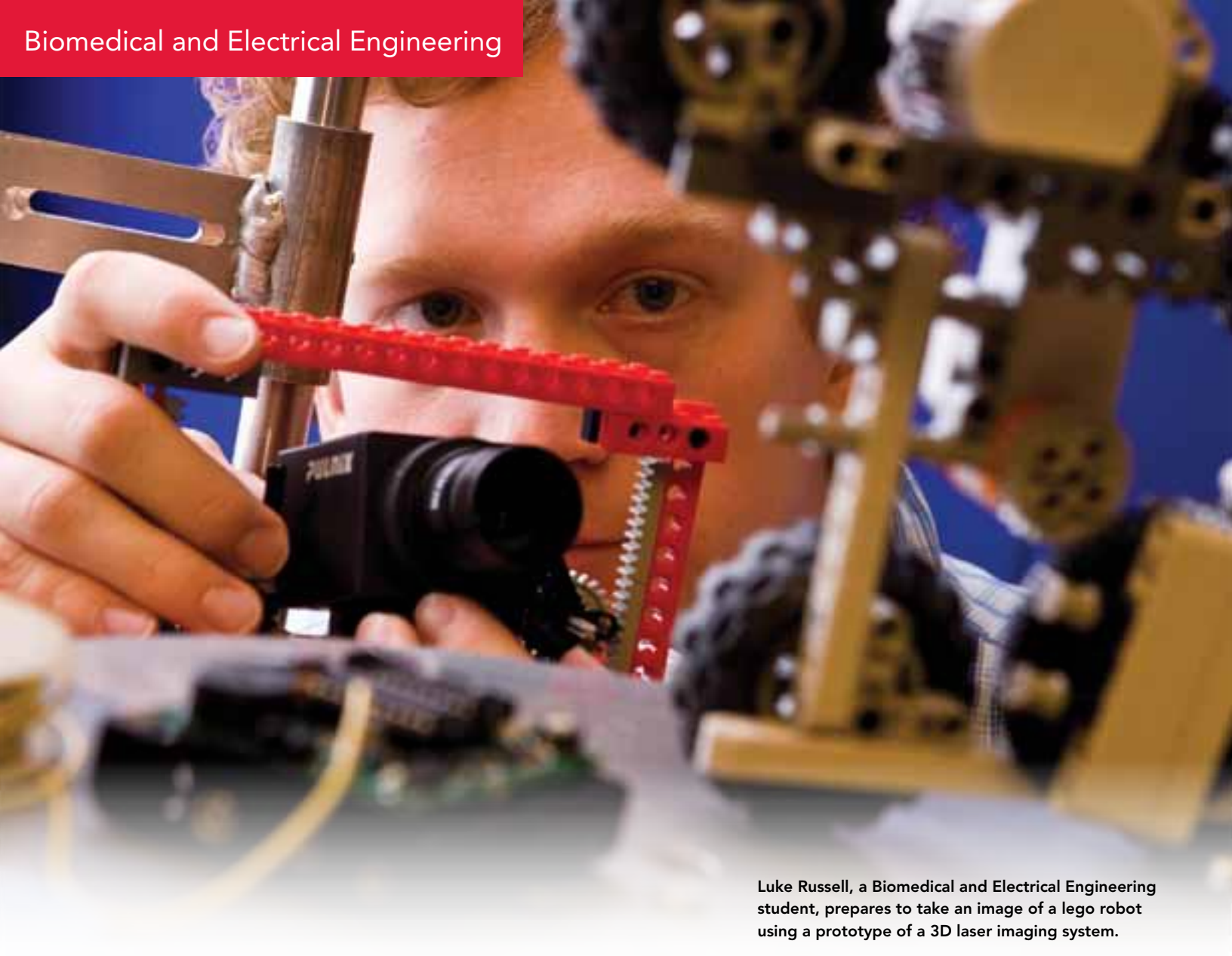
The program offers a choice of two streams of study: the Structural Stream and the Environmental Stream. In the first two years, students in both streams study a similar core of courses in engineering, math, science and introductory architecture. In the third and fourth years of the program, the streams become more specialized. As a Structural Stream student, you will concentrate on conservation and sustainability in the design of new structures, and the assessment, rehabilitation and retrofit of existing structures. The Environmental Stream allows you to develop sustainable building practices with a focus on life cycle analysis of structures, water quality and conservation, air quality, and disposal of materials and waste streams. Students in both areas complete a specialized design project in their final year, as well as study green building design and rehabilitation of heritage buildings.

Please refer to the *Carleton University Undergraduate Calendar* at **carleton.ca/cuuc** for more information on courses as well as details on the co-operative education option for this program.

After graduation

As a graduate in this field, you will have acquired a skill set that industry has identified as lacking in current post-secondary school education in Canada. You will be well equipped with the knowledge and skills needed to work in the engineering field and will benefit from the increased recognition of the need for building professionals with unique expertise in historic or designated heritage buildings and the conservation process. You may also continue studies in graduate programs in conservation and sustainability or choose to work towards professional designation as an architect by entering Carleton's Master of Architecture program.

Graduates of the program will have the knowledge and skills to use resources efficiently while creating buildings that are better for both human health and the environment.



Luke Russell, a Biomedical and Electrical Engineering student, prepares to take an image of a lego robot using a prototype of a 3D laser imaging system.

Biomedical and Electrical Engineering

Increasingly, the field of health care relies on technology. Biological signals, such as those from the heart and brain, are routinely used for both diagnostic and therapeutic purposes. Computer tools are used to collect and analyze data, such as gene sequence databases that contain millions of entries.

Mechanical elements, sensors, actuators and electronics make medical devices work—and can even be used to deliver drugs inside the human body. Advances in medical imaging techniques such as MRI and PET scans lead to the early diagnosis of disease and better treatment and prevention. Medical informatics, telemedicine and electronic health records help improve the delivery of health care.

Biomedical and electrical engineering is a fast-growing field that uses technology to design and build new components and systems for biomedical solutions to problems in medicine and biology.

sce.carleton.ca

The Carleton advantage

Carleton's Bachelor of Engineering (BEng) degree program in Biomedical and Electrical Engineering provides comprehensive studies in electrical engineering and science with applications in biotechnology and medicine. The program offers:

- a strong emphasis on bioinformatics, bio-signal processing, information technology in biomedicine, micro-technology for sensors and micro-electro-mechanical systems (MEMS), instruments and measurements, and cardiovascular devices;
- a progressive co-operative education (co-op) option—the program is highly linked with local hospitals and the University of Ottawa Heart Institute; and
- excellent scholarships for high-standing students.

Unparalleled resources

At Carleton, you will benefit from:

- state-of-the-art biomedical research facilities, including a biological signals laboratory and medical imaging laboratory, as well as telemedicine and tele-operations facilities;
- collaborations with outstanding area hospitals such as the Children's Hospital of Eastern Ontario (CHEO) and other health care establishments;
- a superb undergraduate computing network, including Windows-based PCs and Sun Ultra workstations;
- prominent professors from the medical field who work closely with our engineering professors; and
- access to industry-sponsored laboratories such as the Alcatel, Texas Instruments and Mitel laboratories.

Professor Adrian Chan and his students examine whether food borne bacteria can be detected and identified by odour. Here, they prepare samples to be tested by an electronic nose.

Program of study

The BEng in Biomedical and Electrical Engineering degree program is fully accredited by the Canadian Engineering Accreditation Board. When you graduate from this program, you will meet the educational requirements for registration as a professional engineer. The program is also designed to meet the prerequisite courses required by most medical schools in North America.

As a student in this program, you will spend your first year learning the fundamentals of science and mathematics, including biology, chemistry and physics. In subsequent years, you will build on your knowledge in mathematics and science, but increasingly study topics in electrical engineering, electronics, computer engineering and software. Senior courses emphasize biomedical engineering and apply your knowledge to the biomedical and health care fields. You will have the opportunity for hands-on practice through supervised project work, extensive laboratory and clinical field experience, and oral and written presentations.

Please refer to the *Carleton University Undergraduate Calendar* at carleton.ca/cuuc for more information on courses as well as details on the co-operative education option for this program.

In addition to housing state-of-the-art research facilities, Carleton's engineering building provides several common areas for students to gather and work on group projects.

After graduation

Graduates of this program find employment in health-care establishments and medical facilities, working with computers, medical equipment or medical devices. Rewarding work can also be found in developing health care technologies such as electronic implants, safer medical materials and devices, or superior data management and diagnostic systems. You will also be well prepared for continued studies at the graduate level or in medicine.

Carleton graduate student Idana Veledar examines fixation and movement of a total hip replacement in an artificial thigh bone after subjecting it to the types of loads that would be expected in daily activities such as walking and stair climbing.

Biomedical and Mechanical Engineering

Biomedical engineers design and build components and systems for applications that help solve biological and medical problems—including prostheses, artificial organs, drug delivery systems and a broad range of surgical and life-support systems used in medical practice.

Carleton's program in Biomedical and Mechanical Engineering provides training in mechanical engineering principles used to analyze and solve problems related to biomechanical engineering, biotechnology and medicine. Core mechanical engineering courses are complemented by courses in areas such as biofluids, biomechanics, biomaterials and biomedical device design. In the fourth year of study, you will participate in a major biomedical design project that further develops quantitative and experimental skills in a team setting while providing outstanding practical experience.

The Carleton advantage

Carleton University's Bachelor of Engineering (BEng) in Biomedical and Mechanical Engineering offers:

- a progressive co-operative education (co-op) option;
- strong emphasis on hands-on laboratories and design; and
- excellent scholarships for high-standing students.

Unparalleled resources

As a student in the Biomedical and Mechanical Engineering program, you will benefit from:

- modern, well-equipped laboratories;
- excellent computer facilities;
- proximity to, and collaboration with, area hospitals, biotechnology firms, research institutions and government agencies and departments; and
- an interdisciplinary approach with opportunities to work with, and learn from, students in other engineering programs.

Carleton graduate student Andrew Geddes (2007) developed a device to measure the position and force of a doctor's fingertips during abdominal examinations. This research will be applied to patient simulators developed in fourth-year research projects by students.

Program of study

The BEng program in Biomedical and Mechanical Engineering has been designed to meet the strict professional and academic requirements of the Canadian Engineering Accreditation Board. The program is also designed to meet the prerequisite courses required by most medical schools in North America.

