FACULTY OF ENGINEERING AND APPLIED SCIENCE

FACULTY OF ENGINEERING AND APPLIED SCIENCE

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Venkatesan, R., B.E.(Hons.) *Madurai*, M.Sc.E., Ph.D. *New Brunswick*, P.Eng.; Professor, Electrical and Computer Engineering; Dean *pro tempore*, July 1, 2011 - July 31, 2012

Naterer, G. F., B.Math., M.A.Sc., Ph.D. *Waterloo*, FCSME, FASME, FEIC, P.Eng.; Professor, Mechanical Engineering; Dean as of August 1, 2012

Associate Dean (Undergraduate Studies)

Fisher, A.D., B.Sc. *Queen's*, M.Eng. *McMaster*, FEC, P.Eng.; Associate Professor, Mechanical Engineering

Associate Dean (Graduate Studies)

Lye, L.M., B.Sc.(Hons.) *Bolton Inst.*, Ph.D. *Manitoba*, FCSCE, FEC, P.Eng.; Winner of the President's Award for Distinguished Teaching, 2003-2004; Professor, Civil Engineering

Interim Associate Dean (Research)

Moloney, C.R., B.Sc.(Hons.) *Memorial,* M.A.Sc., Ph.D. *Waterloo*; Professor, Electrical and Computer Engineering

Acting Director, Ocean Engineering Research Centre

Qiu, W., B.Eng., M.A.Sc. *Dalian University of Technology*, Ph.D. *Dalhousie*, P.Eng., Associate Professor, Ocean and Naval Architectural Engineering

Director, Industrial Outreach

Fisher, A.D., B.Sc. *Queen's*, M.Eng. *McMaster*, FEC, P.Eng.; Associate Professor, Mechanical Engineering; Associate Dean (Undergraduate Studies)

Manager, Finance and Administration

Elliott, B., B.Comm. *Memorial*

Manager, Engineering Laboratories

Pike, D., B.Eng., M.Eng. *Memorial*

Professores Emeriti

Haddara, M.R., B.Sc. *Ain-Shams*, M.S., Ph.D. *Berkeley*, C.Eng., P.Eng.
Jordaan, I.J., B.Sc.(Eng.), M.Sc.(Eng.) *Witwatersrand*, Ph.D. *London*, FRSC, P.Eng.; University Research Professor, Awarded 1997
Peters, G.R., B.Sc. *Memorial*, B.A.Sc. *Toronto*, Ph.D., *Aberdeen*, P.Eng.
Sharp, J.J., B.Sc., A.R.C.S.T., M.Sc. *Glasgow*, Ph.D. *Strathclyde*, F.I.C.E., F.C.S.C.E., F.EIC, P.Eng., C.Eng.
Walsh, J., B.Eng.(Hons.) *TUNS*, Ph.D. *Calgary*, P.Eng.

Honorary Research Professors

Bass, D.W., B.Sc. *Hull*, Cert.Ed. *London*, M.Phil. *Birkbeck College*, Ph.D. *Warwick*
Bruce-Lockhart, M.P., S.B., S.M., *M.I.T.*, P.Eng.; Winner of the President's Award for Distinguished Teaching, 2006-2007
Friis, D.A., B.Sc. *Newcastle*, M.B.A. *Toronto*, Siv. Ing., P.Eng.
Molgaard, J., B.Sc. *Belfast*, Ph.D. *Leeds*, P.Eng.
Seshadri, R., B.E.(Hons.) *Jabalpur*, M.Tech. *I.I.T. Madras*, M.Sc., Ph.D. *Calgary*, FCSME, FEIC, FASME, P.Eng.
Swamidas, A.S.J., B.E.(Hons.), M.Sc.(Eng.) *Madras*, Ph.D., *I.I.T. Madras*, P.Eng.

Civil Engineering Discipline

Chair

Hussein, A., B.Sc.(Eng.) *Ain Shams University*, M.Eng., Ph.D. *Memorial*, P.Eng.; Associate Professor

Professor

Husain, T., B.Sc.Eng. (Hons.) *Aligarh*, M.Eng. *AIT Bangkok*., Ph.D. *British Columbia*, P.Eng.

Associate Professors

Adluri, S.M.R., B.Tech., *J.N.T. Univ.*, M.Tech. *I.I.T. Kanpur*, M.A.Sc., Ph.D. *Windsor*
Chen, B., B.Eng. *Jilin*, M.Sc. *Peking*, Ph.D. *Regina*, P.Eng.
Coles, C.A., B.Eng., M.Eng., Ph.D. *McGill* , P.Eng.
Hawlader, B.P., B.Sc. Eng. *BUET*, M.Eng. *AIT*, Ph.D. *Yokohama National*
Kenny, S. P., B.Eng., M.Eng. *Memorial*, Ph.D. *Dalhousie*, P.Eng.
Niefer, R.A., B.Sc., Ph.D. *Windsor*
Phillips, R., B.Sc.(Hons.) *Bristol*, M.Phil., Ph.D. *Cambridge*, P.Eng.; Joint appointment with C-CORE
Snelgrove, K.R., B.Eng. *Memorial*, M.A.Sc., Ph.D. *Waterloo*, P.Eng.

Assistant Professors

Bruneau, S.E., B.Eng. *Memorial*, M.E.Sc. *U.WO*, Ph.D. *Memorial*, P.Eng.
Hassan, A.A.A., B.Sc., M.Sc. *Ain Shams University*, M.A.Sc., Ph.D. *Ryerson University*, P.Eng.
Zhang, B., B.Sc.(Hons.), M.Sc. *Jilin University*, Ph.D. *Regina*

Electrical and Computer Engineering Discipline

Chair

Peters, D.K., B.Eng. *Memorial*, M.Eng., Ph.D. *McMaster*, FEC, P.Eng., Associate Professor

Professors

Gill, E.W., B.Sc., B.Ed., M.Eng., Ph.D. *Memorial*, P.Eng.
Gosine, R.G., B.Eng. Memorial, Ph.D. Cambridge, FEC, P.Eng.; Winner of the President's Award for Outstanding Research, 1997-1998, Petro-Canada Young Innovator Award, 1998; J.I. Clark Chair; Associate Vice-President (Research), Collaborations and Partnerships
Heys, H.M., B.E.Sc. *Western Ontario,* Ph.D. *Queen's,* P.Eng.
Jeyasurya, B., B.Tech. *I.I.T. Madras*, M.Tech. *I.I.T. Bombay*, Ph.D. *New Brunswick*, P.Eng.
O'Young, S.D., B.Eng. *Saskatchewan*, M.A.Sc., Ph.D. *Waterloo*, P.Eng.
Quaicoe, J.E., B.Sc. (Eng.) *Ghana*, M.A.Sc., Ph.D. *Toronto*, FEC, P.Eng.; Winner of the President's Award for Distinguished Teaching, 2001-2002
Rahman, M.A., B.Sc.(Eng.) *Bangladesh*, M.A.Sc. *Toronto*, Ph.D. *Carleton*, L.F.I.E.E.E., F.I.E.T., L.F.I.E., F.E.I.C., F.C.A.E., C.Eng., P.Eng.; University Research Professor, Awarded 1993

Associate Professors

Ahmed, M.H., B.Sc., M.Sc., *Ain-Shams*, Ph.D. *Carleton*, P.Eng.
Dobre, O., D.Eng., Ph.D. *Politechnica Univeristy of Bucharest*, P.Eng.
George, G.H., B.Sc. *Southampton*, Ph.D. *Wales (U.C. Cardiff)*, Cert.Ed., (C.N.A.A.), F.R.A.S.
Iqbal, M.T., B.Sc. *UET Lahore*, M.Sc., *QAU Islamabad*, Ph.D. *Imperial College, London*, P.Eng.
Li, C., B.Eng.(Hons.), M.Eng. *Harbin Institute of Technology*, Ph.D. *Memorial*, P.Eng.
Masek, V., Dipl.Ing. University of West Bohemia, M.Sc., Ph.D. University of Electro-Communications, Tokyo
Norvell, T.S., B.Sc.(Hons.) *Dalhousie*, M.Sc., Ph.D. *Toronto*
Vardy, A., B.Eng. *Memorial*, M.Sc. *Sussex*, Ph.D. *Carleton*; Joint appointment with Engineering and Computer Science

Assistant Professors

Huang, W., B.S., M.S., Ph.D. *Wuhan University*, M.Eng. *Memorial*
Zhang, L., B.E., M.Sc.(Eng.) *H.U.S.T. Wuhan*, Ph.D. O-V-G *Magdeburg*

Mechanical Engineering Discipline

Chair

Krouglicof, N., B.Eng.(Hons.), Ph.D. *Concordia*; Baader-Canpolar Industrial Research Chair in Machine Vision; Associate Professor

Professors

Hinchey, M.J., B.A.Sc., M.A.Sc., Ph.D. *Toronto*, P.Eng.
Mann, G.K.I., B.Sc. *University of Moratuwa*, M.Sc. *Loughborough University of Technology*, Ph.D. *Memorial*
Muzychka, Y.S., B.Eng. *Memorial*, M.A.Sc., Ph.D. *Waterloo*, P.Eng.; Petro-Canada Young Innovator Award 2004
Sharan, A.M., B.Tech., *I.I.T. Bombay*, M.S. *Wash. State*, Ph.D. *Concordia*, P.Eng.

Associate Professors

Fisher, A.D., B.Sc. *Queen's*, M.Eng. *McMaster*, P.Eng.
Hsiao, A.C., B.Sc. *Massachusetts Institute of Technology*, M.Sc., Ph.D. *Carnegie Mellon University*, M.B.A. *Memorial*
Hookey, N.A., B.Eng. *Memorial*, M.Eng., Ph.D. *McGill*, P.Eng.
Munaswamy, K., B.E., *S.V. Univ. Tirupathy*, M.Tech., Ph.D., *IIT Madras*, P.Eng.
Rideout, D.G., B.Eng. *Memorial*, M.Sc.(Eng.) *Queen's*, Ph.D. *Michigan*, P.Eng.

Assistant Professor

Yang, J., B.Sc. *Tangshan Institute of Science and Technology*, M.Sc. *Southern Institute of Metallurgy*, Ph.D. *Tianjin University*, P.Eng.

Ocean and Naval Architectural Engineering Discipline

Chair

Daley, C.G., B.E.Sc. *Western Ontario*, M.S.E. *Princeton*, Dr. Tech. *Helsinki*, FEC, P.Eng.; Professor

Professors

Colbourne, D.B., B.Eng. *Memorial*, S.M. *MIT*, Ph.D. *Memorial*, P.Eng.

Veitch, B.J., B.Eng., M.Eng. *Memorial*, Dr.Tech., Lic.Tech. *Helsinki*, P.Eng.; Winner of the President's Award for Outstanding Research, 2004-2005

Associate Professor

Bachmayer, R., Dipl.Ing. *Techical University Karlsruhe*, M.Sc., Ph.D. *Johns Hopkins*; Canada Research Chair in Ocean Technology, Petro-Canada Young Innovator Award, 2009

Walker, D., B.Eng., Ph.D. *Memorial*, P.Eng.

Assistant Professors

Akinturk, A., B.Sc.(Eng.) *Istanbul Technical University*, M.A.Sc. *University of Newcastle Upon Tyne*, Ph.D. *University of Britiish Columbia*

Peng, H., B.Eng., M. A. Sc. *Dalian University of Technology*, Ph.D. *Dalhousie*, P.Eng.

Process Engineering

Chair

Khan, F.I., B.Sc.(Eng.) *AMU*, M.E. *IIT Roorkee*, Ph.D. *Pondicherry,* P.Eng.; Professor

Professors

Butt, S.D., B.Eng., M.Sc. *Memorial*, Ph.D. *Queens*, P.Eng

Hawboldt, K.A., B.Sc. *Saskatchewan*, M.Sc., Ph.D. *Calgary*, P.Eng.

Johansen, T.E., B.A.Sc., M.Sc., Ph.D. *University of Oslo*; Canada Research Chair in Petroleum Reservoir Engineering and Characterization

Associate Professor

Shirokoff, J.W., B.Sc.(Eng.), Ph.D. *Queen's*, P.Eng.

Assistant Professors

Alam, S., B.Sc.(Eng.) *BUET*, M.Sc., Ph.D. *Saga*, P.Eng.

Imtiaz, S., B.Sc, M.Sc. *Bangladesh University of Engineering and Technology*, M.Sc. *Calgary*, Ph.D. *Alberta*

James, L.A., B.A.Sc.(Eng.) *University of New Brunswick*, M.ASc., Ph.D. *Waterloo*, E.I.T.

Zhang, Y., B.Eng., M.Eng. *Tianjin*, Ph.D. *National University of Singapore*, P.Eng.