The fundamentals of basic science and mathematics included in your first year provide a solid foundation for second-year courses emphasizing engineering science. Third- and fourth-year studies include courses that focus on biomedical applications such as biofluids, biomaterials, biomechanics and biomechanical device design, balanced by courses that provide well-rounded training in mechanical engineering.

Please refer to the *Carleton University Undergraduate Calendar* at carleton.ca/cuuc for more information on courses as well as details on the co-operative education option for this program.

After graduation

As a graduate of this program, you will be qualified to work in many industrial and public organizations in the fields of medical devices, biomedical engineering, health services, diagnostic equipment, medical instruments and medical information systems. These industries are continuing to grow at a phenomenal rate, both in Canada and globally, and the demand for specialists in this area is expected to increase.

Civil Engineering

Civil engineers plan, design, build, maintain, rehabilitate and manage the infrastructure in which we live and work. This infrastructure includes the buildings, highways, railways, airports, subway systems, bridges, pipeline systems, canals, water systems and other aspects of the physical framework that our world depends on.

By choosing Civil Engineering as a path for your studies, you are well on your way to a rewarding career in which you can make meaningful contributions to the development and evolution of our physical world.

The Carleton advantage

Carleton University's Bachelor of Engineering (BEng) degree program in Civil Engineering offers:

- courses and design projects in structural, geotechnical and transportation engineering;
- a program of study that emphasizes problem-solving skills, laboratory experience, design and advanced computer methods for civil engineering;

- a progressive co-operative education (co-op) option;
- opportunities to participate in collaborative design projects with industry, government and other research agencies in the Ottawa region; and
- excellent scholarships for students with high academic standing.

Unparalleled resources

You will find excellent laboratory and computer facilities at Carleton. For example, you may become involved in research studies that test the materials of large-scale specimens using the specialized facilities of the strong floor in the Minto Centre for Advanced Studies in Engineering. Carleton's proximity to the laboratories of the National Research Council Canada gives you access to additional research and resource facilities.

Program of study

The BEng degree program in Civil Engineering is fully accredited by the Canadian Engineering Accreditation Board. When you graduate from this program, you will meet the educational requirements for registration as a professional engineer.

Photo courtesy of Igor Milasin

Engineering students prepare their entry for the annual Troitsky Bridge Building Competition at Concordia University in Montreal. Competitors use skill and imagination to construct simple bridges from dental floss, popsicle sticks and glue. Entries are judged on aesthetics, originality, presentation and strength—some bridges can support over 5,000 pounds of force.

At Carleton, you will develop a broad background in engineering in your first two years of study. In your final two years, you can specialize in one of the following categories:

- **Structural engineering**—the construction and functioning of safe, reliable buildings and bridges, as well as the analysis and assessment of existing structures;
- **Transportation engineering**—the planning and design of safer systems and facilities for traveling and transportation on land, by water or in the air;
- **Geotechnical engineering**—the use of soil and rock as building foundations or as the framework for structures such as tunnels and mines; and
- **Municipal engineering**—the range of tasks handled by municipal governments, such as road or bridge maintenance, water and waste water treatment and urban planning.

In addition, you may choose to take a concentration in Management. This option provides a series of management courses beginning in the second year, enabling you to gain valuable skills in accounting, marketing and project management.

Please refer to the *Carleton University Undergraduate Calendar* at carleton.ca/cuuc for more information on courses as well as details on the co-operative education option for this program.

The capital advantage

The National Research Council Canada (NRC) is the country's scientific and industrial research agency. Based in Ottawa, the NRC helps turn ideas and knowledge into new products, processes and services. Outstanding government scientists and engineers work directly with partners from Carleton University and from industry. These collaborations mean that Carleton students enjoy access to the latest technology and research, especially in the areas of aerospace, hydraulics, information technology, transportation and micro-structural sciences.

Hottest research

Professor George Hadjisophocleous, Canada's first Industrial Research Chair in Fire Safety Engineering, is an internationally recognized expert in the field of fire safety. A combination of computer modelling and full-scale testing allows Professor Hadjisophocleous and his team to examine how fire develops and spreads in buildings, the toxic gases it produces, how fast it moves, how occupants behave, and the effectiveness of preventive measures.

After graduation

As a graduate of this program, you will have expertise in analysis, computer applications, design, construction and management. That expertise can be used to plan and execute projects in areas that include, but are not limited to, building and bridge construction, design and construction of runways and seaports, energy resource development, engineering for cold climates, and water and waste water treatment.

The Mitel-sponsored VoIP Research Laboratory is served by a Mitel 3300MXe IP PBX which interfaces to Mitel's family of PoE technology IP phones.

Communications Engineering

Communications engineers are specialists in the planning, building and operating of the systems that define the ways in which we carry out our business, leisure and personal lives.

As the architects and implementers of new generations of wireless systems, Internet applications, cloud computing, satellites, smart phones, social networking technologies, and integrated voice, data and video telecommunications, communications engineers will play an important role in the world economy in the future.

sce.carleton.ca

The Carleton advantage

The Bachelor of Engineering (BEng) degree program in Communications Engineering offers:

- integrated studies in the principles and practice of telecommunications and related computer technologies;
- a progressive co-operative education (co-op) option;
- the development of strong problem-solving skills through hands-on laboratories and design work;
- lecturers who are communications experts from the university as well as from industry and government; and
- excellent scholarships for high-standing students.

Unparalleled resources

As a Communications Engineering student at Carleton, you will benefit from modern, well-equipped laboratories and facilities on campus. In addition, you will benefit from Carleton's proximity to, and close association with, the laboratories of the federal Communications Research Centre, the National Research Council Canada and local technology companies.

Program of study

The BEng program in Communications Engineering is fully accredited by the Canadian Engineering Accreditation Board. When you graduate from this program, you will meet the educational requirements for registration as a professional engineer.

The program provides a broad foundation in the basics of mathematics, the physical sciences, the engineering sciences and technology. It includes communications theory and practice, design and analysis of telecommunications components, systems, software, applications, and regulatory and social issues, and will give you a strong background in real-time computer systems and software engineering. The program is designed to provide you with the flexibility required to practise in a world of rapidly changing technology, as well as the specific knowledge and skills that employers in the telecommunications and information industries are looking for.

Please refer to the *Carleton University Undergraduate Calendar* at carleton.ca/cuuc for more information on courses as well as details on the co-operative education option for this program.

After graduation

As a graduate of our program in Communications Engineering, you will have a wide variety of employment options in the telecommunications, transportation, financial and defence industries, as well as government and private research and development, regulatory agencies and standards organizations.

Computer Systems Engineering

Computer systems engineers focus on the design, implementation and testing of complex systems that have computers as components. They create and implement computer-based systems to solve problems in areas such as real-time control systems, autonomous robotics, wireless networks, distributed systems, multimedia applications and more.

Their work is apparent in almost everything we build — from smart phones, modern gaming devices, intricate communications networks and terrestrial transportation, to avionics, innovative medical devices and the systems that control the infrastructure in our lives.

sce.carleton.ca

Improving Communications

Dean of Engineering and Design Rafik Goubran works on innovative techniques to improve the speech quality in wireless phones and on voice transmission over the Internet (VoIP). With his team, he explores modern stereophonic high-fidelity teleconferencing and video-conferencing systems, including microphone arrays and steerable cameras. The team also works on medical applications, such as smart apartments for the independent living of seniors. His research is done in collaboration with industry, the Elisabeth Bruyère Research Institute, the Elisabeth Bruyère Hospital, the Natural Sciences and Engineering Research Council, and Communications and Information Technology Ontario.

The Carleton advantage

Carleton's Bachelor of Engineering (BEng) degree program in Computer Systems Engineering contributes to Ottawa's reputation as a high-tech centre. Partnerships and close interactions with leading firms and organizations enrich our curriculum; in return, these companies and organizations tap into Carleton as a rich source of talent, ideas and expertise.

The BEng in Computer Systems program offers:

- integrated studies in the areas of computer systems organization, software engineering, real-time systems, electronics, computer networking, and general systems design;
- a progressive co-operative education (co-op) option;
- an emphasis on problem-solving skills and hands-on experience through laboratory and design work; and
- excellent scholarships for high-standing students.

Unparalleled resources

At Carleton, you will benefit from:

- well-equipped laboratories and computer facilities on campus; and
- Carleton's proximity to, and close association with, the laboratories of the Communications Research Centre, the National Research Council Canada and local technology companies.

Program of study

This BEng program is fully accredited by the Canadian Engineering Accreditation Board. When you graduate from the program, you will meet the educational requirements for registration as a professional engineer.

As a student in the Computer Systems Engineering program, you will first acquire a broad base of knowledge in science, mathematics, computers, and engineering science and design. Over the next three years of the program, you will take courses that combine software, hardware and computer networking studies. You will become adept in object-oriented programming, C++ and Java, real-time systems, software engineering, and other specialized topics (with possible focus on robotics or artificial intelligence), and have the opportunity to undertake an advanced research project.