Cross-Appointment, Adjunct, Professional Affiliate

Bose, N., B.Sc., Ph.D. *Glasgow*, F.S.N.A.M.E., C.Eng., P.Eng.; Adjunct Professor

Byrne, R., B.Sc.(Hons.), B.Eng. *Memorial*, M.Sc., Ph.C. *Victoria*; Cross Appointment (Computer Science)

Gillard, P., B.Sc., M.Sc., Ph.D. *Memorial*; Cross Appointment (Computer Science)

Hubbard, P., B.Sc.Eng., M.Sc.Eng. *Queens*, Ph.D. *McGill*; Adjunct Professor (DRDC)

Khan, A., B.Sc. *AMU*, M.Sc. *KFUPM*, Ph.D. *Memorial*, P.Eng.; Adjunct Professor (Dept. Environment and Conservation)

Kocabiyik, S., B.Sc., M.Sc. *Middle East Tech.*, Ph.D. *Western Ontario*; Petro-Canada Young Innovators Award, 2000; Cross appointment with the Department of Mathematics

Lee, K. B.Sc., *Dalhousie*, M.Sc., Ph.D. *Toronto*; Adjunct Professor (COOGER)

Liu, P., B.Eng. *Wuhan Jiao Tong*, M.Eng., Ph.D. *Memorial*; Adjunct Professor

Mak, L., B.Eng., M.Eng., M.B.A. *Memorial*; Adjunct Professor (NRC-IOT)

Marzouk, H., B.Sc. *Cairo*, M.Sc., Ph.D. *Saskatchewan*, FCSCE, P.Eng.; Adjunct Professor (Ryerson University)

McGuire, P., B.Sc. Ph.D. *Toronto*, P.Eng; Adjunct Professor (C-CORE)

Murrin, D. B.Eng., M.Eng., Ph.D. *Memorial*; Adjunct Professor (C-CORE)

Ordonez, M., Ing. *UTN*, M.Eng., Ph.D. *Memorial*; Adjunct Professor (SFU)

Williams, C., B.A.Sc.(Hons.), M.A.Sc., Ph.D. *British Columbia*; Adjunct Professor (NRC-IOT)

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Co-ordinators

Hudson, J.F., B.Eng. *McGill*, P.Eng.

Jin, G., B.Eng. *Memorial*, P.Eng.

Oldford, D.B., B.Sc. *Memorial*, B.Eng. *Dalhousie*

Raheja, A., B.Eng. *Bangalore*, M.B.A. *Memorial*, Associate Director

Smith, G.S., B.Eng., M.B.A. *Memorial*

Sullivan, P., B.Eng. *Memorial*, M.B.A. Ottawa

Wadden, N., B.Eng. *Memorial*

1 The Memorial University of Newfoundland Code

The attention of all members of the University Community is drawn to the section of the University Calendar titled **The Memorial University of Newfoundland Code**, which articulates the University's commitment to maintaining the highest standards of academic integrity.

2 Faculty Description

The Faculty of Engineering and Applied Science offers a co-operative undergraduate program leading to the degree of Bachelor of Engineering, as well as graduate programs leading to the degrees of Master of Engineering, Master of Applied Science, Master of Engineering Management, and Doctor of Philosophy. Through teaching, research and outreach, the Faculty of Engineering plays a critical role in the economic development of the province, and graduates from the programs hold key positions in the major industrial developments in our province. A growing number of our recent graduates are leading emerging high-technology companies and hold important positions in national and international industries and governments, contributing to the University's global impact. Research in the Faculty of Engineering and Applied Science has a strong focus on research and development opportunities associated with the general technological needs of our society. The Faculty maintains a very strong sense of identity and cooperation among students, faculty, and staff, and prides itself on its strong linkages with industry and the engineering profession.

Additional information regarding the Faculty of Engineering and Applied Science is available at www.engr.mun.ca.

Students must meet all regulations of the Faculty in addition to those stated in the general regulations. For information concerning fees and charges, admission/readmission to the University, and general academic regulations (undergraduate), refer to the ***UNIVERSITY REGULATIONS***.

2.1 Accreditation Status

Graduates of Memorial University of Newfoundland's engineering programs have been enjoying the benefits of full accreditation with the Canadian Engineering Accreditation Board (CEAB) since 1975. Accreditation for the Process Engineering major will be sought, in line with the normal procedures of the CEAB, in 2013.

2.2 Objectives of the Bachelor of Engineering Degree Program

The objectives of the undergraduate program are to provide students an excellent academic experience and to equip graduates with the ability to solve a broad range of problems in our rapidly changing technological, economic and social environment. To this end, the Faculty is committed to educate graduates who have:

1. a strong foundation and knowledge in engineering fundamentals with a capacity to know how, when and where to use the knowledge in specific ways;
2. an ability to identify, formulate, analyse and solve engineering problems and a capacity to integrate material from more than one subject and to apply appropriate engineering principles to arrive at correct and effective solutions;
3. a comprehensive knowledge in the fundamentals of engineering practice, including an ability to use analytical techniques, experimental and laboratory skills and modern engineering simulation and design software tools;
4. a broad knowledge of the principles and skills in engineering design, development and management in global, cultural and business contexts;
5. a multidisciplinary view with an ability to work effectively as members of teams, composed of individuals from different disciplines and different professional cultures;
6. strong oral and written communication skills with a capacity to produce effective technical documents and to use current communication techniques and tools;
7. a culture of life-long learning with a capacity to engage in continuous self-improvement, personal enrichment and professional development; and
8. a broad sense of social, ethical and professional responsibility with a capacity to demonstrate an understanding and appreciation of the human dimension of technology and its impact on mankind.

3 Description of Program

The Bachelor of Engineering Degree at Memorial University of Newfoundland is a Co-operative Program in which regular full-time academic study is supplemented by four month periods of full-time work in positions related to the student's future career. The Bachelor of Engineering degree program is available in the following six majors: Civil Engineering, Computer Engineering, Electrical Engineering, Mechanical Engineering, Ocean and Naval Architectural Engineering, and Process Engineering.

Engineering One, the first-year of the engineering program, comprises courses in mathematics and basic science (physics and chemistry), as well as courses covering engineering fundamentals which are common to each of the majors. The engineering courses in Engineering One introduce students to engineering problem-solving, analysis, design, communication, and teamwork. Students will develop an understanding of the different engineering specialities, as well as the interdisciplinary nature of engineering practice.

The specialized major programs of Civil Engineering, Computer Engineering, Electrical Engineering, Mechanical Engineering, Ocean and Naval Architectural Engineering, and Process Engineering are offered in academic terms 3 through 8. Students in the Mechanical Engineering major may also choose to pursue an Offshore Oil and Gas Engineering option (OOGE) in the last three terms of the program. For specific details on each major, refer to the appropriate **Program Regulations**.

Electives can be tailored to meet the needs of those who plan to go straight into industry and those who wish to join the increasing number of our graduates who are pursuing advanced degrees.

All courses of the Faculty are designated by the abbreviation ENGI.

3.1 Program of Study

1. Courses in the engineering program are normally taken in blocks as shown in the appropriate program table. Students must satisfy the criteria for promotion as described below under **Promotion Regulations** to remain in the Engineering program.
2. The Engineering Program consists of eight academic terms and four work terms. The first-year of the Engineering Program, known as Engineering One, forms a core that is common to all majors. All students must successfully complete the requirements of Engineering One prior to being promoted to Academic Term 3.
3. In 1000 level Engineering courses, registration priority is given to students who have been admitted to Engineering One. Other students will be admitted to these courses only with the approval of the Associate Dean (Undergraduate Studies).
4. In these program regulations, including the program tables, wherever reference is made to English 1080 or Chemistry 1050, these courses may be replaced by courses deemed equivalent by the relevant academic unit.
5. Upon entering Academic Term 3, students begin to specialize in their academic program, in one of the following six majors: Civil Engineering, Computer Engineering, Electrical Engineering, Mechanical Engineering, Ocean and Naval Architectural Engineering, or Process Engineering. All Engineering students who successfully complete the Engineering One requirements during their first year of Engineering will be guaranteed a place in Academic Term 3, although not necessarily in the preferred major as indicated under **Promotion Regulations, Promotion Status (Engineering One)**.
6. Upon entering Academic Term 6, students in the Mechanical Engineering major may choose to pursue the Offshore Oil and Gas Engineering option (OOGE).
7. Engineering courses in Academic Term 3 and beyond (i.e., those with numbers 3000 and greater) are restricted to students who have been admitted or promoted to the appropriate academic term and major (e.g., Academic Term 3 for 3000 level courses, restricted by major). Other students will be admitted to these courses only with the approval of the Associate Dean (Undergraduate Studies) in consultation with the appropriate Discipline Chair.

   Some of the courses offered in academic terms 3 to 8 are taken by all Engineering students, others are offered for more than one major, but most technical courses in academic terms 3 to 8 are specific to the individual majors. Students should refer to the program descriptions for the detailed course requirements in each phase of their program.
8. Technical elective courses may be offered in terms other than those indicated in the program tables.
9. A student who has previously met a technical elective requirement in a given semester or wishes to defer it, may request an exemption or deferral by applying to the Associate Dean (Undergraduate Studies), who will consult the appropriate Discipline Chair. A minimum grade of 60% is required for credit to be given towards a student's engineering program for any technical elective taken outside the normal blocks as shown in the tables.
10. Students registered in Academic Term 7 of any Engineering major are eligible to apply for admission to a **Master of Engineering** fast-track option (M.Eng.). The purpose of the option is to encourage students interested in pursuing graduate studies to begin their graduate program while still registered as an undergraduate student. While enrolled in the option, a student may complete some of the M.Eng. Degree requirements and potentially be able to graduate earlier from the M.Eng. Program. For further details and the

regulations regarding the option, refer to the **School of Graduate Studies, Regulations Governing the Degree of Master of Engineering**.

3.2 Complementary Studies

1. The Complementary Studies component has been developed to make students aware of the function and responsibilities of the Professional Engineer in society and the impact that engineering in all its forms has on environmental, economic, social and cultural aspects of our society. This complements the technical expertise and communications skills developed and practised in all components of the program.
2. The Complementary Studies component is the same for all programs and consists of a minimum of 21 credit hours as follows:
   - English 1080 or English 1020
   - Engineering 3101
   - Engineering 4102
   - One 3 credit hour course that deals with the effect of technology on society and the environment. The course is to be chosen from Engineering 6101, Sociology 2120, Philosophy 2571 or the former Philosophy 2801, Sociology 4107
   - Engineering 7102
   - One Elective course of a 3 credit hour value chosen from the arts, humanities, social sciences and management and approved by the Associate Dean (Undergraduate Studies) of the Faculty of Engineering and Applied Science. List A is an approved list of courses maintained by the Office of the Associate Dean (Undergraduate Studies) of the Faculty of Engineering and Applied Science and is available at the web site www.engr.mun.ca.
   - One Elective course of a 3 credit hour value chosen from the humanities and social sciences and approved by the Associate Dean (Undergraduate Studies) of the Faculty of Engineering and Applied Science. This course must be second-year or higher and it is intended to provide experience with the central issues, methodologies and thought processes of the humanities and social sciences. List B is an approved list of courses maintained by the Office of the Associate Dean (Undergraduate Studies) of the Faculty of Engineering and Applied Science and is available at the web site www.engr.mun.ca.
3. In order to graduate, the student must obtain an overall average of at least 60% in the 21 credit hours in Complementary Studies courses required in the program.

3.3 Bachelor of Engineering Majors

The Bachelor of Engineering degree program is available in the following six majors: Civil Engineering, Computer Engineering, Electrical Engineering, Mechanical Engineering, Ocean and Naval Architectural Engineering, and Process Engineering.

3.3.1 Civil Engineering

Civil Engineering deals with the planning, design, and construction of roads, railways, harbours, docks, tunnels, bridges, buildings, water supplies, hydroelectric power development, and sewage collection, treatment, and disposal systems.

The Civil Engineering major provides a broad introduction to the scientific principles and engineering techniques necessary for an understanding of the fundamental problems tackled by civil engineers.

3.3.2 Computer Engineering

Computer Engineering is the design and analysis of computer systems applied to the solution of practical problems. It encompasses both hardware and software design in applications ranging from telecommunications and information systems to process control and avionics. Computer Engineering students learn the mathematics of discrete and continuous systems, the design of digital machines such as processors and memories, the fundamentals of software design, and the principles used in communications systems such as telephone networks and the Internet.

Computer Engineering shares many fundamentals with Electrical Engineering, which are covered in a common curriculum up to and including Academic Term 3. In recognition of the considerable diversity of careers available to computer engineers, students are given latitude in the final three academic terms to choose from a wide range of electives in various specialty areas.

3.3.3 Electrical Engineering

Electrical Engineering is a broad field encompassing the study of control systems, electromagnetics and antennas, power systems, electronics, communications, and computer hardware and software.

Electrical Engineering shares many fundamentals with Computer Engineering, which are covered in a common curriculum up to and including Academic Term 3. In recognition of the considerable diversity of careers available to electrical engineers, students are given latitude in the final three academic terms to choose from a wide range of electives in various specialty areas. Making use of their elective course choices, students in the Electrical Engineering major also have the opportunity to undertake a minor in Physics.

3.3.4 Mechanical Engineering

Mechanical engineering is a highly diversified discipline encompassing the design, analysis, testing and manufacture of products that are used in every facet of modern society. Mechanical engineers analyse and design using the principles of motion, energy, and force to ensure that the product functions safely, efficiently, reliably, and can be manufactured at a competitive cost. This activity requires a thorough knowledge of materials, mathematics, and the physical sciences, and an ability to apply this knowledge to the synthesis of economical and socially acceptable solutions to engineering problems.

Mechanical Engineering is designed to provide students with a knowledge in the following four areas: design and dynamics area, emphasizing solid mechanics, material science, dynamics, vibrations and machine component design; thermo-fluids area, focussing on thermodynamics, heat transfer and fluid mechanics; mechatronics area, dealing with electro-mechanical systems, control, robotics, and automation; and manufacturing/industrial area, which encompasses CAD/CAM, production and operation management. In Academic Term 6, students may select the Offshore Oil and Gas option (OOGE). Students may choose from a wide range of electives in various specialty areas in academic terms 7 and 8.

3.3.5 Ocean and Naval Architectural Engineering

Ocean and Naval Architectural Engineering covers aspects of both naval architecture and ocean engineering. The Ocean and Naval Architectural Engineering major is the only accredited undergraduate program specifically in naval architecture/ocean engineering in Canada. The major is designed to provide education to work in marine transport, ship and boat building, offshore engineering,

submersibles design and many related marine areas. The undergraduate program is also a comprehensive preparation for graduate studies, research and consulting in ocean engineering.