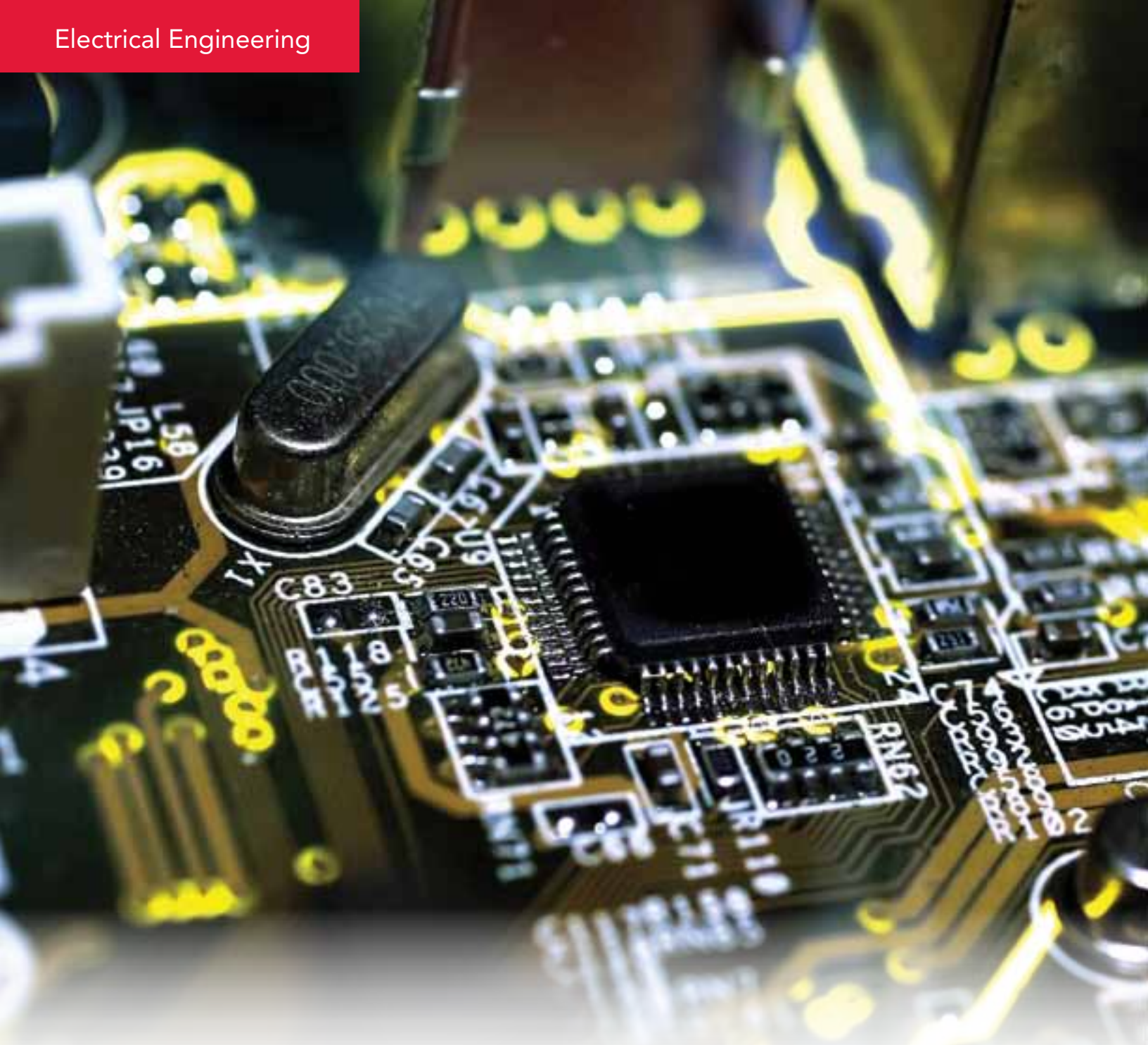
Please refer to the *Carleton University Undergraduate Calendar* at **carleton.ca/cuuc** for more information on courses as well as details on the co-operative education option for this program.

After graduation

After graduating from the Computer Systems Engineering degree program at Carleton, you will be able to design software or computer hardware. You will have special skills in working at the interface of hardware and software, especially in the area of embedded and autonomous systems, microcontroller applications, telecommunications, and the engineering of computer-based systems. Graduates of the program are the founders of, and active leaders in, several high-tech companies specializing in computer systems and information networks.

Katherine Newcombe, Computer Systems Engineering

In her final year of study in Computer Systems Engineering, Katherine Newcombe plays an active role in the Carleton University Robotics Club, a club that welcomes all students with an interest in robotics, regardless of their academic program. She is also gearing up to run the Go Eng Girl program—an outreach initiative designed to encourage more girls to consider engineering as a course of study. The program allows young girls (Grades 7-10) to explore the engineering profession through a full day of special guest speakers, hands-on activities, laboratory tours and opportunities to meet current female engineering students.



Electrical Engineering

Carleton electrical engineers are transforming civilization and society. Working in industry, government and universities, they create the light we read by, the devices we use to play our music, and the computers we work, game and socialize on.

This revolution in lifestyle is achieved through the design of the largest and the smallest structures ever built by humans. Working with nano-scale devices smaller than most living cells, electrical engineers design the microchips used in larger devices from cellphones to satellites and supercomputers. This vast array of networked devices is powered by the largest man-made structure in the world; a massive

grid, designed by electrical engineers, moves energy from large power stations, wind generation farms and solar power arrays to places all over the world, creating light and heat, transporting people, irrigating land and powering phones and computers.

The Carleton advantage

Carleton University's Bachelor of Engineering (BEng) degree program in Electrical Engineering offers:

- strong specializations in wireless electronics, integrated circuit design and fabrication, nano-technology, green energy, biomedical sensors and technologies, antennas, light-wave devices, aerospace electronics, and design automation;
- opportunities for students to design their own integrated circuits in our on-campus fabrication facility—one of the few such facilities at a Canadian university;
- access to Ottawa's large concentration of telecommunications and high-tech companies, federal government research labs, as well as leading hospital and medical research facilities such as the Heart Institute and the Children's Hospital of Eastern Ontario (CHEO), enabling you to develop contacts for future employment;
- a progressive co-operative education (co-op) option; and
- excellent scholarships for high-standing students.

Unparalleled resources

At Carleton, you will benefit from:

- modern, well-equipped laboratories and computer facilities right on campus;
- on-site facilities for manufacturing integrated circuits;
- our close association with the largest government electrical engineering (EE) laboratories in Canada including the Communications Research Centre Canada and the National Research Council Canada; and
- a superb undergraduate computing network, including the latest models of Windows-based PCs and Sun Ultra workstations with state-of-the-art computer-aided design (CAD) tools.

Program of study

The BEng in Electrical Engineering degree program is fully accredited by the Canadian Engineering Accreditation Board. When you graduate from this program, you will meet the educational requirements for registration as a professional engineer.

The first year of the program emphasizes fundamentals in mathematics and science. Second year offers introductory courses in network analysis, electronic circuit design, object-oriented programming and numerical analysis, while continuing to develop a strong base of mathematical and computer skills. Third-year courses provide specialization in digital and analog circuit design, semiconductor device physics, electromagnetics and real-time programming.

Fourth year offers options for further development in areas such as wireless electronics, antennas, integrated circuit design, layout and fabrication, fibre optic communications, nano-electronics, sensors and sensing technology, solar cell/photovoltaic technology, power systems, aerospace electronics and CAD for electronics engineering.

Please refer to the *Carleton University Undergraduate Calendar* at carleton.ca/cuuc for more information on courses as well as details on the co-operative education option for this program.

After graduation

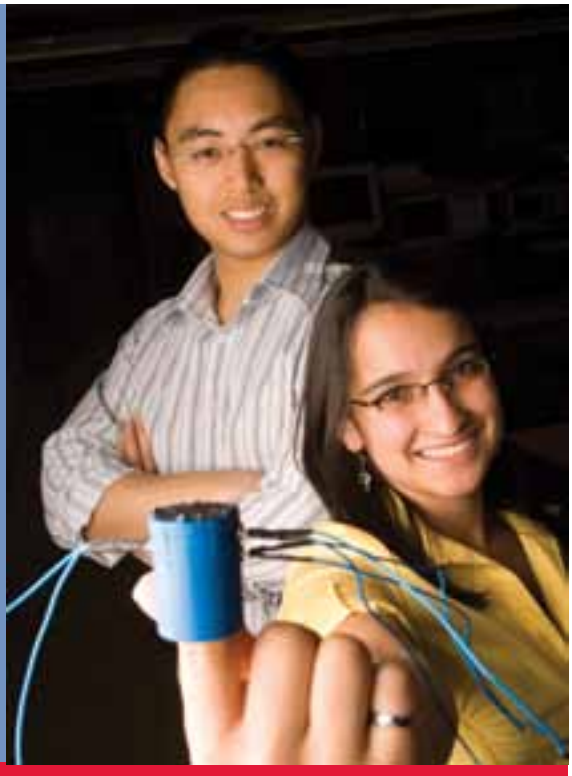
As a Carleton Electrical Engineering graduate, you can expect to find employment with companies developing products and services in wireless electronics, biomedical electronics, instrumentation, mobile electronics, electrical power and smart grids, renewable energy systems, computer/game hardware, telecommunications, and aerospace and space electronics.

Luz Osorio and Phong Nguyen

As undergraduate engineering students, Luz Osorio and Phong Nguyen teamed up to undertake a senior research project. Working in close collaboration, they created a medical device called a pulse oximeter. The pulse oximeter shines light through tissue and measures the rate of light absorption in order to determine oxygen levels in the blood. "The device has numerous applications," explains Phong. "It can be used to monitor patients during surgery or childbirth, as well as high performance athletes and pilots."

All engineering students, regardless of their area of specialization, complete a fourth-year project on a special topic of interest. The study is guided by a professor but completed independently by teams, usually composed of two to twenty-five students. "This kind of project prepares you for a professional work environment in a very real way," says Luz. "The team has to pace itself well, divide up the work, submit progress reports and problem solve together over the course of the year."

Although it took most of their final year of studies to complete, this project came with a few extra rewards for Luz and Phong. They not only won a departmental competition for their work, but also went on to win a university-wide contest followed by a third-place finish competing against Eastern Ontario universities.



A Carleton student examines a silicon wafer in our on-campus clean room, a microfabrication laboratory that facilitates integrated circuit design and testing.

Engineering Physics

Engineering physics applies fundamental physical science to the solution of technological problems. As an Engineering Physics graduate, you will be well educated in material science, applied physics, electronics and nanotechnology.

You will also be highly skilled in the development of new technologies in semiconductor, optical and nano-scale integrated devices for telecommunications, biomedical and renewable energy applications.

The Carleton advantage

Carleton's Bachelor of Engineering (BEng) degree program in Engineering Physics has two main areas of focus:

integrated semiconductor devices, and optical devices and systems. This program offers:

- a set of options in fourth year that allow you to focus on semiconductor devices,

nanotechnology or modern optics;

- the opportunity to design your own integrated circuits (ICs), which are manufactured right on campus;
- a unique team-design project course in first year;
- excellent computing resources;
- access to Ottawa's high-tech companies, enabling you to develop contacts for future work;
- a progressive co-operative education (co-op) option; and
- excellent scholarships for high-standing students.

Unparalleled resources

At Carleton, you will benefit from:

- outstanding computer networks and modern, well-equipped laboratories (Carleton is one of the few universities in the country with its own in-house IC fabrication facilities);
- our proximity to, and close association with, the laboratories of the National Research Council Canada (NRC) and the Communications Research Centre; and
- the Canadian Photonics Fabrication Facility, available to Carleton students for the design, fabrication and testing of state-of-the-art photonics and optoelectronics components and systems.

Program of study

The BEng degree program in Engineering Physics is fully accredited by the Canadian Engineering Accreditation Board. When you graduate from this program, you will meet the educational requirements for registration as a professional engineer.

Your program begins with a broad and fundamental background in physics and electronics. During the first year, you will have a unique opportunity to participate in a small class and collaborate closely with a senior professor on a team project that involves the design and implementation of an optical system. This course introduces you to engineering design early in your studies, making your subsequent years more relevant and interesting. The second and third years of the program provide a strong background in both physics and engineering, with courses in programming, electronics and modern physics. Fourth year allows you to specialize in either semiconductor device technology or applied optics. Electives are also available in IC design, telecommunications electronics, computer-aided design, microwave engineering, integrated sensors and many other areas.

Please refer to the *Carleton University Undergraduate Calendar* at carleton.ca/cuuc for more information on courses as well as details on the co-operative education option for this program.

After graduation

As a graduate of this program, you will find rewarding opportunities in a variety of technical careers, particularly with semiconductor, computer and telecommunications firms. You could design and fabricate ICs or work with renewable energy devices, microwave and optical systems, or sensor technology. Some graduates build careers in biomedical engineering and medical physics or pursue advanced studies at the graduate level.

Many research-intensive government departments and agencies, including the National Research Council, are located in the National Capital Region.

Environmental Engineering

Environmental issues are increasingly at the forefront of the agendas of industry, governments, non-governmental organizations and individuals today. These issues range from global ones, like climate change, to local ones, such as the secure supply of drinking water to urban populations.

Environmental engineers design and implement technologies that protect both the environment and public health and prevent, control or limit pollution. Water and waste water treatment, air pollution and emissions control, solid and hazardous waste management, remediation of contaminated sites, and environmental impact assessment are just a few examples of important areas that require an environmental engineer's in-depth understanding of environmental issues and technical expertise in innovative solutions.

The Carleton advantage

Carleton University's Bachelor of Engineering (BEng) degree program in Environmental Engineering is one of only a few in Canada. Our program includes a modified common engineering core program, a

group of courses specific to environmental engineering, as well as additional courses in biology and chemistry.

Carleton offers:

- an emphasis on problem solving and hands-on laboratory work;
- a progressive co-operative education (co-op) option;
- opportunities to participate in collaborative design projects with industry, government and other research agencies in the Ottawa region;
- a wide choice of complementary courses from other faculties, such as Arts and Social Sciences;
- a challenging final-year project; and
- excellent scholarships for high-standing students.

Unparalleled resources

We also offer:

- modern, well-equipped laboratories and computer facilities on campus; and
- proximity to, and close association with, the laboratories of the National Research Council Canada, Natural Resources Canada and Environment Canada.

Program of study

The BEng program in Environmental Engineering is fully accredited by the Canadian Engineering Accreditation Board. When you graduate from this program, you will meet the educational requirements for registration as a professional engineer.

The program includes a wide range of topics—from life cycle analysis and environmental impact assessment, to the design of industrial waste water treatment processes and waste containment systems for solid and hazardous waste management. Courses specific to Carleton's Environmental Engineering program include the following four broad areas:

- air pollution control;
- groundwater flow and contaminant transport;
- solid and hazardous waste management; and
- water and waste water treatment.

Banu Örmeci

Professor Örmeci holds the Canada Research Chair in Waste Water and Public Health Engineering, and is a recipient of an Ontario Early Researcher Award. Previously with Duke University in the United States, she says "I chose Carleton because of its strong commitment to education, quality research and outreach to society, as well as its proximity to Canada's top research institutions."

The first year of the program is based largely on common core courses. In the second year, you will take the first program-specific courses, along with additional courses in biology and chemistry. Third year introduces environmental engineering courses that cover the unifying fundamental principles for all four areas outlined above. Fourth-year courses are more applied and provide greater in-depth study in these areas.

Please refer to the *Carleton University Undergraduate Calendar* at carleton.ca/cuuc for more information on courses as well as details on the co-operative education option for this program.

Robyn Chatwin-Davies, Environmental Engineering

Robyn Chatwin-Davies is a third-year Environmental Engineering student from British Columbia. In addition to her studies, she is the co-president of Engineers Without Borders (Carleton University Chapter), an organization dedicated to the creation of opportunities for rural Africans to access clean water, generate income from small farms, and gain better access to the types of services and infrastructure needed to improve lives.

After graduation, Robyn is considering pursuing a master's degree but would first like to travel and work overseas in the water and sanitation sector.

After graduation

As an environmental engineer, you will find employment opportunities in industry, municipalities, consulting firms, federal and provincial regulatory agencies, and research establishments. Environmental engineers have a wide range of career options that include, but are not limited to, designing and operating waste management systems, advising on pollution control, responding to environmental disasters, working in a regulatory environment or undertaking research.

Race car competition

Each year since 1998, Engineering and Design students have been given the opportunity to design and build an open-wheeled racing car as part of a collaborative fourth-year project. The cars, built to the specifications of the Society of Automotive Engineers (SAE), are entered into an annual international competition. Participating in this competition helps students go beyond textbooks and theory. It can even help some land their first engineering jobs by linking them with recruiters from leading companies in the automotive and mobility industries.

Photo courtesy of Garth Gullekson, Darlington Mediaworks

Mechanical Engineering

Almost anything that is built to move can be considered mechanical. Mechanical engineers use their understanding of science and engineering to analyze, design, manufacture and maintain mechanical systems.

Mechanical systems are found in a wide array of applications, including transportation, terrestrial and extraterrestrial exploration, energy generation and conversion, and medical devices. The versatility of the training offered through the Carleton Mechanical Engineering program opens the door to a vast range of career possibilities.

The Carleton advantage

Carleton's Mechanical Engineering program emphasizes engineering

fundamentals and challenging laboratory and design work. Our graduates are well recognized for their skills and knowledge, as well as their ability to adapt to changing technologies.

This Bachelor of Engineering (BEng) degree program offers:

- comprehensive study in one of Canada's largest mechanical engineering departments;
- a concentration in Integrated Manufacturing option;
- excellent laboratory and computer facilities;
- a progressive co-operative education (co-op) option;
- a unique and challenging final-year group design project;
- excellent scholarships for high-standing students; and
- collaborative design projects with government and other research institutes.

The capital advantage

Advances in technology are changing the way we travel, how we communicate and our methods for doing business. Many of these advances have their roots in university research laboratories or in partnerships between universities and industry. Carleton University, situated in the midst of Canada's largest concentration of high-tech companies, forges strong partnerships with the country's most promising organizations for the research and development of ideas.

Unparalleled resources

At Carleton, Mechanical Engineering students benefit from:

- outstanding campus laboratory and computer facilities, including wind tunnels, equipment for structural tests, facilities for material testing, and laboratories to study thermodynamic and heat transfer phenomena;
- fully-equipped computer-aided design and prototype fabrication and testing facilities; and
- proximity to Canada's National Research Council (NRC) laboratories and opportunities for collaborative design projects with the NRC as well as other research institutes in the Ottawa region.

Program of study

The BEng in Mechanical Engineering is fully accredited by the Canadian Engineering Accreditation Board.

Well-rounded training of students enrolled in this program is realized through courses emphasizing engineering sciences in the areas of dynamics, thermodynamics, solid mechanics, materials, fluid mechanics, control systems and robotics, and heat transfer. These are complemented by several other courses and a capstone project focused on engineering design. You will learn to apply your mechanical engineering skills through several elective courses chosen from a broad range of fields—including noise control, energy conversion and power generation, manufacturing and production processes, aerodynamics and flight mechanics, vehicle engineering, spacecraft design, mechatronics, robotics, propulsion and biomedical engineering.

Please refer to the *Carleton University Undergraduate Calendar* at carleton.ca/cuuc for more information on courses as well as details on the co-operative education option for this program.

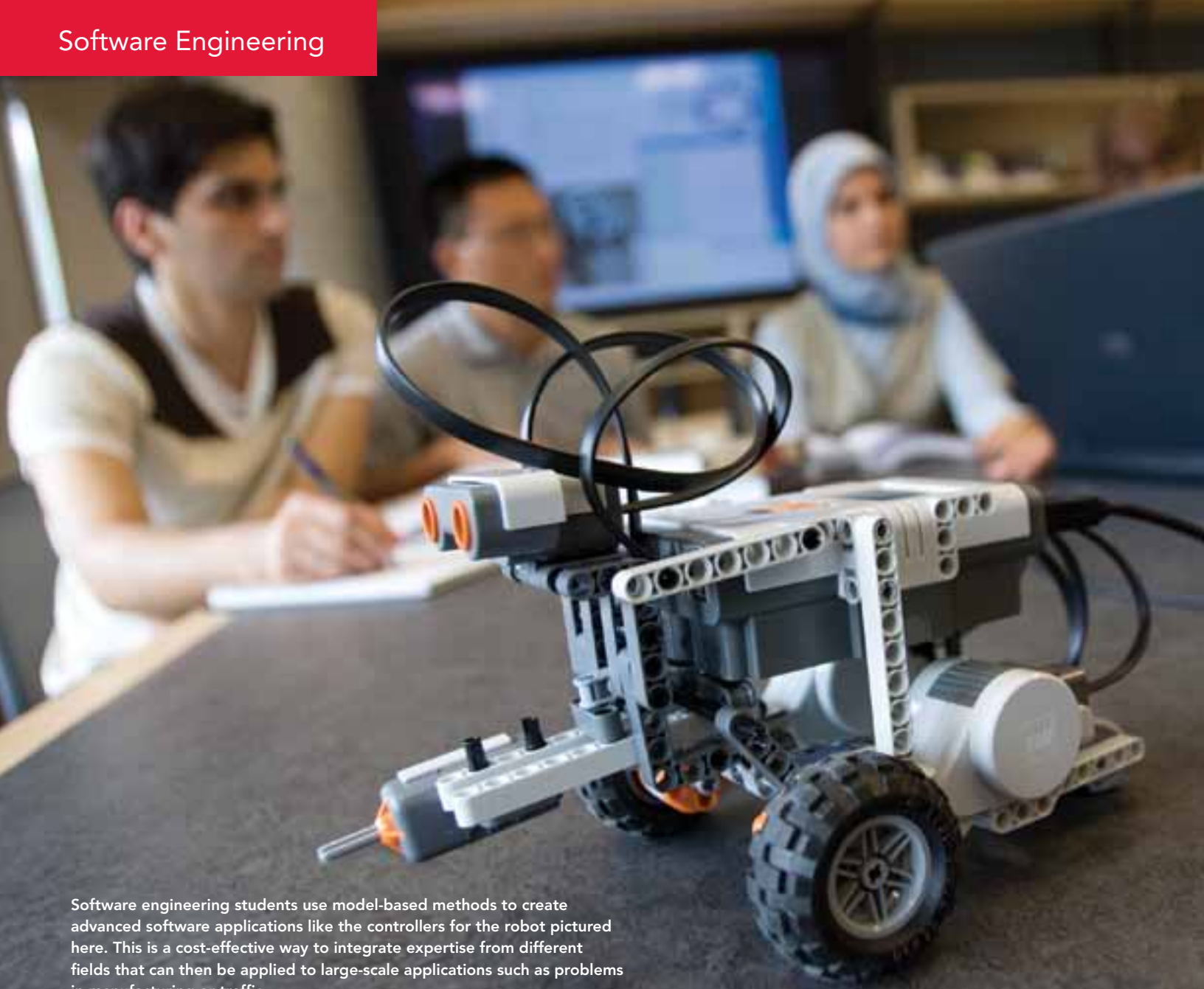
Leading her field

Professor Moyra McDill (left) is an award-winning teacher and researcher in Mechanical Engineering. She has been recognized through a number of awards including a Carleton University Students' Choice Best Professor Award and a YMCA-YWCA Women of Distinction Award. She is an excellent role model for aspiring engineers, male and female alike—she was the first woman to complete a doctoral degree in Mechanical Engineering at Carleton and the first to be hired into the department as a faculty member.