Naval Architecture is primarily concerned with the design and construction of ships, offshore structures and other floating equipment and facilities. Ocean Engineering extends this focus to cover virtually all aspects of engineering related to the world's oceans. Topics including sub-sea systems and oceanographic science add core ocean engineering content to the program. Students will be able to further develop their particular interests by using the focus stream to study any of a wide variety of topics, reflecting the tremendous diversity of the field.

A student's selection of courses for the focus stream requires the prior approval of the discipline chair of Ocean and Naval Architectural Engineering. In order to graduate, the student must obtain an overall average of at least 60% in the 12 credit hours in focus stream courses required in the program.

3.3.6 Process Engineering

Process Engineering is a diversified discipline encompassing new development, design, optimization, and operation of sustainable processes for human needs. A process engineer uses biological, chemical, and physical processing of substances to modify their nature, their properties, and/or the composition of mixtures to produce useful products. This activity requires a thorough knowledge of materials, chemical and physical sciences, and mathematics and an ability to apply this knowledge in an economical and sustainable way to engineering development.

The process engineering major is designed to provide students with a specialization in the areas of minerals and metals processing, and downstream oil and gas processing. Throughout the major and within each area of specialization, emphasis is placed on green and clean processes which are environmentally benign and inherently safe. The goal of this major is to prepare graduates with knowledge and ability to implement this knowledge in a sustainable manner to larger-scale industrial development.

3.4 Work Terms

Engineering work term registration, grading, and tuition fee charges and payments are governed by the ***UNIVERSITY REGULATIONS*** in this Calendar and those outlined below. Engineering work term placement and opt-outs, conduct, and evaluation are governing by the *Engineering Student Co-op Handbook* which is available at www.mun.ca/coop/home/enghandbook.pdf.

Students must complete successfully a minimum of four work terms in order to graduate with a Bachelor of Engineering degree. The Bachelor of Engineering degree offers the opportunity to complete up to five work terms beyond academic term 3. Students are expected to complete as many of these work terms as possible. Students who expect to complete the Engineering One requirements by the end of the Winter semester may apply to the Committee on Undergraduate Studies to undertake a work term during the Spring semester of Engineering One. Academic performance is the basis for approving such requests.

All students in academic terms 3 to 7 and any student approved to complete a work term during the Spring semester of Engineering One will be registered automatically during the regular registration period for the next scheduled work term unless the student has opted-out. Students may opt out of up to two work terms beyond Academic Term 3 by completing the procedures outlined in the *Engineering Student Co-op Handbook*. Opt outs normally are approved only in cases where students have successfully completed a minimum of four work terms.

3.4.1 General Information

- During work terms students are brought into direct contact with the engineering profession, exposed to the work place setting, expected to assume ever-increasing responsibility in employment situations as their education advances, and introduced to experiences beyond the scope of those which could be provided in the classroom.
- Students are responsible for finding suitable work placements. The Division of Co-operative Education provides resources to assist in this process.
- Students who cannot meet the demands of the work term may be required by the Faculty to withdraw from the work term until they can demonstrate an ability to continue in the program.
- Following the date of automatic registration for a work term, only students who are registered for that work term will be approved to join the job placement process and be approved to begin a work placement
- Students are not permitted to drop work terms without prior approval of the Committee on Undergraduate Studies, on the recommendation of the Division of Co-operative Education. Students who drop a work term without permission, or who fail to honour an agreement to work with an employer, will be assigned a grade of FAL (fail) for that work term.
- Students who conduct themselves in such a manner as to cause their termination from the job, will be assigned a grade of FAL (fail) for that work term.

3.4.2 Evaluation of Work Terms

Two components are considered in work term evaluation: work performance and a communications component, as described in the *Co-operative Student Handbook* which is available at www.mun.ca/coop/home/enghandbook.pdf.

Each component is evaluated separately and equally weighted resulting in one of the following classifications: Outstanding, Above Expectations, Satisfactory, Marginal Pass, Fail. Both evaluations will be recorded on the transcript. Overall evaluation of the work term will result in the assignment of one of the following final grades:

- Pass with distinction (PWD): To receive a PWD, a student must obtain an evaluation of Outstanding in both the communications and work performance components of the work term.
- Pass (PAS): To receive a PAS, a student must achieve an evaluation of Marginal Pass or better in the communications component and in the performance component of the work term.
- Fail (FAL): A student receiving a Fail in either the communications or performance component of the work term will receive a FAL. For promotion from the work term, a student must obtain PWD or PAS.

3.5 Continuing Engineering Education

The Faculty of Engineering and Applied Science has a firm commitment to continuing engineering education and offers a variety of seminars and short courses in St. John's and in other centres for practising engineers. For applicability of courses towards diplomas and certificates in Engineering, contact the Continuing Engineering Education office by telephone to (709) 864-7467, in-person at EN 3017, or through the website at www.engr.mun.ca/continuing/index.php.

4 Admission/Readmission Regulations for the Faculty of Engineering and Applied Science

In addition to meeting ***UNIVERSITY REGULATIONS***, students must meet the admission/readmission regulations for the Faculty of Engineering and Applied Science.

4.1 General Information

1. Entry to Engineering One and to the majors offered by the Faculty is competitive for a limited number of placements. Meeting the minimum admission requirements does not guarantee acceptance into the Engineering program. The final decision on admission or readmission to Engineering One or any engineering major rests with the Admissions Committee of the Faculty.
2. Admission or readmission to the University does not necessarily constitute admission or readmission to Engineering One or to any major.
3. The primary criterion used in reaching decisions on applications for admission or readmission is the Admission Committee's judgement of the likelihood of an applicant succeeding in the program.

4.2 Application Forms and Deadlines

1. The program of the Faculty commences in the Fall semester. The deadline for application for admission is March 1. Students are encouraged to submit their applications as early as possible since the Faculty may begin to offer provisional admissions as early as February to students applying to begin their program in September.
2. The deadline for application for readmission, for students who were previously admitted to a Faculty program, is June 1 for the Fall semester, October 1 for Winter, and February 1 for Spring.
3. Applications received after the relevant deadline may be considered as time and space permit. Incomplete applications will not be considered.
4. Application forms are available in person from the Faculty's General Office and the Office of the Registrar or through the Faculty's website at www.engr.mun.ca. Application forms may also be obtained by writing to the Faculty of Engineering and Applied Science, Memorial University of Newfoundland, St. John's, NL, A1B 3X5, or to the Office of the Registrar, Admissions Office, Memorial University of Newfoundland, St. John's, NL, A1C 5S7.
5. All applications for admission or readmission must be submitted to the Office of the Registrar. A complete application package includes an application to the University (for those who have not attended Memorial University of Newfoundland in the two preceding semesters), an application to the Faculty and any other required supporting documentation. Application fees must be paid when the application forms are submitted.

4.3 Admission Requirements to the Faculty Program

Applicants may apply for admission to the University in a category as defined in the Calendar section under ***UNIVERSITY REGULATIONS*** **- Admission/Readmission to the University (Undergraduate), Categories of Applicants, Admission Criteria and Other Information**. In addition to meeting these regulations, applicants to the faculty program in the following categories must meet the requirements as indicated below.

4.3.1 High School Applicants

- The Faculty of Engineering and Applied Science encourages applications from high school students who have an interest in pursuing an engineering degree and who have achieved a good academic performance during high school.
- High school applicants admitted to the program who are admissible to the required Engineering One courses Mathematics 1000, Physics 1050, and Chemistry 1050 are expected to be able to complete the Engineering One requirements during their first two semesters at Memorial University of Newfoundland.
- High school applicants who are not admissible to these courses, but who are interested in pursuing an engineering degree, are encouraged to apply to the Faculty and to discuss an appropriate first-year program with the Associate Dean (Undergraduate Studies).

4.3.2 Memorial University of Newfoundland Applicants

- To be eligible for consideration for admission to Engineering One, students who are attending or have previously attended this University must have a cumulative average of at least 60% or an average of at least 65% on their most recent 30 attempted credit hours and be admissible to (or have previously completed) the Engineering One courses Mathematics 1000, Physics 1050 and Chemistry 1050.
- To be eligible for consideration for admission to Academic Term 3, students who are attending or have previously attended this University must meet the requirements stated in the **Promotion Regulations, Promotion Status (Engineering One)**.

4.3.3 Transfer Applicants

- Applicants seeking admission through transfer from accredited post-secondary institutions must have achieved a minimum overall average of 60% to be considered for admission.
- A student's placement within a program, and requirements needed to complete the program, will be determined on an individual basis at the time of admission. Transfer applicants must complete a majority of the credit hours in their program at Memorial University of Newfoundland.

4.4 Other Information

1. The Faculty will notify applicants in writing regarding an admission decision to the Faculty program.
2. Students admitted to the program in any term, without receiving credit for all courses required up to that level, must successfully complete those courses prior to graduation.
3. Students who have been admitted to one major offered by the Faculty and who wish to change to another major within the Faculty must submit a new application for admission to the program. This application must be submitted to the Office of the Registrar by the appropriate deadline date as outlined above in **Application Forms and Deadlines** and will be considered in competition with all other applications.

4. Students admitted full-time to the program and who decline the offer of admission or who fail to register for the appropriate courses during the term of admission will be considered withdrawn from the program. Such students, if they subsequently wish to be considered for admission, must submit a new application for admission to the program. This application must be submitted to the Office of the Registrar by the appropriate deadline date in **Application Forms and Deadlines** above and will be considered in competition with other applications.

5 Program Regulations

5.1 Civil Engineering Program Regulations

5.1.1 Civil Engineering Major

- The full-time 141 credit hour Bachelor of Engineering (Co-operative), Civil Engineering Major, requires eight academic terms and four work terms.
- The 141 credit hours shall normally be taken in the academic terms and order as set out in **Table 1 Civil Engineering Major**.
- Work terms shall normally be taken in the order as set out in **Table 1 Civil Engineering Major**.

Table 1 Civil Engineering Major

Term	Required Courses	Elective Courses
Engineering One	Chemistry 1050 English 1080 ENGI 1010 ENGI 1020 ENGI 1030 ENGI 1040 Mathematics 1000 Mathematics 1001 Mathematics 2050 Physics 1050 Physics 1051	Students who are expecting to complete the Engineering One requirements during the first two semesters may apply to undertake a work term during the Spring semester. In this case, the prerequisite course ENGI 200W must be completed during the Winter semester.
Fall Academic Term 3	ENGI 3101 ENGI 3425 ENGI 3610 ENGI 3703 ENGI 3731 ENGI 3934	ENGI 200W (if not completed during Engineering One).
Winter	001W or 002W	
Spring Academic Term 4	ENGI 4102 ENGI 4312 ENGI 4421 ENGI 4425 ENGI 4717 ENGI 4723	
Fall	001W or 002W or 003W	
Winter Academic Term 5	ENGI 5312 ENGI 5434 ENGI 5706 ENGI 5713 ENGI 5723	Complementary Studies Elective
Spring	002W or 003W or 004W	
Fall Academic Term 6	ENGI 6322 ENGI 6705 ENGI 6707 ENGI 6713	Complementary Studies Elective 3 credit hours from: ENGI 6718, 6749
Winter	003W or 004W or 005W (optional)	
Spring Academic Term 7	ENGI 7102 ENGI 7704 ENGI 7713 ENGI 7745 ENGI 7748	3 credit hours from: ENGI 7706, 7707, 7716, 7723, 8671, 8691, 8692 or other courses as specified by the Discipline Chair
Fall	004W or 005W (optional) or 006W (optional)	
Winter Academic Term 8	ENGI 8700 ENGI 8740 ENGI 8751	Complementary Studies Elective 6 credit hours from: ENGI 8670, 8676, 8690, 8705, 8708, 8713, 8717, other courses as specified by the Discipline Chair

5.2 Computer Engineering Program Regulations

5.2.1 Computer Engineering Major

- The full-time 141 credit hour Bachelor of Engineering (Co-operative), Computer Engineering Major, requires eight academic terms and four work terms.
- The 141 credit hours shall normally be taken in the academic terms and order as set out in **Table 2 Computer Engineering Major**.
- Work terms shall normally be taken in the order as set out in **Table 2 Computer Engineering Major**.

Table 2 Computer Engineering Major

Term	Required Courses	Elective Courses
Engineering One	Chemistry 1050 English 1080 ENGI 1010 ENGI 1020 ENGI 1030 ENGI 1040 Mathematics 1000 Mathematics 1001 Mathematics 2050 Physics 1050 Physics 1051	Students who are expecting to complete the Engineering One requirements during the first two semesters may apply to undertake a work term during the Spring semester. In this case, the prerequisite course ENGI 200W must be completed during the Winter semester.
Fall Academic Term 3	ENGI 3101 ENGI 3424 ENGI 3821 ENGI 3861 ENGI 3891 Physics 3000	ENGI 200W (if not completed during Engineering One).
Winter	001W or 002W	
Spring Academic Term 4	ENGI 4102 ENGI 4424 ENGI 4823 ENGI 4854 ENGI 4862 ENGI 4892	
Fall	001W or 002W or 003W	
Winter Academic Term 5	ENGI 5420 ENGI 5821 ENGI 5854 ENGI 5865 ENGI 5895	Complementary Studies Elective
Spring	002W or 003W or 004W	
Fall Academic Term 6	ENGI 6861 ENGI 6871 ENGI 6876 ENGI 6892	Complementary Studies Elective 3 credit hours from: ENGI 6855 or other courses as specified by the Discipline Chair
Winter	003W or 004W or 005W (optional)	
Spring Academic Term 7	ENGI 7102 ENGI 7804 ENGI 7824 ENGI 7894	6 credit hours from: ENGI 7814, 7825, 7854, 7855, 7952, 8680, other courses as specified by the Discipline Chair
Fall	004W or 005W (optional) or 006W (optional)	
Winter Academic Term 8	ENGI 8854 ENGI 8894	Complementary Studies Elective One free elective which must be a 5000-level or higher Engineering course, or a 2000-level or higher course either from the Faculty of Arts or the Faculty of Science, or a 3000-level or higher course from the Faculty of Business Administration. Selection of a course must be approved by the Discipline Chair. 6 credit hours from: ENGI 7680, 8821, 8826, 8863, 8868, 8879, 8801-8805, or other courses as specified by the Discipline Chair

5.3 Electrical Engineering Program Regulations

5.3.1 Electrical Engineering

- The full-time 141 credit hour Bachelor of Engineering (Co-operative), Electrical Engineering Major, requires eight academic terms and four work terms.
- The 141 credit hours shall normally be taken in the academic terms and order as set out in **Table 3 Electrical Engineering Major**.
- Work terms shall be taken in the order as set out in **Table 3 Electrical Engineering Major**.
- The requirements for a minor in Physics in the Electrical Engineering program are detailed under **Faculty of Science, Minor In Physics**. Students wishing to undertake a minor in Physics must obtain approval from the Discipline Chair for their course selection.