Professor McDill specializes in the thermal-stress analysis of welding processes. The results of her research have led to the development of a well-known software tool that is used worldwide.

After graduation

With training in this field, you will be recognized for your ability to adapt to changing technologies and to work effectively in interdisciplinary team settings. Employment possibilities are broad, with challenging and rewarding opportunities in energy utilities, industrial and government laboratories, engineering firms and a variety of consulting agencies.



Software engineering students use model-based methods to create advanced software applications like the controllers for the robot pictured here. This is a cost-effective way to integrate expertise from different fields that can then be applied to large-scale applications such as problems in manufacturing or traffic.

Software Engineering

Exciting new technologies are transforming the way we live and work—technologies such as distributed computing and the Internet, multimedia applications, and health care systems.

The phenomenal growth in computing, and the related information technology industry, has resulted in a tremendous demand for software engineers—people who are qualified to develop reliable, economical and high-quality software systems.

The Carleton advantage

At Carleton University, the Bachelor of Engineering (BEng)

degree program in Software Engineering is much more than computer programming. It offers comprehensive study in important areas such as software security, reliability and quality, as well as in creative solutions needed to meet the requirements of end-users. At Carleton, we teach essential discipline components such as programming paradigms and design notations. In addition, we emphasize rapid design with sufficient flexibility for future changes, as well as safety, economy and efficiency.

The BEng degree program in Software Engineering offers:

- integrated studies in the principles and practice of software systems development and related computer technologies;
- a challenging final-year design project;
- an emphasis on problem-solving skills and hands-on laboratory and design work;
- a progressive co-operative education (co-op) option; and
- excellent scholarships for high-standing students.

Unparalleled resources

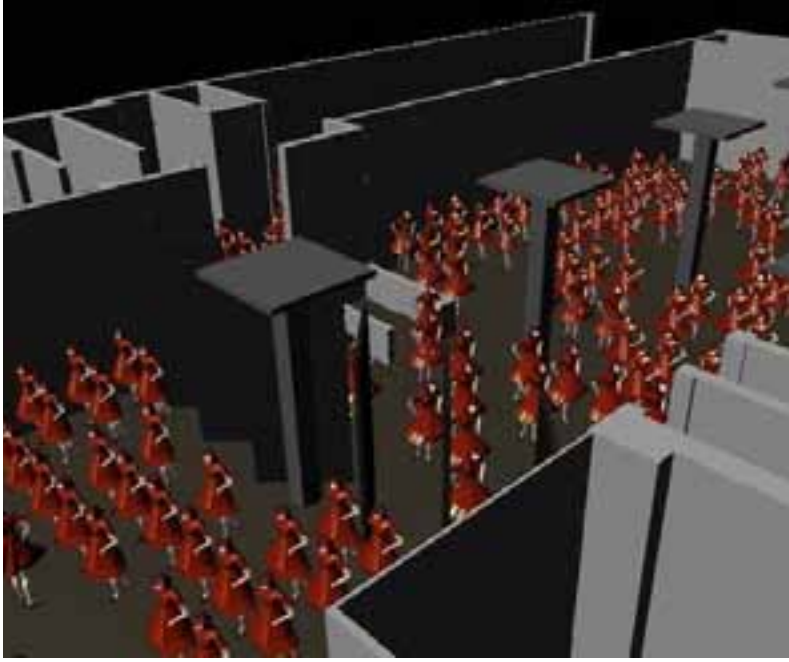
As a Carleton student, you will benefit from:

- modern, well-equipped laboratories and computer facilities right on campus; and
- Carleton's proximity to, and close association with, the laboratories of the Communications Research Centre, the National Research Council Canada and many local technology companies.

Program of study

The BEng program in Software Engineering is fully accredited by the Canadian Engineering Accreditation Board. When you graduate from this program, you will meet the educational requirements for registration as a professional engineer.

As a student in the program, you will acquire a strong foundation in mathematics, physical sciences, engineering principles and communications. As you advance in the program, you will also study computing theory; the processes, methods and tools for software development; and the regulatory and social aspects of developing software systems. You will learn to design software rapidly—while maintaining the flexibility needed to accommodate future changes—and become increasingly specialized in object-oriented programming (using C++ and Java) and real-time computer systems.

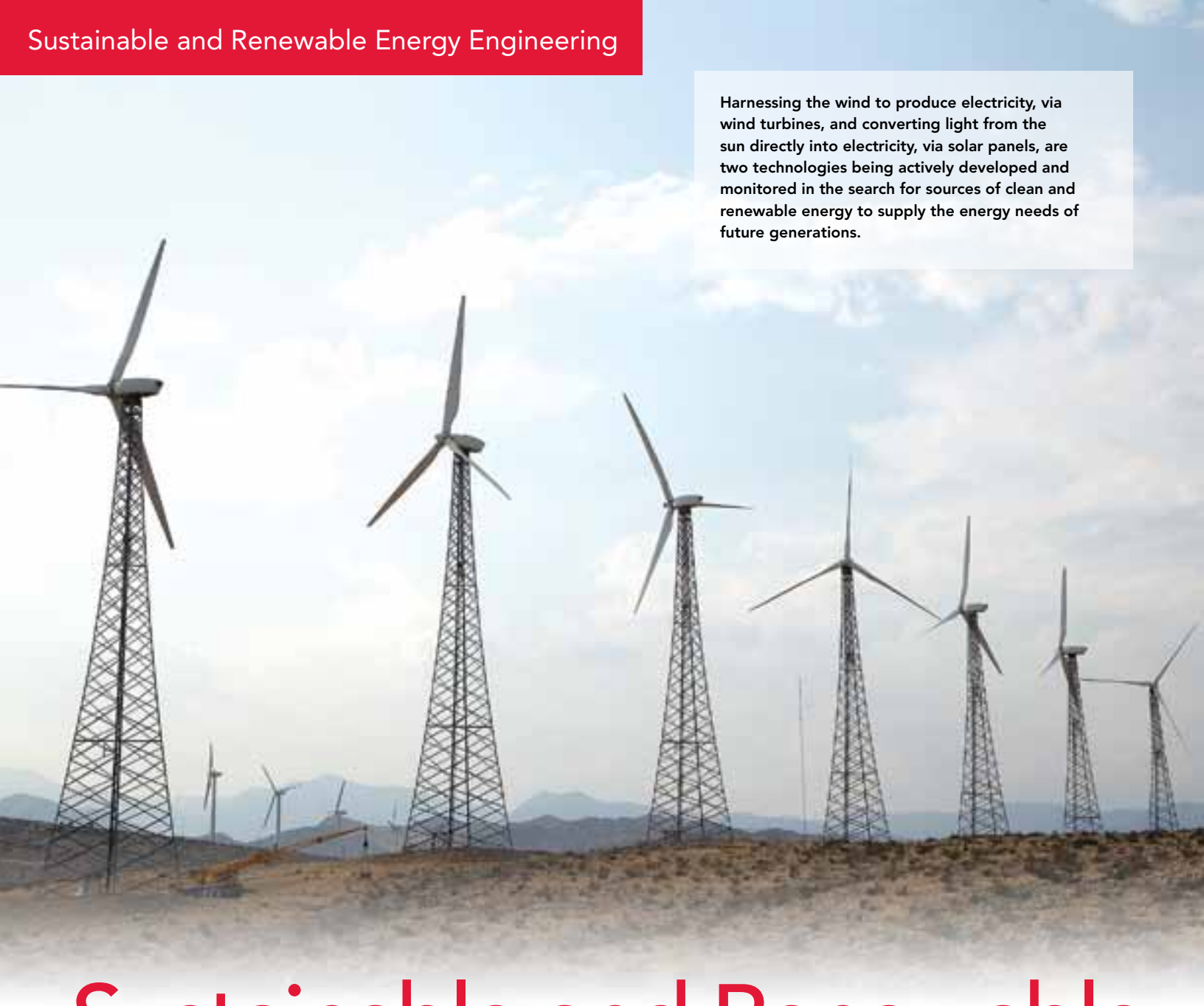


Architecture and engineering students integrate advanced modeling tools and the 3D models pictured here to analyze problems such as fire evacuations of buildings.

Please refer to the *Carleton University Undergraduate Calendar* at carleton.ca/cuuc for more information on courses as well as details on the co-operative education option for this program.

After graduation

Graduates from this program have numerous career opportunities in the areas of health care, aerospace, manufacturing, multimedia, information technology and telecommunication, and are well prepared to specify, design, implement and maintain complex software systems. In addition, you will be able to manage the development and deployment of software products. Examples of the products that you could develop as a software engineer include embedded real-time systems (e.g., aircraft, medical devices), computer graphics and animation, online banking or e-commerce applications, multimedia and mobile computing systems, telephone switches and networks, routers, and database systems. Potential employers can be found in both the public and private sectors.



Harnessing the wind to produce electricity, via wind turbines, and converting light from the sun directly into electricity, via solar panels, are two technologies being actively developed and monitored in the search for sources of clean and renewable energy to supply the energy needs of future generations.

Sustainable and Renewable Energy Engineering

Sustainable energy links energy to the broader societal process of 'sustainable development'—embracing economic, social and environmental dimensions. It points to the ways different forms of energy can contribute to societal well-being, and to the need to transform patterns of energy production and consumption to avoid grave environmental impacts.

Sustainable energy is concerned with 'renewable energy'—or energy that draws on cyclical natural flows (such as solar, geothermal, hydro, wind and biomass). But it is also concerned with the way in which non-renewable resources can be used more effectively, by minimizing environmental impacts and ensuring they make a positive contribution to sustainable development. As a field of study, sustainable energy engineering examines the major challenges confronting modern society as it attempts to meet energy needs in an economically efficient, socially responsible and environmentally friendly manner.

The Carleton advantage

The Bachelor of Engineering (BEng) program in Sustainable and Renewable Energy Engineering offers:

- a problem-solving approach to learning, as well as a professional focus on sustainable and renewable energy technologies;
- the opportunity to follow one of two study streams suited to your background and interests;
- a progressive co-operative education (co-op) option;
- a final-year design project that is executed in a team setting, bringing together knowledge, skills and expertise gained throughout the program; and
- excellent scholarships to high-standing students.

Unparalleled resources

Carleton University's laboratory, fabrication and computer facilities are state-of-the-art. As a student in the Sustainable and Renewable Energy Engineering program, you will have access to program-specific facilities such as:

- an energy, combustion and air emissions laboratory;
- a large-scale atmospheric boundary-layer wind tunnel for wind-farm performance studies;
- a large-scale water channel for the study of hydropower technology;
- fuel cell development laboratory;
- thermodynamics/energy conversion laboratory;
- power electronics and smart grids laboratory; and
- a microfabrication facility for applications such as photovoltaics and power harvesting.

Program of study

The BEng program in Sustainable and Renewable Energy has been designed to meet the strict professional and academic requirements of the Canadian Engineering Accreditation Board.

There are two streams in the program:

Stream A: Smart Technologies for Power Generation and Distribution

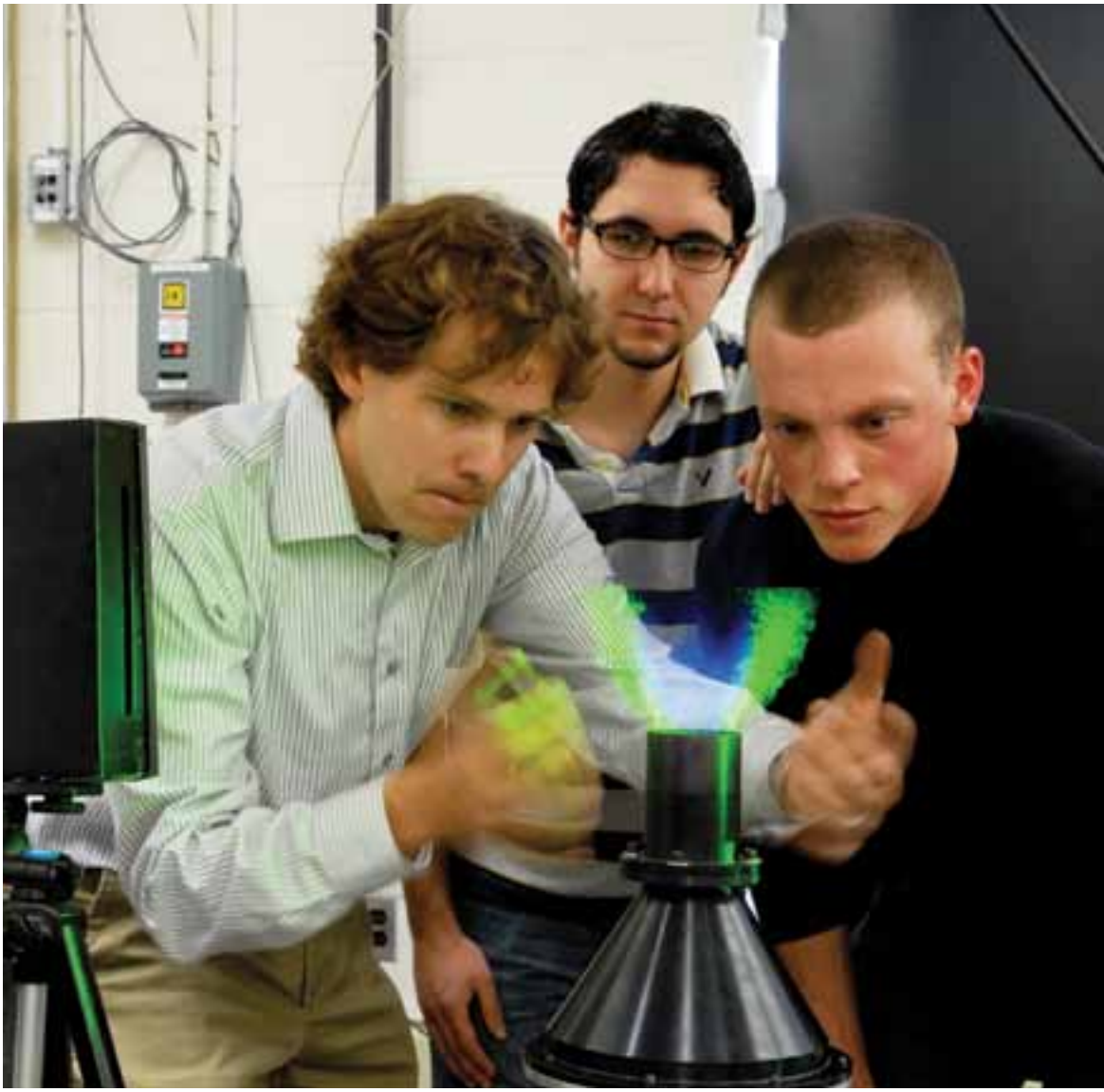
Stream B: Efficient Energy Generation and Conversion

Both streams provide a solid core of courses and laboratory work that prepare you for a successful professional career in industry and the public sector, or for further studies at advanced levels. Both streams contain courses in basic and applied science, complemented by stream-specific courses addressing topics such as electronics, smart-grid systems, technology utilized for generating and converting energy sustainably, and environmental issues.

Please refer to the *Carleton University Undergraduate Calendar* at carleton.ca/cuuc for more information on courses as well as details on the co-operative education option for this program.

After graduation

Graduates of this program are well prepared for challenging positions in energy-intensive industries and related government agencies, including power utilities, power generation facilities, distribution networks and the construction industry. They are also in demand by manufacturers of materials and equipment for renewable energy projects, the transportation industry (particularly hybrid vehicles) and emerging service industries specializing in energy efficiency.



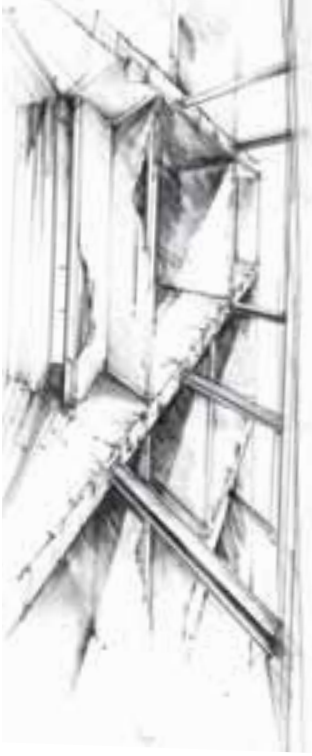
Professor Matthew Johnson (left), who holds a Canada Research Chair in Energy and Combustion Generated Air Emmisions, utilizes advanced optical techniques in his laboratory. Here, he and students illuminate a flame with a laser sheet (in green) which allows them to view a plane in the flow and subsequently measure 3D velocities.

Architectural Studies

The study of architecture is an exploration of many disciplines and calls for a comprehensive course of university study. Architecture students learn how to juggle the conflicting demands of function, aesthetics, technology and economics while becoming skilled in writing, drawing, model-making, photography, video, digital media and oral presentation.

The Carleton advantage

Carleton's Azrieli School of Architecture and Urbanism offers the Bachelor of Architectural Studies (BAS), a four-year program that qualifies you for professional studies at the master's level. While a post-graduate degree is required to practice architecture in North America, the BAS degree prepares you for a career in a range of design



First-year students take a free-hand drawing course and are introduced to various media and techniques through a wide range of studio and outdoor exercises.

fields, as well as for positions in such areas as education, history, conservation, community advocacy and public policy.

At Carleton, we offer many exciting opportunities that round out your classroom experiences, including:

- the **Carleton University Immersive Media Studio**—a research centre for modelling and visualization using immersive, digital and hybrid media;
- the **Carleton Solids and Light Tectonics Laboratory**—for the study of materiality in architecture;
- **Directed Studies Abroad**—two- to four-week excursions to various destinations;
- **Workshop courses** in areas such as furniture design, stage design, advanced painting and drawing; and
- a **Forum Lecture Series**—held at the National Gallery of Canada, this lecture series exposes you to acclaimed architects including Arthur Erickson, Moshe Safdi and Jean-Marc Ibos, among others.

Unparalleled resources

Carleton offers the finest facilities in Canada. You will benefit from:

- design studios with personal work space;
- fabrication facilities for woodworking, metal machining and welding;
- assembly room for models and full-scale projects;
- a photographic lab with a 12-station darkroom and video-editing suites;
- extensive computer facilities;
- a technical library and reading room; and
- an exhibition gallery.

Program of study

In the BAS program, you will spend your first year acquiring a broad foundation for your subsequent studies. First-year courses include an introduction to architecture, drawing, and multimedia applications, as well as general study in engineering, art history and the social sciences.

Over the next three years, you will continue your studies in one of four areas:

- Design
- Urbanism
- Conservation and Sustainability
- Philosophy and Criticism

You will take courses in architectural history and theory, urbanism, technology and sustainability, and will draw your electives from other disciplines offered at Carleton.

Please refer to the *Carleton University Undergraduate Calendar* at carleton.ca/cuuc for more information on courses as well as details on the co-operative education option for this program.

After graduation

Graduates of our Architectural Studies program are at work around the world in fields as varied as building design, urban design, fashion design, filmmaking, computer animation, environmental/sustainable building consultation, project management and historical architectural preservation.

For a third-year project, BAS students designed and built outdoor dining pavilions, weaving food and architecture together. Students were encouraged to use found objects and recyclable materials.