Table 3 Electrical Engineering Major

Term	Required Course	Elective Courses
Engineering One	Chemistry 1050 English 1080 ENGI 1010 ENGI 1020 ENGI 1030 ENGI 1040 Mathematics 1000 Mathematics 1001 Mathematics 2050 Physics 1050 Physics 1051	Students who are expecting to complete the Engineering One requirements during the first two semesters may apply to undertake a work term during the Spring semester. In this case, the prerequisite course ENGI 200W must be completed during the Winter semester.
Fall Academic Term 3	ENGI 3101 ENGI 3424 ENGI 3821 ENGI 3861 ENGI 3891 Physics 3000	ENGI 200W (if not completed during Engineering One).
Winter	001W or 002W	
Spring Academic Term 4	ENGI 4102 ENGI 4430 ENGI 4823 ENGI 4841 ENGI 4854 ENGI 4862	
Fall	001W or 002W or 003W	
Winter Academic Term 5	ENGI 5420 ENGI 5800 ENGI 5812 ENGI 5821 ENGI 5854	Complementary Studies Elective
Spring	002W or 003W or 004W	
Fall Academic Term 6	ENGI 6813 ENGI 6843 ENGI 6855 ENGI 6871	Complementary Studies Elective 3 credit hours from: ENGI 6856, 6876, other courses as specified by the Discipline Chair
Winter	003W or 004W or 005W (optional)	
Spring Academic Term 7	ENGI 7102 ENGI 7803 ENGI 7824	9 credit hours from: ENGI 7811, 7825, 7844, 7854, 7855, 7856, 7952, 8680, other courses as specified by the Discipline Chair
Fall	004W or 005W (optional) or 006W (optional)	
Winter Academic Term 8	ENGI 8826 ENGI 8853	Complementary Studies Elective One free elective which must be a 5000-level or higher Engineering course, or a 2000-level or higher course either from the Faculty of Arts or the Faculty of Science, or a 3000-level or higher course from the Faculty of Business Administration. Selection of a course must be approved by the Discipline Chair. 6 credit hours from: ENGI 5865, 7680, 8821, 8845, 8879, 8806-8809, other courses as specified by the Discipline Chair

5.4 Mechanical Engineering Program Regulations

5.4.1 Mechanical Engineering Major - General Option

- The full-time 141 credit hour Bachelor of Engineering (Co-operative), Mechanical Engineering Major - General Option, requires eight academic terms and four work terms.
- The 141 credit hours shall normally be taken in the academic terms and order as set out in **Table 4 Mechanical Engineering Major - General Option**.
- Work terms shall normally be taken in the order as set out in **Table 4 Mechanical Engineering Major - General Option**.

Table 4 Mechanical Engineering Major - General Option

Term	Required Courses	Elective Courses
Engineering One	Chemistry 1050 English 1080 ENGI 1010 ENGI 1020 ENGI 1030 ENGI 1040 Mathematics 1000 Mathematics 1001 Mathematics 2050 Physics 1050 Physics 1051	Students who are expecting to complete the Engineering One requirements during the first two semesters may apply to undertake a work term during the Spring semester. In this case, the prerequisite course ENGI 200W must be completed during the Winter semester.
Fall Academic Term 3	ENGI 3101 ENGI 3424 ENGI 3901 ENGI 3911 ENGI 3934 ENGI 3941	ENGI 200W (if not completed during Engineering One).
Winter	001W or 002W	
Spring Academic Term 4	ENGI 4102 ENGI 4312 ENGI 4430 ENGI 4901 ENGI 4932 ENGI 4951	
Fall	001W or 002W or 003W	
Winter Academic Term 5	ENGI 5911 ENGI 5927 ENGI 5931 ENGI 5951 ENGI 5961	Complementary Studies Elective
Spring	002W or 003W or 004W	
Fall Academic Term 6	ENGI 6901 ENGI 6927 ENGI 6933 ENGI 6951 ENGI 6961	Complementary Studies Elective
Winter	003W or 004W or 005W (optional)	
Spring Academic Term 7	ENGI 4421 ENGI 7102 ENGI 7926 ENGI 7928	6 credit hours from: ENGI 7901, 7903, 7911, 7934, 7952, other courses as specified by the Discipline Chair
Fall	004W or 005W (optional) or 006W (optional)	
Winter Academic Term 8	ENGI 8926	Complementary Studies Elective One free elective which must be a 5000-level or higher Engineering course, or a 2000-level or higher course either from the Faculty of Arts or the Faculty of Science, or a 3000-level or higher course from the Faculty of Business Administration. Selection of a course must be approved by the Discipline Chair. 9 credit hours from: ENGI 8903, 8911, 8933, 8935, 8937, 8945, 8964, other courses as specified by the Discipline Chair

5.4.2 Mechanical Engineering Major - Offshore Oil and Gas Engineering Option

- The full-time 141 credit hour Bachelor of Engineering (Co-operative), Mechanical Engineering Major – Offshore Oil and Gas Engineering Option, requires eight academic terms and four work terms.
- The 141 credit hours shall normally be taken in the academic terms and order as set out in **Table 5 Mechanical Engineering Major - Offshore Oil and Gas Option**.
- Work terms shall normally be taken in the order as set out in **Table 5 Mechanical Engineering Major - Offshore Oil and Gas Option**.

Table 5 Mechanical Engineering Major - Offshore Oil and Gas Engineering Option

Term	Required Courses	Elective Courses
Engineering One	Chemistry 1050 English 1080 ENGI 1010 ENGI 1020 ENGI 1030 ENGI 1040 Mathematics 1000 Mathematics 1001 Mathematics 2050 Physics 1050 Physics 1051	Students who are expecting to complete the Engineering One requirements during the first two semesters may apply to undertake a work term during the Spring semester. In this case, the prerequisite course ENGI 200W must be completed during the Winter semester.
Fall Academic Term 3	ENGI 3101 ENGI 3424 ENGI 3901 ENGI 3911 ENGI 3934 ENGI 3941	ENGI 200W (if not completed during Engineering One).
Winter	001W or 002W	
Spring Academic Term 4	ENGI 4102 ENGI 4312 ENGI 4430 ENGI 4901 ENGI 4932 ENGI 4951	
Fall	001W or 002W or 003W	
Winter Academic Term 5	ENGI 5911 ENGI 5927 ENGI 5931 ENGI 5951 ENGI 5961	Complementary Studies Elective
Spring	002W or 003W or 004W	
Fall Academic Term 6	ENGI 6602 ENGI 6901 ENGI 6927 ENGI 6933 ENGI 6951 ENGI 6961	
Winter	003W or 004W or 005W (optional)	
Spring Academic Term 7	ENGI 4421 ENGI 7102 ENGI 7926 ENGI 8693	Complementary Studies Elective 3 credit hours from: ENGI 8671, 8692
Fall	004W or 005W (optional) or 006W (optional)	
Winter Academic Term 8	ENGI 8690 ENGI 8694 ENGI 8926	Complementary Studies Elective 3 credit hours from: ENGI 8903, 8911, 8935, 8945, 8964, other courses as specified by the Discipline Chair 3 credit hours from: ENGI 8670, 8676

5.5 Ocean and Naval Architectural Engineering Program Regulations

5.5.1 Ocean and Naval Architectural Engineering Major

- The full-time 141 credit hour Bachelor of Engineering (Co-operative), Ocean and Naval Architectural Engineering Major, requires eight academic terms and four work terms.
- The 141 credit hours shall normally be taken in the academic terms in the academic terms order as set out in **Table 6 Ocean and Naval Architectural Engineering Major**.
- Work terms shall normally be taken in the order as set out in **Table 6 Ocean and Naval Architectural Engineering Major**.

Table 6 Ocean and Naval Architectural Engineering Major

Term	Required Courses	Elective Courses
Engineering One	Chemistry 1050 English 1080 ENGI 1010 ENGI 1020 ENGI 1030 ENGI 1040 Mathematics 1000 Mathematics 1001 Mathematics 2050 Physics 1050 Physics 1051	Students who are expecting to complete the Engineering One requirements during the first two semesters may apply to undertake a work term during the Spring semester. In this case, the prerequisite course ENGI 200W must be completed during the Winter semester.
Fall Academic Term 3	ENGI 3001 ENGI 3054 ENGI 3101 ENGI 3901 ENGI 3934 Mathematics 2000	ENGI 200W (if not completed during Engineering One).
Winter	001W or 002W	
Spring Academic Term 4	ENGI 4011 ENGI 4020 ENGI 4102 ENGI 4312 Mathematics 3260	Focus Stream Elective *
Fall	001W or 002W or 003W	
Winter Academic Term 5	ENGI 5003 ENGI 5020 ENGI 5022 Mathematics 3202	Complementary Studies Elective Focus Stream Elective *
Spring	002W or 003W or 004W	
Fall Academic Term 6	ENGI 6003 ENGI 6005 ENGI 6055 ENGI 6933	Complementary Studies Elective Focus Stream Elective *
Winter	003W or 004W or 005W (optional)	
Spring Academic Term 7	ENGI 7000 ENGI 7007 ENGI 7033 ENGI 7035 ENGI 7102	ENGI 7045, 7706, 7707, 7934, 8691, 8692, other courses as specified by the Discipline Chair
Fall	004W or 005W (optional) or 006W (optional)	
Winter Academic Term 8	ENGI 8000 Physics 4300	Complementary Studies Elective Two of ENGI 8003, 8054, 8058, 8074, or other courses as specified by the Discipline Chair Focus Stream Elective *

***Focus Stream Electives**:

The courses in the Focus Stream allow a student to pursue a specialization in an area of interest. The area can be in engineering, the sciences, the arts and humanities or business. Students will plan their own focus stream, with approval by the Committee on Undergraduate Studies upon the recommendation of the Discipline Chair of Ocean and Naval Architectural Engineering.

In reviewing the plan for the stream, the Faculty will be looking for clear educational goals by each student, with increasingly advanced courses in the topic area. The stream is not meant to be a series of random free electives, and especially not a series of introductory courses. The stream will enable students to complete a significant part of a minor in almost any subject. Students are encouraged to take the required additional courses to complete such a minor. Interdisciplinary experience and education is increasingly valuable and this focus stream opportunity will provide our graduates with unique and special knowledge.

5.6 Process Engineering Program Regulations

5.6.1 Process Engineering Major

- The full-time 141 credit hour Bachelor of Engineering (Co-operative), Process Engineering Major, requires eight academic terms and four work terms.
- The 141 credit hours shall normally be taken in the academic terms and order as set out in **Table 7 Process Engineering Major**.
- Work terms shall normally be taken in the order as set out in **Table 7 Process Engineering Major**.

Table 7 Process Engineering Major

Term	Required Courses	Elective Courses
Engineering One	Chemistry 1050 English 1080 ENGI 1010 ENGI 1020 ENGI 1030 ENGI 1040 Mathematics 1000 Mathematics 1001 Mathematics 2050 Physics 1050 Physics 1051	Students who are expecting to complete the Engineering One requirements during the first two semesters may apply to undertake a work term during the Spring semester. In this case, the prerequisite course ENGI 200W must be completed during the Winter semester.
Fall Academic Term 3	Chemistry 1051 ENGI 3101 ENGI 3424 ENGI 3600 ENGI 3901 ENGI 3911	ENGI 200W (if not completed during Engineering One)
Winter	001W or 002W	
Spring Academic Term 4	ENGI 4102 ENGI 4421 ENGI 4602 ENGI 4621 ENGI 4625 ENGI 4717	
Fall	001W OR 002W OR 003W	
Winter Academic Term 5	ENGI 5601 ENGI 5621 ENGI 5671 ENGI 5911 ENGI 5961	Complementary Studies Elective
Spring	002W or 003W or 004W	
Fall Academic Term 6	ENGI 6631 ENGI 6651 ENGI 6671 ENGI 6901 ENGI 6961	Complementary Studies Elective
Winter	003W or 004W or 005W (optional)	
Spring Academic Term 7	ENGI 7102 ENGI 7621 ENGI 7623 ENGI 7640 ENGI 7651	3 credit hours from ENGI 7691, 8691, other courses as specified by the Discipline Chair
Fall	004W or 005W (optional) or 006W (optional)	
Winter Academic Term 8	ENGI 8640 ENGI 8671 ENGI 8677	Complementary Studies Elective One free elective which must be a 5000-level or higher Engineering course, or a 2000-level or higher course either from the Faculty of Arts or the Faculty of Science. or a 3000-level or higher course from the Faculty of Business Administration. Selection of a course must be approved by the Discipline Chair. 3 credit hours from: ENGI 8911, 8670, 8676, 8696. other courses as specified by the Discipline Chair.

5.7 Advanced Standing

Students are occasionally admitted to later terms in Engineering from other institutions. Such entry is normally based on a detailed analysis of the student's record and is handled on a case-by-case basis. Such students should contact the Office of the Associate Dean (Undergraduate Studies).

6 Promotion Regulations

6.1 General Information

1. In addition to meeting the promotion regulations for the Faculty of Engineering and Applied Science, all students must meet the general academic regulations (undergraduate). For further information refer to the ***UNIVERSITY REGULATIONS* - General Academic Regulations (Undergraduate)**.
2. Success in the programs depends on meeting the requirements of both academic terms and work terms.

6.2 Promotion Status (Engineering One)

1. The requirements for promotion to Academic Term 3 are:
   a. an overall average of at least 65% on the following nine courses: Mathematics 1001, Mathematics 2050, Physics 1051, Chemistry 1050, English 1080 (or equivalent), ENGI 1010, ENGI 1020, ENGI 1030 and ENGI 1040; and
   b. a grade of at least 55% in each of the above nine courses.
2. In order to remain in the Engineering program, students admitted to Engineering One must complete the requirements for promotion to Academic Term 3 before the end of the academic year of admission.
3. Students who fail to meet the requirements for promotion to Academic Term 3 before the end of the academic year of admission will be deemed to have withdrawn from the Engineering program.
4. Promotion from Engineering One guarantees admission to one of the six majors, but not necessarily to a student's preferred major. The Faculty reserves the right to limit the number of spaces available in each major. The Faculty also reserves the right to guarantee admission into a particular major at the time of admission into the Engineering program.
5. Students completing the requirements of Engineering One are required to apply for their major by March 1 of the academic year of admission, indicating their preferences for major in rank order. All Engineering students who successfully complete Engineering One in the academic year of admission will be guaranteed a place in Academic Term 3, although not necessarily in the preferred major.

6.3 Promotion Status (Beyond Engineering One)

A student's eligibility for promotion from semesters beyond Engineering One will be determined at the end of each term. Promotion from each academic semester will be based upon the student's Promotion Average for the semester. The Promotion Average, which will appear on the transcript, is calculated to be the overall average of courses completed in the semester excluding complementary studies, focus stream electives and free elective courses. Promotion from work terms will be determined based upon the grade awarded in that work term.

A student's promotion status will be determined beyond Engineering One and at the end of each term in one of the following three categories:

6.3.1 Clear Promotion

Clear Promotion means that a student can proceed to the next term without restrictions.

1. A student completing or repeating an academic term will receive a Clear Promotion by obtaining a promotion average of at least 60% and a numeric grade of at least 50% in each of the courses included in the calculation of the promotion average in that academic term.
2. A student completing a work term will receive a Clear Promotion by obtaining an overall grade of PAS or PWD in that work term.

6.3.2 Probationary Promotion

A student who is not eligible for Clear Promotion from an academic semester but who achieves a promotion average of at least 60% in that term will be granted Probationary Promotion.

1. A student's Probationary Promotion status will be reflected on the University Transcript under the Promotion Average for the semester.
2. A student with Probationary Promotion from an academic term may continue to the subsequent work term under the condition that entry into the next academic term is not allowed until the student's status is changed to Clear Promotion.
3. A student with Probationary Promotion at the end of the final academic term will not be recommended for graduation until the student's status is changed to Clear Promotion.
4. To change Probationary Promotion to Clear Promotion for a semester the student must satisfy the Faculty that he or she is competent in the subject of the ENGI course(s) in which the student has failed to achieve 50%. This will normally entail re-examination(s), after which the student will be declared to have passed or failed a test of competency in the subject(s) concerned. No numerical grade will be assigned in the re-examination(s). Upon passing a re-examination, the original grade submitted for the course will be changed to PAS, but the promotion average will not change.
5. Re-examination will be at a time determined by the Faculty.
6. A student with Probationary Promotion who does not complete the re-examination(s) or who fails in the re-examination(s) must repeat the corresponding failed course(s) successfully in order to change the Probationary Promotion to Clear Promotion.

6.3.3 Promotion Denied

Promotion Denied status is awarded when a student does not meet the requirements for Clear Promotion or Probationary Promotion.

The student's Promotion Denied status will be reflected on the University Transcript under the Promotion Average for the semester.

1. A student with Promotion Denied status will be required to withdraw from the Faculty.
2. A student with Promotion Denied status may apply for readmission to the program after two semesters. Subject to space being available, a student will be readmitted into the term from which promotion was denied. An academic term may be repeated only

once, and not more than two academic terms may be repeated in the entire program.

3. A student who is denied promotion for failing a work term may be considered for readmission. A student readmitted under this clause must successfully complete four work terms prior to graduation.
4. A student who has been denied promotion as a result of having failed a work term and who, in the opinion of the Faculty, can benefit from a remedial program, may be permitted an extension of time, not to exceed the end of the registration period of the subsequent semester, to complete the requirements of the work term.
5. A student who is denied promotion from an academic term will be required to repeat all required courses in which the student obtained a numeric grade of less than 60% in that term. A technical elective course in which the student obtained a numeric grade of less than 60% may be replaced by a course acceptable in the student's program.
6. A student with Promotion Denied status at the end of the final academic term will not be recommended for graduation until the student's status is changed to Clear Promotion.

6.4 Other Information

1. The appropriate discipline will make a recommendation to Faculty Council on each student's promotion status at the end of each of academic terms 3 to 8.
2. To be recommended for graduation, a student must have clear promotion from Academic Term 8, must have successfully completed at least four work terms and must have an average of at least 60% in the 21 credit hours in complementary studies as described in **Description of Program, Complementary Studies**.
3. The Office of Co-operative Education will make a recommendation to Faculty Council on each student's promotion status at the end of each work term.
4. A student must have completed at least one work term successfully, in order to be promoted to Academic Term 5.
5. A student must have completed at least two work terms successfully, in order to be promoted to Academic Term 6.
6. A student must have completed at least three work terms successfully, in order to be promoted to Academic Term 7.
7. A student must have completed four work terms successfully, in order to be promoted to Academic Term 8.
8. A student denied promotion shall be permitted only one readmission to the same term and a total of no more than two readmissions to the Faculty.
9. No course required in any of academic terms 3 to 8 of the program may be attempted more than twice.
10. Students may be required to withdraw from their program at any time, if, in the opinion of the Faculty, they are unlikely to benefit from continued attendance.

7 Waiver of Faculty Regulations

Every student has the right to request a waiver of Faculty regulations. Students seeking a waiver of University academic regulations should refer to the ***UNIVERSITY REGULATIONS* - General Academic Regulations Undergraduate - Waiver of Regulations**.

1. The Faculty Council reserves the right in special circumstances to modify, alter, or waive any Faculty regulation in its application to individual students, where merit and equity so warrant in the judgment of the appropriate Committee of the Faculty Council.
2. All requests must be submitted to the Office of the Associate Dean (Undergraduate Studies) for submission to the appropriate Committee of the Faculty. Students must submit their request in writing. Medical and/or other documentation to substantiate the request must be provided.
3. Requests for waivers of admission requirements will be submitted to the Admissions Committee who will make a recommendation for action to the Committee on Undergraduate Studies of the Faculty.
4. Requests for a waiver of a course(s) required in academic terms 3 to 8 should be made prior to the commencement of the academic term and will be considered by the Committee on Undergraduate Studies, upon recommendation of the appropriate Discipline Chair.
5. Requests for a waiver of a work term will be considered by the Committee on Undergraduate Studies upon recommendation of the Office of Co-operative Education. Any waiver granted does not reduce the total number of work terms required for the degree below an absolute minimum of three.

8 Appeal of Regulations

8.1 Faculty Appeal Committee

Appeals against decisions of the Faculty Admissions Committee and appeals against promotion decisions of Faculty Council will be considered by the Faculty Appeal Committee.

1. An appeal against promotion decisions of Faculty Council will normally only be considered upon presentation of evidence which has not been placed before Faculty Council.
2. Any such appeal must be made within one month of the issue of the decision of the Admission Committee or within one month of the issue of results by the Registrar, as the case may be.
3. When a student has requested a re-read of an examination paper which may affect an appeal that appeal must nevertheless be made within one month of the issue of the original results, and consideration of the appeal will be delayed until the result of the re-read is available.

8.2 Other Appeals

Any student whose request for waiver of Faculty regulations has been denied has the right to appeal. For further information refer to the ***UNIVERSITY REGULATIONS* - General Academic Regulations (Undergraduate) - Appeal of Regulations**.

9 Course Descriptions

All courses of the Faculty are designated by ENGI.

9.1 Work Terms and Non-Credit Courses

001W Engineering Work Term 1 represents, for most students, their first experience in an engineering or related work environment. Students are expected to learn, develop and practise the basic standards of behaviour, discipline and performance normally found in a professional work environment. Students are also expected to learn the basics of technical writing and to become familiar with the various communications tools used in a technical work environment.
Two documents must be submitted for evaluation for the communications component for Work Term 1. Additional communication requirements such as technical reports or manuals may be requested by the employer. The two documents to be submitted to the Engineering Co-operative Education Office are the Personal Job Diary and the Work Term Journal or Short Technical Report or Portfolio. Detailed guidelines for the preparation of these documents are provided in the *Co-operative Student Handbook*. These documents shall be submitted or postmarked no later than the last official day of the work term as shown in the University Calendar.
CH: 0
LC: 0
PR: ENGI 200W

002W Engineering Work Term 2 requires students to have sufficient academic grounding and work experience to contribute in a positive manner to the engineering design and problem solving processes practised in the work environment. Students are expected to show greater independence and responsibility in their assigned work functions than in Work Term 1. An ability to deal, under supervision, with complex work-related concepts and problems should also be demonstrated. Students can become better acquainted with their chosen discipline, and can observe and appreciate the attitudes, responsibilities, and ethics normally expected of engineers.
The communications component for Work Term 2 consists of a formal, descriptive technical report describing a technical process, project, procedure or investigation chosen from the student's work environment. Students are also expected to keep a job diary, which will not be submitted but must be available for review during monitoring.
Guidelines for the preparation of a descriptive technical report are provided in the *Co-operative Student Handbook*. The report shall be submitted or postmarked no later than the last official day of the work term as shown in the University Calendar.
CH: 0
LC: 0
PR: ENGI 001W, ENGI 3101

003W Engineering Work Term 3 requires greater participation in the student's selected engineering discipline. Students become more experienced and proficient with the appropriate design procedures than in the preceding work terms. Students are expected to acquire improved speed and accuracy in their work and at the same time accept greater responsibility and be able to function with less direct supervision. Self-confidence and initiative as well as improved analytical skills are expected to develop at this stage in the student's engineering education.
The communications component for Work Term 3 consists of a formal technical report on a topic related to a specific theme prescribed by the Faculty and the Co-operative Education Office. Examples of themes would be sustainable development and environmental stewardship. Ideally the report would relate to the student's work in the areas of process, project, procedure or investigation.
Guidelines for the preparation of a descriptive technical report are provided in the *Co-operative Student Handbook*. The report shall be submitted or postmarked no later than the last official day of the work term as shown in the University Calendar.
CH: 0
LC: 0
PR: ENGI 002W

004W Engineering Work Term 4 requires students to engage in various facets of engineering, such as design, analysis, project management, specifications, plans, formal proposals, tender documents, etc. Participation in their selected engineering discipline is expected. Students should continue to gain an appreciation of the use and importance of acquired analytical skills in engineering analysis as well as the application of specifications and codes. Students should have a level of responsibility commensurate with their academic background and experience.
The communications component for Work Term 4 consists of an oral presentation on a technical subject taken from the student's work environment and preferably related specifically to the student's work. The presentation should be of 10 minutes duration and will be given on campus in a formal setting after students have returned to class. A written summary is also required. Guidelines for the preparation of this oral presentation are provided in the *Co-operative Student Handbook*.
CH: 0
LC: 0
PR: ENGI 003W

005W Engineering Work Term 5 requires students to engage in various facets of engineering, such as design, analysis, project management, specifications, plans, formal proposals, tender documents, etc. Participation in their selected engineering discipline is expected. Students should continue to gain an appreciation of the use and importance of acquired analytical skills in engineering analysis as well as the application of specifications and codes. Students should have a level of responsibility commensurate with their academic background and experience. The promotion criteria for this work term will be determined by the Committee on Undergraduate Studies. Students in the new program can apply to enter Work Terms 5 and 6.
CH: 0
LC: 0
PR: ENGI 004W

006W Engineering Work Term 6 requires students to engage in various facets of engineering, such as design, analysis, project management, specifications, plans, formal proposals, tender documents, etc. Participation in their selected engineering discipline is expected. Students should continue to gain an appreciation of the use and importance of acquired analytical skills in engineering analysis as well as the application of specifications and codes. Students should have a level of responsibility commensurate with their academic background and experience. The promotion criteria for this work term will be determined by the Committee on Undergraduate Studies. Students in the new program can apply to enter Work Terms 5 and 6.
CH: 0
LC: 0
PR: ENGI 005W

200W Professional Development Seminars are offered during the Fall and Winter semesters prior to a student's first work term. These seminars introduce the co-operative education process and prepare the student for work terms. These seminars are graded PAS or FAL based on attendance, participation and assignments.
AR: attendance is required
CH: 0
LC: as scheduled

9.2 Engineering One Courses

1010 Engineering Statics is the first course in Engineering mechanics. Forces and moments are described with vector algebra, leading to a description of the equilibrium conditions for particles and solid bodies. The importance of free body diagrams is highlighted. This knowledge is then applied to the analysis of trusses, frames and machines. Additional topics include an examination of friction and the concepts of centre of force, centroids and second moments of area.
CO: Mathematics 1000
CR: the former ENGI 1313
OR: tutorial 1 hour per week
PR: Level III Physics or Physics 1020 or equivalent

1020 Introduction to Programming is an introduction to algorithmic problem solving techniques and computer programming, including basic program control structures (sequence, call, branch, loop) and data representations, functional decomposition, and design by contract. Exercises and examples are drawn from a variety of engineering disciplines and are implemented using a standard modern programming language.
CR: the former ENGI 2420
LH: at least four 2-hour sessions per semester
PR: eligibility to register for Mathematics 1000

1030 Engineering Graphics and Design provides two complementary competencies. Firstly, it provides an introduction to the fundamentals of graphic communication, including orthographic projections, three dimensional pictorials, sectioning and dimensioning. Both sketching and CAD are utilized. Secondly, the course introduces students to standard design methodologies. The graphics and design competencies are reinforced through lab and project exercises.
LH: 3
PR: eligibility to register for Mathematics 1000

1040 Mechanisms and Electric Circuits is offered in two serial modules, including laboratory and workshop practice, and a team project to expose students to the concept of system integration involving electrical and mechanical systems. The electrical module provides an introduction to dc circuits, with an analysis of dc circuits used in control, measurement and instrumentation systems. The mechanism module provides an introduction

to machine components such as belts, pulleys, gears, and simple linkages. The laboratory and workshop component introduces students to hands-on practice in basic laboratory instruments, tools and safety procedures. A team project involves the construction, assembly and testing of a simple mechanism.
LH: 3
PR: Level III Physics or Physics 1051 (which may be taken concurrently) and Mathematics 1000 (which may be taken concurrently).