For their fourth-year project, ID students Payam Shalchian, Terrence Cong Li and Christine Nguyen designed adaptable structures, shelters and furniture for a proposed redevelopment of the Batawa ski hill area.

Industrial Design

The form and function of almost all of the everyday objects that surround us are the result of an elaborate process of design.

To meet the demands of mass manufacturing, every aspect of a product must be determined. The experts who carry out this work are industrial designers. Working in teams, industrial designers examine the demand for particular products, the available materials, production methods, environmental impact, costs and whether the final product will meet the needs of prospective customers.

The Carleton advantage

Carleton's unique and well respected Industrial Design program blends design studio with applied sciences, such

as mathematics and physics, and social sciences such as psychology and business. Industrial designers are visual thinkers, and at Carleton University you will learn how to use your drawing and modelling abilities to communicate product concepts. Through progressive stages of design development, you will learn how these concepts evolve in relation to materials, technologies and manufacturing processes, ecological issues, and the users' abilities and perceptions.

Carleton offers:

- hands-on learning through internships, work-study and a progressive co-operative education (co-op) option;
- design projects in partnership with private and public sector partners—past collaborators include SMART Technologies, Y Design Studio, CNIB, the Canadian Paralympic Foundation, and the National Capital Commission;
- a prime Ottawa location that provides access to excellent medical and scientific research facilities, as well as galleries, museums and a design workforce of more than 3,500 people; and
- a highly popular annual graduation exhibition that attracts visitors and industry employers.

Unparalleled resources

At Carleton, you will benefit from:

- design studios;
- photographic facilities;
- modeling and testing laboratories;
- wireless computing facilities; and
- a mass-production/mould simulation laboratory and rapid prototyping equipment.

Program of study

The Industrial Design program begins with an introduction to the theory and practice of design, as well as courses in mathematics, physics, psychology and economics. In second year, topics such as mass-production technology, ergonomics, perception and computer applications are presented, along with electives from architecture, business, computer science or engineering.

In third and fourth year, you will focus largely on design projects carried out in the School of Industrial Design's studios and laboratories. There you will make drawings, models and full-scale prototypes and test their viability. Projects may include almost any imaginable commodity, from medical equipment and transportation devices to building components, tools and furniture. Internships and work-study opportunities exist, as well as a co-operative education option.

Please refer to the *Carleton University Undergraduate Calendar* at carleton.ca/cuuc for more information on courses as well as details on the co-operative education option for this program.

Fourth-year student Ian Murchison developed a portable defibrillator with its own power source which could be used by medical professionals working in the field (for example, on earthquake rescue missions).

Annual graduation exhibition

A highlight of the year is the school's annual graduation exhibition in April. Open to the public, the exhibition showcases the projects of senior Industrial Design students, and illustrates the incredible range of design diversity and skill developed by students over the course of the program. The exhibition also attracts many potential employers from different facets of industry.

After graduation

As an Industrial Design graduate, you could go on to an exciting career in industrial design, graphic design, exhibit design, packaging design or manufacturing. You could also work as a design consultant or become part of an emerging class of design entrepreneurs. Carleton grads have worked with clients all over the world, including Power Athletics, Teknion, Lee Valley Tools, Umbra, Prada, Armani and Sony—to name just a few.

Interactive Multimedia and Design program students at work in Carleton's motion capture laboratory.

Information Technology

The information technology industry is fast-paced and constantly evolving. As a student in Carleton's Bachelor of Information Technology programs, you will develop the theoretical knowledge and practical skills needed to address the IT issues of today—as well as those of the future.

The Bachelor of Information Technology (BIT) offers two distinct programs—Network Technology (NET) and Interactive Multimedia and Design (IMD)—that provide an exciting opportunity for a unique blend of college and university-level study. A joint venture between Carleton University and Algonquin College, the programs combine hands-on practical skills with a strong theoretical and industrial background.

The Carleton/ Algonquin advantage

At Carleton University, you will develop analytical problem-solving skills and gain a broad foundation of knowledge through advanced, in-depth studies in various multidisciplinary courses. At Algonquin College, you will focus on applied, hands-on training in current IT systems and technologies. In both the NET and IMD programs, co-operative education opportunities round out your experience, with placements in technology companies, private-sector organizations and government agencies.

When you graduate, you will receive a Bachelor of Information Technology degree from Carleton and an Advanced Diploma in Technology (for NET students) or an Advanced Diploma of Applied Arts (for IMD students) from Algonquin College.

Unparalleled resources

As a student in one of the BIT programs, you will benefit from:

- professors and instructors at both institutions who have a strong understanding of the industry and are actively engaged in research on the leading edge of interactive multimedia and networking; and
- state-of-the-art laboratories and new facilities at both institutions, featuring the best technology available—such as smart classrooms, up-to-date networking equipment from Cisco, animation software and motion capture systems.

Program of study

NETWORK TECHNOLOGY (NET)

The NET program focuses on the design, installation, operation and management of complex information networks, such as those that make up the Internet. The program is multidisciplinary in nature, combining studies in computer and network technology with courses in physics, mathematics, communications, and arts and social sciences. In this program, you not only explore theories and concepts, but also learn to design, install, operate, reconfigure and manage advanced IT networks in state-of-the-art networking laboratories. The NET program has a partnership with the Cisco Networking Academy program, whereby students are trained to successfully write the Cisco Certified Network Associate (CCNA) and Professional (CCNP) certification exams. This enables NET students to earn industry-recognized certification that is in high demand in the job market.

Laryssa Sirko and Rutendo Zvirawa, two Network Technology students, configure a multimedia network.

INTERACTIVE MULTIMEDIA AND DESIGN (IMD)

The IMD program is suitable for students who are both artistically inclined and technologically adept. You will acquire the tools you need to take an idea from its initial concept through to design, prototyping, testing and delivery. The program provides a multidisciplinary education in diverse subjects, including computer animation and visual effects, game design and development, graphic design, project management, 3D visualization, and human-computer interaction. Courses in science, mathematics, marketing and design complement the program. You will become adept at determining the shape of digital media, designing interfaces, and scripting the way that users will interact with the products you create. These products can range from video games and animated shorts to educational tools and interactive websites.

Please refer to the *Carleton University Undergraduate Calendar* at carleton.ca/cuuc for more information on courses as well as details on the co-operative education option for both programs.

After graduation

This unique degree/diploma combination creates career opportunities for you in a variety of interesting work environments. Graduates of the NET program will find careers in governments, network design and management companies, finance companies, system integrators, telecom operators, educational institutions, and other business enterprises requiring network design, management and operation. Graduates of the IMD program will find challenging work in areas such as computer animation, video game design and development, graphic design, user-interface design, product development, and web application and software development.

This image of a BIT-themed F1 race car, created by student Grant Moore as part of a 3D-modeling term project, uses high-detail textures, animation rigging and advanced rendering techniques.

Third-year Electrical Engineering student Simon Mack landed a co-op placement in the Flight Research Laboratory at the National Research Council's Institute of Aerospace Engineering.

Gain real world Experience

Learning by doing has always been a rewarding enhancement to your academic studies in classrooms and laboratories. Co-operative education provides you with the opportunity to apply your knowledge, and also help you pay for your studies.

Co-op work term placements allow you to combine your academic studies with periods of paid employment in a field related to your studies. Although getting your degree can take a little longer, it's worth the investment of your time. You will graduate with career-related experience as well as contacts in the job market.

Learning through co-op

Co-operative education offers you the chance to gain practical experience, solve

real-world problems, and apply theory and course applications to practical work situations. You will gain valuable experience in your field of study and develop professional contacts, but also earn money to help pay for your studies at the same time.

Carleton's co-op program is organized so that your work term placements become longer as you gain more knowledge and skills. This allows you to see projects through to completion and to get involved in more ambitious, complex types of research as you progress.

All of Carleton's Engineering and Design programs have a co-op option with work term placements of 4, 8, 12 or 16 months, either with a particular organization or with multiple employers. Placements normally begin at the end of your second year, when you have gained the ability, knowledge and confidence to make a substantial contribution to the organization.

Recent employers

The Ottawa region is home to one of Canada's largest concentrations of government research agencies and high-tech companies. Carleton's co-operative education and engineering internship programs are well established in this network, providing you with superb opportunities for rewarding experiences in well-known organizations such as:

- Teknion Furniture Systems (Architecture & Industrial Design)
- Mxi Technologies
- RIM
- IBM
- Department of National Defence
- GasTops
- Ericsson
- Alcatel-Lucent
- National Research Council

You can also work internationally or elsewhere in Canada with companies such as the Canadian Space Agency, Kelowna Flightcraft, Rolls Royce Canada and Electronic Arts Canada.

Other work options

You may also apply to work in a Carleton research lab for the summer, supported by federal research grants from agencies such as NSERC (Natural Sciences and Engineering Research Council).

Sample work/study pattern

Year	One			Two			Three			Four			Five	
Term	**Fall**	**Winter**	**Summer**	**Fall**	**Winter**	**Summer**	**Fall**	**Winter**	**Summer**	**Fall**	**Winter**	**Summer**	**Fall**	**Winter**
Pattern	Study	Study		Study	Study	Work	Work	Study	Study	Work	Work	Work	Study	Study

The grid above provides a sample of a work/study pattern for a Carleton Engineering student. Your job search typically begins in the winter of your second year, and your first work term takes place after you complete your second year of studies. In January, you return to school to complete your third year of study. In September, you work again for a 12-month period, and then return to school to complete your degree. No matter what engineering program you choose, you have five opportunities to complete the four work terms required for a co-op designation on your degree. For a look at work/study patterns for all degree programs, please visit **carleton.ca/co-op**.

For his co-op placement, Martin Lariviere (right) worked with Carleton architecture graduate Fred Vermeulen (left) of Vermeulen Hind Architects on a large cancer-centres project. For Vermeulen, "the co-op program is great in creating opportunities for students to see aspects of the profession that the school setting cannot create."

Making the Transition

The first year of university study can be overwhelming. Carleton University offers a network of support services to help you make the transition successfully.

We can help you develop effective study skills, understand the university's academic regulations, choose or change programs, and find answers to your questions. You can participate in orientation sessions, meet with academic advisors, attend workshops on study strategies, sign up for leadership development programs and access our resource material—all strategies to help you achieve your academic and personal goals.