9.3 Academic Term 3 Courses

3001 Ocean/Naval Design is an introductory course to design in naval architecture and ocean engineering. It introduces the design challenges in a marine setting. A series of modules will familiarize the students with the main design issues. The first module covers the basic economic question of why ships are built. This is followed by an examination of the materials of construction and the primary fabrication method – welding. The third module deals with manufacturing, including design for manufacturing and the workflow process itself. The final module examines methods of marine design and performance evaluation. This covers numerical and experimental simulation methods and design software. There are several relevant labs and a design project.
LH: at least six 3-hour laboratory sessions per semester

3054 Ocean Engineering Hydrostatics is an introductory course to naval architecture and marine engineering. It discusses the basic principles of the statics of rigid floating or submerged structures. These include: ships, offshore platforms and submersibles. Methods of analysis of the hydrostatics, stability and trim, damage stability and the statics of mooring systems are introduced. Applications are also discussed.
LH: at least nine 3-hour laboratory sessions per semester
PR: ENGI 1010

3101 The Engineering Workplace is a course that deals with issues associated with professional engineering practice. Topics will include workplace and professional ethics, public and workplace occupational health and safety including first-aid, equity, gender and diversity issues, and technical written, oral and visual communication.
AR: attendance is required

3424 Engineering Mathematics includes ordinary differential equations of first order and first degree; linear ordinary differential equations of higher order, methods of undetermined coefficients and variation of parameters; applications to electric circuits and mass-spring systems; Laplace transforms; partial differentiation; convergence of series; Taylor and binomial series; remainder term; and an introduction to Fourier series.
CH: 4
CR: the former ENGI 2422
LC: 4
OR: tutorial 1 hour per week
PR: Mathematics 1001, Mathematics 2050

3425 Mathematics for Civil Engineering I includes sequences & series, functions of a single parameter, conic sections, polar coordinates, partial differentiation, multiple integration, introduction to first order ordinary differential equations.
CH: 4
LC: 4
OR: tutorial 1 hour per week
PR: Mathematics 1001 and 2050

3600 Introduction to Process Engineering is an introductory course in process engineering, which comprises principles and the practical aspects of organic, inorganic and biochemical processes. It emphasizes the structure and properties of organic, inorganic, and bio-chemicals; process flow sheeting, process variable identification and production processes. The course uses extensive examples from industrial processes. In laboratory sessions students will use HYSYS and OLI software to study process characteristics.
CO: Chemistry 1051
LH: at least four 2-hour sessions per semester

3610 Earth Sciences for Civil Engineering is an introduction to basic concepts in Geology and Mining with emphasis on applications in Civil, Geological, Mining and Environmental Engineering through the use of case histories. It includes the study of rocks and minerals in selected field and laboratory exercises.
LH: 3

3703 Surveying and Geomatics includes plane surveying: distance, elevation, and angle measurements; horizontal and vertical curves; plane survey calculations; area and volume computations. Photogrammetry will be studied, including sensors and platforms, mathematics of photogrammetry; instruments and equipment, photogrammetric products, digital photogrammetry, remote sensing, and introduction to global positioning and geographical information systems (GIS). A surveying field school to introduce students to the use of surveying equipment and mapping will be held in the first two weeks of the term.
LH: 3
OR: 36-hour field school conducted during the first two weeks of the semester

3731 Materials for Construction includes structure of metals and nonmetals; deformation of metals; strengthening mechanisms in metals; concrete and cementitious materials; admixtures; iron and steel; brick masonry; concrete masonry; mortar grout and plaster; reinforced masonry structures; wood and wood products. Relevant experiments are conducted.
LH: at least ten 3-hour sessions per semester
OR: up to ten 1-hour tutorials per semester

3821 Circuit Analysis begins with a review of elementary circuits, then considers wye-delta transformation, bridge circuits; transient analysis of first- and second -order circuits; sinusoidal steady state analysis, phasor diagrams, maximum power transfer, frequency selective circuits (filters); and Laplace transforms in circuit analysis (transients, steady state, transfer function).
CO: ENGI 3424
CR: Physics 3550
LH: at least five 3-hour sessions per semester
OR: tutorial 1 hour per week
PR: Mathematics 1001, Mathematics 2050, ENGI 1040

3861 Digital Logic includes number systems and Boolean algebra; minimization techniques for Boolean functions; basic combinational logic circuit analysis and design; flip-flops, state machine design and implementation; decoders, multiplexors, registers, counters; simple arithmetic and logic unit (ALU) algorithms; introduction to hardware description languages (VHDL) for logic component and circuit modelling.
CR: Computer Science 3723
LH: at least six 3-hour sessions per semester
OR: up to eight tutorial sessions per semester
PR: ENGI 1040

3891 Advanced Programming includes advanced procedural language programming; data structures, user defined types, pointers; modularization techniques, scope and data hiding; object-oriented programming; classes, objects and attributes; data encapsulation, member and non-member functions; overloading, methods and friend functions; inheritance, sub- and super-classes; templates.
LH: at least nine 2-hour sessions per semester
PR: ENGI 1020

3901 Thermodynamics I is a macroscopic approach to heat, work, and energy; properties of pure substances; conservation of mass, energy for open and closed systems; thermal efficiency and coefficient of performance; second law of thermodynamics; and its corollaries; entropy; second law analysis of thermodynamic systems; second law efficiency.
PR: Mathematics 1001

3911 Chemistry and Physics of Engineering Materials I is an introduction to the structure and properties of engineering materials, in particular materials, semiconductors, ceramics, glasses and polymers. Topics include a review of atomic bonding, discussion of basic crystalline and amorphous structures, point and line defects, and the role these structural features play in elastic and plastic deformations, yield, fracture, glass transition, thermal conductivity, thermal expansion, specific heat and electrical conductivity.
CR: the former ENGI 2205
LH: at least four 3-hour sessions per semester
OR: tutorial 1 hour per week
PR: Chemistry 1050

3934 Dynamics includes kinematics and kinetics of particles using rectangular, normal/tangential and polar coordinates; relative motion using rotating axes; two-dimensional kinematics and kinetics of rigid bodies; force-acceleration, work-energy and impulse-momentum methods.
CR: the former ENGI 2313
OR: tutorial 1 hour per week
PR: ENGI 1010, Mathematics 1001, Mathematics 2050

3941 Production Technology includes an overview of production: production strategies; dimensioning and tolerancing; basic material removal process; forming and shaping process; casting; molding, extrusion and joining processes; computer aided machining; new technologies.
LH: at least eight 3-hour sessions per semester

9.4 Academic Term 4 Courses

4011 Resistance and Propulsion examines the phenomena resisting the motions of ships and some factors considered in the design of the marine screw propeller. The topics include the resistance due to friction, wave making, form appendage, wind and waves, squat, blockage, and shallow water effects, and also include the estimation of powering using methodical series and statistical methods. Topics considered in the design of the marine screw propeller include propeller theory, blade sections, blade strength, methodical series charts, efficiency elements, lifting line calculations, cavitation, and propellers in non-uniform flow.
CR: the former ENGI 5011

LH: 3
OR: tutorial 1 hour per week
PR: ENGI 3054

4020 Marine Fluid Dynamics includes fluid statics; fluid flow phenomena, in general and in marine applications; control volume analysis of fluid motion; conservation of mass, momentum and energy; differential approach to flow analysis; head losses; applications of conservation laws; external v.s. internal flow; dimensional analysis and scaling; fluid-structure interaction concepts; potential flow theory, lift and Kutta-Joukowski theorem; viscous flow, boundary layers and drag.
LH: at least one 3-hour session per semester
OR: tutorial 1 hour per week
PR: ENGI 3054

4102 Engineering Economics is an introduction to the concepts in the determination of the economic feasibility of engineering projects; time value of money – interest rates, depreciation, annual, present and future worth analysis; benefit-cost analysis, tangible and intangible benefits and costs; economic risk and sensitivity analysis, economic optimization.

4312 Mechanics of Solids I examines force analysis of structures and structural components, free body diagrams of structure, components and section of a components, definition of a stress at point, stress notation, complementary property of shear stress, definition of strain, normal strain, shear strain, thermal strain, mechanical properties of materials, analysis of prismatic members due to axial, bending and torsion loading, analysis of beams, shear force and bending moment diagrams, combined loads; and the transformation of stresses and strains.
LH: at least four 1-hour sessions per semester
OR: up to ten 1-hour tutorials per semester
PR: ENGI 1010

4421 Probability and Statistics includes probability, probability distributions, probability densities, sampling distribution, hypothesis testing, regression and correlation.
CR: the former ENGI 3423, STAT 2510
OR: tutorial 1 hour per week
PR: Mathematics 1001

4424 Discrete Mathematics for Computer Engineering is an introduction to discrete mathematics including a selection of topics such as propositional logic, introductory predicate logic, mathematical reasoning, induction, sets, relations, functions, integers, graphs, trees, and models of computation.
CR: the former ENGI 3422, Mathematics 2320, or the former Computer Science 2740
OR: tutorial 1 hour per week
PR: Mathematics 2050

4425 Mathematics for Civil Engineering II examines the analytical solutions of ordinary differential equations of the first and higher orders and numerical methods: errors, round off and stability, solution to nonlinear equations, curve fitting and interpolation methods, numerical differentiation and integration.
CH: 4
CR: the former ENGI 4422
LC: 4
OR: tutorial 1 hour per week
PR: ENGI 3425

4430 Advanced Calculus for Engineering includes parametric vector functions; polar curves; gradient, divergence and curl; multiple integration; vector calculus, theorems of Green, Stokes and Gauss; an introduction to partial differential equations; and application of advanced calculus to relevant engineering problems.
CR: the former ENGI 5432
OR: tutorial 1 hour per week
PR: ENGI 3424

4602 Process Engineering Thermodynamics extends the study started in ENGI 3901 of thermodynamics, with special reference to chemical process applications: basic laws, thermodynamic properties of pure fluids and mixtures, heat engines, multicomponent systems, thermal/mechanical equilibrium, chemical equilibrium, and thermodynamics of chemical processes. Special emphasis is placed on the application of thermodynamics to practical problems in chemical engineering such as phase equilibria, solutions and reaction equilibria in separations and reaction engineering.
CR: CHEM 2300, the former CHEM 3300
PR: ENGI 3901

4621 Process Mathematical Methods introduces numerical methods in chemical engineering processes; sets of linear algebraic equations; simultaneous non-linear equations; polynomial functions; numerical integration; numerical differentiation; higher order ordinary differential equations, stiff equations, Runge-Kutta methods, boundary value problems, applications of eigenvalue problems (numerical solutions). It provides applications of the methods to different aspects of process engineering such as reactor design, separation, process modeling, equipment design and analysis.
CO: ENGI 4625
PR: ENGI 3424

4625 Process Engineering Calculations is an introduction to the analysis of chemical processes with an emphasis on mass and energy balances. Stoichiometric relationships, ideal and real gas behaviour are also covered. The course will help process engineering majors in their second year to develop a framework for the analysis of flow sheet problems and will present systematic approaches for manual and computer-aided solution of full scale balance problems.
CO: ENGI 4602
PR: ENGI 3901

4717 Applied Environmental Science and Engineering examines the nature and scope of environmental problems; concept of sustainable development; natural environmental hazards; introduction to ecology, microbiology and epidemiology; basic concepts of environmental quality parameters and standards; solid and hazardous wastes; atmospheric, noise, and water pollution, their measurements, and control.
LH: at least ten 3-hour sessions per semester
PR: Completion of Term 3 of the Civil Engineering program

4723 Geotechnical Engineering I begins with an introduction to soil as a three-phase material and examines physical and mechanical properties; structure; classification of soils; soil compaction; hydraulic properties; permeability; flow of water in soil; flownets; effective stress concept in soils; stresses in soils beneath loaded areas; and one-dimensional consolidation theory.
LH: 3
OR: tutorial 1 hour per week
PR: completion of Term 3 of the Civil Engineering program

4823 Introduction to Systems and Signals begins with an introduction to systems and signals, and includes mechanical and electrical analogues; principles of linear superposition and time-invariance; definitions, properties, and use of the delta function; applications of complex variables and functions; impulse and step responses; input-output relations of continuous-time systems in terms of convolution and transfer functions; frequency response plots; the Fourier transform and applications; applications of Laplace transforms to filtering, communications, and controls.
OR: tutorial 1 hour per week
PR: ENGI 3424, ENGI 3821

4841 Electromechanical Devices includes an introduction to fundamental principles of energy conversion; review of three-phase systems; magnetic fields and circuits; transformer models, performance and applications; basic concepts of rotating machines; performance and control of dc machines.
CR: the former ENGI 5842
LH: at least six 3-hour sessions per semester
OR: up to ten tutorials per semester
PR: ENGI 3424, ENGI 3821

4854 Electronic Circuits I provides an introduction to semiconductor electronic devices and circuits. Topics covered include internal structure of electronic devices; working principles, dc and small-signal models and analysis of p-n junction diodes, bipolar junction transistors and field effect transistors; introduction to digital electronics; differential and multistage amplifier circuits; internal circuits of operational amplifiers; output stages; practical applications of the devices to the design of power supplies, amplifiers and switching circuits. CAD tools are used to illustrate the analysis and design of electronic circuits.
LH: at least ten 3-hour sessions per semester
OR: tutorial 1 hour per week
PR: ENGI 3821, Physics 3000

4862 Microprocessors is a course on microprocessor architecture; assembly language programming: addressing modes, table look up; memory mapped devices; interfacing techniques: parallel, serial; timing control; analog input and output, and computer displays.
LH: at least eight 3-hour sessions per semester
PR: ENGI 3861

4892 Data Structures examines fundamental data structures; recursive structures and programming techniques; modularity and reusability; time complexity and efficient data structures; procedural abstraction; data abstraction and precise documentation of data structures.
CO: ENGI 4424
PR: ENGI 3891

4901 Thermodynamics II examines thermodynamic cycles: power and refrigeration applications; human comfort and air conditioning: mixture of gases and vapours, humidity, psychrometrics; chemically reacting mixtures and combustion.
LH: at least two 2-hour sessions per semester
PR: ENGI 3901

4932 Mechanisms and Machines includes an overview of mechanisms within machines; graphical and analytical methods for position, velocity, and acceleration analysis of moving mechanisms; kinematics and kinetics of planar mechanisms; static and dynamic loads on mechanisms and an

introduction to mechanism synthesis. There is an analysis project.
CR: the former ENGI 3933
OR: tutorial 1 hour per week
PR: ENGI 3934

4951 Mechatronics I focuses on sensors and instrumentation. The topics covered in the course are: electric circuits; electronic sensors; signal conditioning and instrumentation. There is a sensors project and 4 laboratory exercises.
LH: at least four 1-hour sessions per semester
PR: ENGI 1040

9.5 Academic Term 5 Courses

5003 Ship Structures I examines longitudinal strength, still water and wave bending moment, shear and bending moment curves, Smith Correction, section modulus calculation, torsion and racking forces; bulkhead and girder scantlings, portal frame analysis by moment distribution and energy method; finite element analysis and the use of Classification Society rules for design of midship section.
CR: the former ENGI 6002
PR: ENGI 4312

5020 Marine Propulsion is a second course in marine propellers and ship powering. The purpose of this course is to give students the principles of design and analysis of marine screw propellers and other propulsion devices. The course introduces various marine propulsion devices including conventional and unconventional propulsion systems. It covers methods of propeller design and propeller design philosophy. Emphasis is placed on the design of fixed-pitch propellers based on the lifting line theory and the design of ducted propellers. The student will also develop some insight into the design of other propulsion systems such as waterjets and sails.
CR: the former ENGI 6020
LH: at least one 3-hour session per semester
PR: ENGI 4020

5022 Stochastic Processes in Ocean Engineering includes basic concepts in probability, random variables, multiple random variables, descriptive statistics. The random processes component reviews mathematics of functions; introduces system input-output relations of continuous-time systems; contrasts time vs frequency domain representations; introduces frequency response plots and the Fourier transform; includes selected applications for ocean engineering.
OR: tutorial one hour per week
PR: ENGI 4020, Mathematics 3260

5312 Mechanics of Solids II begins with an introduction to earlier concepts then considers strain transformation; deflections of beams and shafts, energy methods; failure theories; buckling of columns and the inelastic behaviour of beams.
LH: at least five 3-hour sessions per semester
PR: ENGI 4312

5420 Probability and Random Processes includes basic concepts in probability, random variables, multiple random variables, descriptive statistics, random processes and selected applications for engineering.
PR: Mathematics 1001

5434 Applied Mathematical Analysis examines numerical and analytical solutions of applied mathematical problems in Civil Engineering, problems with higher order ordinary differential equations, stiff equations, systems of ODE, Runge-Kutta methods, boundary value problems, applications of eigen value problems (numerical solutions), Fourier analysis, elliptic, parabolic and hyperbolic partial differential equations and their numerical solutions with engineering applications.
PR: ENGI 4425

5601 Mass Transfer covers diffusive as well as convective mass transfer, mass transfer correlations, and the application to absorption and dehumidification.
LH: at least seven 2-hour sessions per semester
PR: ENGI 4602

5621 Process Modelling and Analysis is designed to introduce the concepts of process model building and its application in design and process scheduling. It includes fundamentals of process modelling, lumped parameter dynamic models, distributed parameter dynamic models, advanced dynamic model development, application of process models, and computer aided process design. The course will also introduce concepts and applications of process optimization, process flow sheet optimization, process scheduling, and process flexibility analysis.
PR: ENGI 4621, ENGI 4625

5671 Process Equipment Design I introduces the principles of unit operations, grouped into four sections: fluid mechanics, heat transfer, mass transfer and equilibrium stages, and operations involving particulate solids. It also includes design and operation fundamentals of unit operations: size reduction, filtration, evaporation, drying, crystallization, and humidification, and membrane separation.
CO: ENGI 5601
LH: at least four 2-hour sessions per semester
PR: ENGI 4621, ENGI 4625

5706 Design of Concrete Structures begins with a review of concrete mix design. Topics include design methods and requirements, strength of rectangular sections in bending, balanced condition at ultimate strength with tension reinforcement, bending with both tension and compression reinforcement; serviceability, deflections, flexural crack control for beams and one-way slabs; shear strength, inclined cracking, and shear reinforcement; bond stress and development of reinforcement; T-sections in bending; members in compression and bending; length effects, lateral ties, spiral reinforcement and longitudinal bar placement.
LH: at least five 3-hour sessions per semester
PR: ENGI 4312

5713 Fluid Mechanics examines fluid characteristics; fluid statics; buoyancy and stability; kinematics; pressure measurement; continuity, energy and momentum principles; energy and hydraulic grade lines; free jets; laminar and turbulent flow; dimensional analysis; drag on immersed bodies; flow measurement.
CR: the former ENGI 4913
LH: at least five 1-hour sessions per semester
PR: ENGI 4425

5723 Geotechnical Engineering II examines shear strength of soil, types of laboratory and in-situ soil tests; immediate and consolidation settlement of foundations; plastic equilibrium in soils; limit equilibrium method; earth retaining structures; introduction to bearing capacity theories; and stability of slopes. Relevant laboratory exercises and projects are also included.
CR: the former ENGI 6723
LH: 3
PR: ENGI 4723

5800 Electrical Engineering Design students will work in pairs on small design projects that will require them to follow a hierarchy of design process which includes general product definition, specifications and requirements, functional block diagrams, definition of specification of functional blocks for circuit level synthesis and implementation, system integration, simulation or modelling, testing and verification. The small projects are designed to encourage and motivate students to learn and practise the process of design. The course will culminate in a large design project.
CO: ENGI 5821, ENGI 5854
LC: at least 10 lecture hours per semester
OR: meetings with project supervisor as required
PR: ENGI 4841, ENGI 4854, ENGI 4862

5812 Basic Electromagnetics includes a review of relevant vector calculus, including the divergence, gradient and curl operators in Cartesian, cylindrical and spherical coordinates, divergence theorem, Stokes' theorem, and Laplace's and Poisson's equations. Topics in electrostatics include Coulomb's law, potential and energy, conductors, dielectrics, capacitance and electric field boundary conditions. Topics for magnetism include the steady magnetic field, the Biot-Savart law, Ampère's law, magnetic force, potential and magnetic materials and boundary conditions.
PR: ENGI 3821, ENGI 4430

5821 Control Systems I includes an introduction to control systems with a negative feedback; mathematical modelling and transfer functions of electromechanical systems; block diagram reduction and signal flow graphs; controller realization using op-amps; transient response analysis; Routh's stability criterion; basic control actions and response of control systems; root locus analysis and design; frequency response analysis; Bode diagram; gain and phase margins; compensator design in frequency domain; Nyquist stability criterion; A/D and D/A conversion, digital implementations of analog compensators; and an introduction to PID controller tuning methods.
LH: at least four 3-hour sessions per semester
PR: ENGI 4823

5854 Electronic Circuits II provides an introduction to circuits using operational amplifiers. Topics covered include operational amplifier configurations, analysis, and design; transient and frequency response of amplifier circuits; feedback amplifier analysis and design, stability and compensation techniques; noise and distortion in electronic circuits; analysis and design of data converters; and an introduction to analog filter design. CAD tools are used to illustrate the analysis and design of electronic circuits.
LH: at least five 3-hour sessions per semester
PR: ENGI 4823, ENGI 4854

5865 Digital Systems includes concepts, language, tools, and issues pertaining to specification, modelling, analysis, simulation, testing and synthesis of digital systems, including PLD, FPGA, and ASIC devices. Industry standard CAD tools will be used in this course to facilitate system design and testing.
LH: at least ten 3-hour sessions per semester
PR: ENGI 3891, ENGI 4862

5895 Software Design examines the development process: requirement analysis, design, iterative development, design documentation; an introduction to the Unified Modelling Language: use cases, class diagrams

and sequence diagrams; an introduction to software design patterns: creational patterns, structural patterns and behavioural patterns; object oriented, modular decomposition. The course includes a major design project.
LC: at least 15 lecture hours per semester
OR: meetings with project supervisor as required
PR: ENGI 4892

5911 Chemistry and Physics of Engineering Materials II examines aspects of chemical and physical processes and microscopic structure relevant to the production and use of engineering materials, focussing on metals, alloys, silicates, Portland cement, plastics and adhesives, composites, and wood. Topics include solid-state solutions and compounds, alloy structures, phase diagrams, reaction rates, solid-state transformations, polymerization, oxidation and corrosion, hardness, creep, fatigue, fracture toughness and visco-elastic deformation.
CR: the former ENGI 3205
LH: at least four 3-hour sessions per semester
OR: tutorial 1 hour per week
PR: ENGI 3911

5927 Mechanical Component Design I examines adequacy assessment and synthesis of machine elements with a focus on failure prevention, safety factors, and strength; static failure of ductile and brittle materials, fatigue analysis of components. Topics include the design of power screws, bolted connections, welds, springs, and shafts.
CR: the former ENGI 5926
LH: at least eight 3-hour sessions per semester
PR: ENGI 4312

5931 Advanced Mechanics of Deformable Solids examines stresses due to combined loads, thin-walled pressure vessels, transformation of stresses and strains, principal stresses and strains (two and three dimensional stresses), Mohr's circle, theory failures, stress concentrations, energy methods, buckling of columns, thick-walled cylindrical pressure vessels, rotating disks, multi layered thick walled pressure vessels, shrink fits and contact stresses.
CR: ENGI 5312
LH: at least four 2-hour sessions per semester
PR: ENGI 4312

5951 Mechatronics II focuses on drives and controllers. The topics covered in the course are: electric motors; actuators; control circuits. There is a motors project and 4 laboratory exercises.
LH: at least four 1-hour sessions per semester
PR: ENGI 4951

5961 Fluid Mechanics I examines fluid statics; fluid flow phenomena; control volume analysis; conservation of mass, momentum, and energy; Bernoulli equation; head losses, applications of conservation laws: flow measurement devices; pipe networks; momentum devices, dimensional analysis, boundary layer phenomena, lift and drag.
CR: the former ENGI 4913
LH: at least five 1-hour sessions per semester

9.6 Academic Term 6 Courses

6003 Ship Structures II is an introduction to ship structural safety and rational design. Topics include local strength analysis, elastic, plastic and ultimate strength of plating, frames and grillages, buckling of columns and plates and fatigue and fracture in ships.
CR: the former ENGI 7002
LH: at least one 4-hour session per semester
PR: ENGI 5003

6005 Floating Ocean Structures Design introduces floating structures used in the offshore petroleum industry, along with functional requirements, such as drilling and production, of the platforms. Field development criteria are discussed in the context of platform concept selection and synthesis. Environmental loads are examined, focussing on wave loads and ice loads. Diffraction theory and its application on offshore structures is presented. Offshore safety is discussed in terms of major hazards, risk management, and case studies.
CR: the former ENGI 7005
LH: 1
PR: ENGI 3054

6055 Marine Cybernetics examines propulsion and motion control of ships, submersibles and offshore structures. Building upon the student's knowledge of mathematics, mechanics and hydrodynamics provides an introduction to control systems and mathematical modeling of marine systems. Course components include: basic control actions and response of control systems; simulation and design of control systems; dynamic positioning; power management; marine automation.
LH: at least four 2-hour sessions per semester
PR: ENGI 4011

6101 Assessment of Technology deals with the issues of the impact of technology on society from an economic, environmental and sociological point of view. Public safety as an engineering responsibility will also be covered. Students will be expected to participate in group discussions, write a number of essays and give oral presentations.