Asking for help and advice

As a starting point, be sure to acquaint yourself with the specific support services in place for all students in the Faculty of Engineering and Design programs—Engineering, Information Technology, Architecture, and Industrial Design.

- Our Undergraduate Academic Support Office provides engineering students with support and advice on schedules, registration and more. The office maintains a comprehensive and regularly updated website that serves as a vital resource for all engineering students, regardless of year or program.
  carleton.ca/engineering/uas
- A dedicated website provides Information Technology students with information relevant to both programs of this degree. In addition, academic advisors from both Algonquin College and Carleton University are available to help with questions.
  bitdegree.ca
- Architecture students are encouraged to visit the school's website for information on registration, suggested electives for first-year students, announcements and special events. Office staff are available to answer questions related to the program and provide assistance with registration. Academic advisors are available by appointment.
  carleton.ca/architecture
- The School of Industrial Design's website serves as an important resource for all ID students, with information on registration, computer requirements, suggested electives, Orientation Week activities and more. Office staff can help with questions and point you in the right direction for academic advice.
  id.carleton.ca

Student Academic Success Centre

The Student Academic Success Centre (SASC) is Carleton's centralized academic advising and learning support centre. The programs offered by SASC help you with the following:

- Time management
- Note-taking
- Academic reading
- Stress management
- Multiple-choice exams
- General exam preparation

carleton.ca/sasc

For a full list of all services available to you as a Carleton student, please visit carleton.ca/students.

University Registrar's Office

The Registrar's Office manages academic activities and records, including transcript requests, course registration and more.
carleton.ca/registrar

Student Experience Office

The Student Experience Office (SEO) helps students adjust to university life and provides constant support throughout the degree years. The office oversees a wide variety of programs, such as:

- **Summer, Fall and Winter Orientation**—brings students together on campus to tour facilities, gather information and meet other students;
- **Community Service Learning**—initiatives to help students link what they learn in class to what they experience in the community;
- **Leadership Development**—provides opportunities for students to enhance leadership skills; and
- **Parent and Family Outreach**—includes news and events for families.

carleton.ca/seo

Supportive facilities

MacOdrum Library

Centrally located, the Library houses a collection of more than 3.4 million books, journals, government documents, maps, newspapers, music scores, CDs, microforms, archives and rare materials. A large proportion of the collection is available in digital format over the Internet. While in the Library, you can connect to the Library's wireless network or take advantage of the Library's Laptop Loan program. During the fall/winter term, the Library hours are extended to better accommodate students' needs.
carleton.ca/library

Learning Commons

Strategically located inside the Library, the Learning Commons is your one-stop study-shop, combining research, IT and Learning Support Services under one roof. Take a five-minute video tour at carleton.ca/learningcommons.

Paul Menton Centre for Students with Disabilities

The Centre co-ordinates academic and support services for students with disabilities. Services include academic accommodations, attendant services, alternate formats, adaptive technology, note-taking, sign language interpretation, and learning support and services specific to individual educational disability needs.
carleton.ca/pmc

Health and Counselling Services

Carleton's multidisciplinary on-campus health care facility provides medical, counselling and health education services to the university's students, faculty and staff.
carleton.ca/health

Future Opportunities

The workplace

A Carleton education prepares you for the world. Graduates of our well recognized programs in Engineering and Design can be found living and working in Canada and around the globe. We make sure you graduate with work experience and a competitive edge. All our programs have co-op options that provide from 12-20 months of possible work experience with over 2,500 possible employers. In addition, our fourth-year projects provide unparalleled opportunities to explore your interests and creativity, and test your ideas and knowledge in real-world applications.

Graduate studies

Many of our graduates continue on to advanced study either in Canada or abroad.

Carleton offers an extensive graduate program in areas of engineering such as aerospace, biomedical, civil, electrical and computer, environmental, materials, mechanical, sustainable energy, technology innovation management, as well as in industrial design and architecture.
carleton.ca/fgpa

Professional programs

Many programs, including law, teaching, medicine and business attract well-rounded applicants from a variety of academic backgrounds. Carleton Engineering and Design programs are excellent preparation for such professional studies.

The summer after Tim Fagan (inset) graduated from Carleton's Industrial Design program, he was hired by Bombardier Inc. In the 11 years that he has been with the firm he has worked on many interesting projects, but one of the most memorable was helping to design the Olympic torch for the Vancouver 2010 Olympics.

Engineering and Design graduate programs

Master of Applied Science
Aerospace Engineering*
Biomedical Engineering*
Civil Engineering*
Electrical and Computer Engineering*
Environmental Engineering*
Materials Engineering*
Mechanical Engineering*
Sustainable Energy
Technology Innovation Management

Master of Architecture
(Professional)

Master of Design

Master of Engineering
Aerospace Engineering*
Civil Engineering*
Electrical and Computer Engineering*
Environmental Engineering*
Materials Engineering*
Mechanical Engineering*
Sustainable Energy
Technology Innovation Management

Master of Infrastructure Protection and International Security
(inter-faculty program between Civil Engineering and Carleton's Norman Paterson School of International Affairs)

Master of Science
Information and Systems Science

Doctor of Philosophy
Engineering*: Aerospace, Civil, Electrical and Computer, Environmental, Mechanical

* *Joint program between Carleton University and the University of Ottawa*

Jenna Wiens

As a high school student, Jenna Wiens participated in the Go Eng Girl program at Carleton which introduces the engineering discipline to female students. From there, she went on to earn a Bachelor of Engineering from Carleton in 2008, winning the prestigious Governor General's Medal at graduation. Today, she is pursuing a graduate degree in Biomedical and Electrical Engineering at the Massachusetts Institute of Technology, one of the world's top-ranked schools for studies in engineering.

Ontario Admission Requirements

How to apply

All interested students must apply online through the Ontario Universities Application Centre (OUAC) website at **www.ouac.on.ca**. If you are presently finishing your last year of high school in Ontario, you must obtain log-in information from your school's guidance office before applying online.

For admission to undergraduate programs, Ontario students must have the Ontario Secondary School Diploma (OSSD) with six 4U/M courses. 4U English is recommended and 4U/M credits for out-of-class co-op work experience will not be considered as part of the six courses. **admissions.carleton.ca/requirements**

Degree program	Areas of study	Required prerequisite courses	Notes
Bachelor of Architectural Studies	• Design • Urbanism • Conservation and Sustainability • Philosophy and Criticism	• English (ENG4U) • Physics (SPH4U) • Advanced Functions (MHF4U) (Calculus [MCV4U] strongly recommended)	**Application deadline:** February 1. **Portfolio deadline:** April 1. Co-operative education available.
Bachelor of Engineering	• Aerospace• • Architectural Conservation and Sustainability• • Biomedical and Electrical• • Biomedical and Mechanical• • Civil• • Communications• • Computer Systems• • Electrical• • Engineering Physics• • Environmental• • Mechanical• • Software• • Sustainable and Renewable Energy•	• Advanced Functions (MHF4U) • Chemistry (SCH4U) • Physics (SPH4U) • One credit from Calculus (MCV4U), Biology (SBI4U), or Earth and Space Science (SES4U) (Calculus [MCV4U] recommended)	One 4U English or French recommended. •Co-operative education and internships available.
Bachelor of Industrial Design		• Advanced Functions (MHF4U) • Physics [SPH4U] (Calculus [MCV4U], Design Technology and Visual Arts strongly recommended)	**Application deadline:** March 1. **Portfolio deadline:** April 1. Information session recommended. Co-operative education available.
Bachelor of Information Technology	• Interactive Multimedia and Design• (Please see notes) • Network Technology•	• English (ENG4U) • One Math credit (4U) • One Science credit (4U or 4M) (Calculus [MCV4U] and Physics [SPH4U] recommended)	Interactive Multimedia and Design **Application deadline:** March 1. **Portfolio deadline:** March 1. The program is not designed to accommodate part-time students. • Co-operative education available.

If you are from outside Ontario, or outside Canada, see Carleton University's website at **carleton.ca/howtoapply** for specific program requirements for all bachelor programs.

Visit Carleton

Book a campus tour

Tours of our beautiful riverside campus, led by our own students, offer you the chance to check out our residences and visit our many facilities. You can also take a specialty tour or, if you prefer, a self-guided walking tour.

BOOK YOUR TOUR:
Online: carleton.ca/tours
By telephone: 1-888-354-4414 (toll-free in Canada) or 613-520-3663.
By email: tours@carleton.ca

Watch our videos

If you can't join us in person, you can always visit us online. We have an ever-expanding video gallery where you can view short videos on our campus, our residences, our co-op programs and more. Be sure to check out our engineering videos to get a first-hand look at what it's like to study engineering at Carleton.
admissions.carleton.ca/video

Contact us

Call, write, or email us at:
Undergraduate Recruitment Office
Carleton University
315 Robertson Hall
1125 Colonel By Drive
Ottawa ON K1S 5B6
Canada

Tel: 613-520-3663
Tel: 1-888-354-4414
(toll-free in Canada)
Email: liaison@carleton.ca
Website: carleton.ca/admissions

Connect with Carleton

You can also get more information about Carleton—our programs, facilities and services—through the following:

UNDERGRADUATE ADMISSIONS WEBSITE
Everything a prospective student needs to know about Carleton University, including programs, campus life, co-op, scholarships and awards can be found here.
carleton.ca/admissions

STUDENT BLOGS
Get an inside look at life at Carleton. Students share their thoughts about campus life, their professors and programs, and the transition from high school to university.
carleton.ca/blogs

facebook

You can also check out our Facebook page to learn more about prospective student news and events, or to view photos from around the Carleton campus. Students on Facebook can log on and search for Carleton University (Official).
facebook.com

Insight

INSIGHT NEWSLETTER
Receive up-to-date news about Carleton University's undergraduate academic programs, admission requirements, scholarships and financial aid, co-op opportunities, and upcoming on- and off-campus recruitment events. Register for our monthly newsletter *Insight@Carleton.*
carleton.ca/insight

Ask Carleton?

ASK CARLETON
You have questions and we have the answers. Visit our online databank of frequently asked questions anytime, day or night.
carleton.ca/admissions

Carleton
UNIVERSITY

Canada's Capital University

Undergraduate Recruitment Office • Carleton University • 315 Robertson Hall • 1125 Colonel By Drive
Ottawa ON K1S 5B6 Canada • Tel: 1-613-520-3663 • Tel: 1-888-354-4414 (toll-free in Canada)
Email: liaison@carleton.ca

carleton.ca/engineering-design

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