6322 Thermal Sciences examines fundamental concepts associated with thermodynamics, fluid dynamics and heat transfer; first and second laws of thermodynamics; system and control volume analysis; classification of flows; introduction to boundary layers and drag; convection, conduction and radiation heat transfer; thermal insulation and calculation of R-values; and cooling of electrical components.
CR: the former ENGI 4322
PR: ENGI 5312

6602 Offshore Petroleum Geology and Technology introduces basic concepts in geology and geophysics of the offshore environment. An outline of petroleum geology is presented, following a path from the origins of hydrocarbons through migration in the Earth's crust, accumulation in reservoirs and the strategies used to discover and to exploit liquids found in the subsurface. Topics include an introduction to the offshore oil and gas industry in harsh environment, type of platforms and structures, exploration phase of offshore oil development, production drilling and completion processes and equipment, and oil and gas transportation system. There are case studies and a project.
PR: completion of Academic Term 5

6631 Chemical Reaction Engineering will cover the fundamentals of chemical kinetics and reaction rate expressions as well as the types of reactors, homogeneous and heterogeneous (catalytic) reactors, and the interrelation between transport phenomena and reaction engineering as it applies to process design. It also includes non-ideal flow, non-ideal reactors, catalytic reaction system, and multiphase reactors.
LH: at least four 2-hour sessions per semester
PR: ENGI 4621, ENGI 5961

6651 Sustainable Engineering in Processing Industries will introduce students to sustainable development and its application to processing operations. Areas such as traditional economic growth, materials cycles, methods for measuring environmental impact, life cycle analysis, waste treatment technologies and recycling technologies will be covered. In addition, the concept of industrial ecology will be included.
PR: ENGI 4625, ENGI 5601

6671 Process Equipment Design II will cover design and operation of equilibrium stage separation processes including distillation, extraction, and leaching. It will also cover advanced concept of equipment design such as heterogeneous system, multiphase system, absorption, and adsorption operation and computer assisted design. Course will use HYSIS and other process equipment design tools.
LH: at least four 2-hour sessions per semester
PR: ENGI 5601, ENGI 5671

6705 Structural Analysis I examines structure classification and loads, building code provisions, analysis of statically determinate arches and frames, shear and moment diagrams for frames, influence lines for statically determinate structures, approximate analysis of indeterminate trusses and frames, the force method of analysing indeterminate beams and frames, an introduction to slope deflection method, and moment distribution method.
LH: at least five 3-hour sessions per semester
PR: ENGI 5312

6707 Design of Concrete and Masonry Structures examines design methods for reinforced concrete two-way slabs, two-way slabs supported on walls and stiff beams, design of two-way slab systems, direct design method and equivalent frame method, design of concrete retaining walls and basement walls, engineered masonry, allowable masonry stresses, mortar stress, analysis and design of flexural members, axial load and bending in unreinforced and reinforced walls, columns and masonry shear walls.
LH: 2
PR: ENGI 5706

6713 Hydraulics examines flow in pipe systems and networks; uniform and non-uniform flow in open channels; hydraulic machinery and associated conduits; design and analysis of culverts; and pipeline/pump system optimization.
LH: at least four 3-hour sessions per semester
PR: ENGI 5713

6718 Environmental Geotechniques examines soil characteristics; soil mineralogy; soil water interaction; soil contaminant interactions; advection, adsorption and diffusion; non-aqueous phase liquids; geosynthetics; design of landfills; and use of waste materials. Relevant software programs are used.
CR: the former ENGI 7718
PR: ENGI 5723

6749 Construction Planning Equipment and Methods includes construction equipment selection and utilization; earthmoving including use of explosives; case studies of major civil projects; principles of project planning and control; computer applications to the construction industry.
CR: the former ENGI 8749

PR: completion of Term 5 of the Civil Engineering program

6813 Electromagnetic Fields is a continuation of the topics started in Engineering 5812, including a review of electrostatics and magnetostatics, Maxwell's equations, Lorentz force, Poynting's theorem, plane waves, and applications including two-wire transmission lines.
LH: at least three 3-hour sessions per semester
PR: ENGI 5812

6843 Rotating Machines examines the fundamentals of rotating machines; design of machine windings; polyphase and single phase induction motor theory and applications; synchronous machine theory; stability and control of synchronous generators; control and protection of rotating machines, an introduction to A.C. motor drives, and machines.
LH: at least six 3-hour sessions per semester
PR: ENGI 4841

6855 Industrial Controls and Instrumentation examines control and instrumentation system components; transducers and signal processing circuits, linear variable differential transformers, power oscillators; electromechanical actuators, solenoids, power drives; A/D and D/A conversion, standard PC interfaces; real-time operating systems; design of discrete-time feedback controllers on a PC platform; system integration, control system tweaking and troubleshooting; programming soft-PLC's using IEC61131.
CR: the former ENGI 7858
LH: at least eight 3-hour sessions per semester
PR: ENGI 5821

6856 Power Electronics is an overview of power semiconductor switches, an introduction to energy conversion and control techniques and examination of controlled rectifiers; phase-controlled converters; switch-mode dc/dc converters; variable frequency dc/ac inverters; ac/ac converters; design of thyristor commutation circuits, gate and base drive circuits, and snubber circuits; thermal models and heat sink design.
CR: the former ENGI 7846
LH: at least ten 3-hour sessions per semester
PR: ENGI 5854

6861 Computer Architecture begins with a review of microprocessors and computer organization. Topics include fundamentals of computer design: performance metrics and cost; instruction set architecture; memory hierarchy design: cache, main memory and virtual memory; pipelining: hazards, parallelism; special purpose processors; multiprocessors and thread-level parallelism.
PR: ENGI 4862

6871 Communication Principles begins with a review of signal representation and analysis and includes distortionless signal transmission, analog modulation (AM, FM and PM), super-heterodyne receiver, sampling theorem, pulse amplitude modulation (PAM), pulse code modulation (PCM), delta modulation, baseband digital transmission, digital modulation techniques (ASK, FSK and PSK).
LH: at least four 3-hour sessions per term
PR: ENGI 4823, ENGI 5420

6876 Communication Networks is an introduction to communication networks such as the telephone network and the Internet. Topics include flow control and error control; circuit switching; packet switching; local area networks; internetworking; communication architectures and protocols.
PR: ENGI 5420

6892 Algorithms, Complexity, and Correctness presents fundamental theories and practices for the design of correct and efficient computing systems, including specification of computing systems and their components, correctness with respect to specifications; methods of verification; algorithmic problem solving strategies (such as divide and conquer, dynamic programming, etc.); tractability and intractability of computational problems.
PR: ENGI 4424, ENGI 4892

6901 Heat Transfer I examines modes of heat transfer; conduction: steady 1-D conduction, thermal resistance, extended surfaces (fins), lumped capacitance analysis, 1-D transient conduction; convection: Newton's law of cooling, convection heat transfer coefficient, external boundary layer flows, internal flows, natural convection; radiation: principles, properties, exchange factors, black body radiation, and enclosures, radiation shields.
LH: at least one 3-hour session per semester
PR: ENGI 4901

6927 Mechanical Component Design II is a continuation of the ENGI 5927 course in analysis and synthesis of machinery, including advanced analysis of machine elements such as clutches, brakes, couplings, journal bearings and gears. Advanced machine design concepts are examined, such as reliability, optimization and techniques for stimulating innovative design. A synthesis project involving the machine elements studied is usually included.
CR: the former ENGI 6926
LH: at least ten 3-hour sessions per semester
PR: ENGI 5927

6933 Mechanical Vibrations examines single degree of freedom systems: free vibration, energy methods, response to harmonic excitation, response to arbitrary inputs, two degree of freedom systems: natural frequencies and mode shapes, dynamic vibration absorber.
CR: the former ENGI 5932
LH: at least four 2-hour sessions per semester
PR: ENGI 3934

6951 Automatic Control Engineering examines the performance of feedback control systems. The topics covered in the course are: feedback control concept; control system performance; control system stability; nonlinear phenomena. There is a project which makes use of a peripheral interface controller or PIC. There are 3 laboratory exercises. Extensive use is made of MATLAB.
CR: the former ENGI 6925
LH: at least three 1-hour sessions per semester
PR: ENGI 5951

6961 Fluid Mechanics II examines differential analysis of fluid motion; conservation of mass: continuity equation; conservation of momentum: Navier-Stokes equations; conservation of energy; inviscid incompressible flows; low Reynolds number flows; boundary layer flows; compressible flows.
CR: the former ENGI 5913
LH: at least three 1-hour sessions per semester
PR: ENGI 5961

9.7 Academic Term 7 Courses

7000 Ocean Systems Design examines the preliminary design methods for the design of marine platforms and vehicles from mission statement to the selection of one or more acceptable solutions; weight and cost estimating, power requirements estimating, and selection of principal design characteristics and economic and operational evaluation of alternative solutions. There are relevant design laboratory projects.
CR: the former ENGI 7052
LH: 3
PR: ENGI 3001, ENGI 3054

7007 Marine Materials examines the properties and uses of steel and aluminum in marine applications. Topics include: overview of shipbuilding process; review of mechanics of materials, Hooke's Law, material failure models; carbon steel properties, grades, classification, testing; welding of steel - fundamentals, processes, preparation, design, drawings, certification; joining of aluminum - riveting, welding.
LH: at least 4 three-hour sessions per semester
PR: CHEM 1050, ENGI 4312

7033 Marine Hydrodynamics examines the fundamental equations of hydrodynamics, boundary layers; potential flow, added mass, damping, circulation, and vorticity; numerical methods for hydrodynamic coefficients; water waves and loading for regular and irregular seas.
LH: at least one 3-hour session per semester
PR: ENGI 4020

7035 Dynamics and Maneuvering of Ocean Vehicles (same as the former ENGI 6030) examines applications of the linearised equations of motion to ocean vehicle problems with single and multiple degrees of freedom; dynamics and maneuvering of marine vehicles: motions in calm water and in waves; hydrodynamics effects such as added mass, radiation and viscous damping; strip theory; irregular motions; and systems for course keeping and motion control.
CR: the former ENGI 6030
PR: ENGI 3054, ENGI 4020

7045 Marine Engineering Systems examines shafting system design; shafting system vibration analysis, study of exciting forces and moments, and balancing of reciprocating and rotating machinery; heat transfer and marine heat exchangers; incompressible fluid flow and piping system design and selection of appropriate pumping devices.
CH: 4
LC: 4
LH: 1
PR: ENGI 3901, ENGI 6933

7102 The Engineering Profession examines the origins and development of Engineering as a profession and its values, the place of technology in society and the nature of technological decisions. Topics will include the role and responsibility of the professional engineer in society, code of ethics, sustainable development and environmental stewardship.
CR: the former ENGI 5101
PR: ENGI 003W

7621 Process Dynamics and Control familiarizes students with the scientific and engineering principles of process dynamics and control. Students will apply and integrate knowledge of chemical engineering to identify, formulate and solve process dynamics problems and develop control systems. Modern computational techniques and tools will be used for solving chemical process control problems. Also students will become

familiar with industrial control systems.
LH: at least six 2-hour sessions per semester
PR: ENGI 5621

7623 Process Simulation provides students with the knowledge and experience to use a process simulator effectively for the analysis and synthesis of process flowsheets, mass and energy balances, sizing of individual component and process unit, reactor modeling, separation device modeling, heat exchanger modeling, and dynamic and steady state analysis.
LH: at least nine 2-hour sessions per semester
PR: ENGI 5621, ENGI 6671

7640 Process Engineering Project I gives students the opportunity to apply the knowledge gained in previous design and technical courses to the complete design of a piece of process equipment, e.g. distillation column, evaporator, membrane separation unit, etc. The goal is to expose the students to practical design issues that arise in process equipment design, and to provide experience in the complete design process as applied to real devices. This course is a precursor to ENGI 8640 where students will work in groups to design a process system.
LC: scheduled as required
PR: completion of academic term 6 of the process engineering program

7650 Offshore Oil and Gas Engineering Project I is a multidisciplinary design project that illustrates the application of previous engineering science and design related courses. The project will be done by teams of students with individuals concentrating their participation in their own engineering discipline. The project topic will be from the offshore oil and gas engineering industry. Lectures will be scheduled as required. This is the Term 7 project and if the scope of the project is such that it needs to continue, then the student will have the option to continue the same project in term 8 (in ENGI 8650).
LC: 1
PR: completion of Academic Term 6

7651 Industrial Pollution Control/Pollution Prevention is designed to introduce methods of industrial pollution assessment and control. Topics include waste characterization, water pollution assessment, water pollution control, air pollution assessment and control, solid waste assessment and control, pollution prevention, environmental risk assessment and risk based decision making.
PR: ENGI 5621, ENGI 6671

7680 Supervisory Control and Data Acquisition examines data acquisition and intelligent field devices; distributed systems and fieldbus technology; programmable logic controllers and programming standards; operator control interface; supervisory control and data acquisition; and enterprise organization.
LH: at least four 3-hour sessions per semester
PR: ENGI 5821

7691 Mining and Metallurgical Process Engineering is designed to provide students with a basic fundamental background to the mining, mineral processing, and extractive metallurgical processing industry from both traditional and modern industrial methodologies. Concepts such as a mine design, mineral flow sheets, extraction methods, and examples from industrial applications will be reviewed with problems.
LH: at least four 2-hour sessions per semester
PR: completion of academic term 6 of the process engineering program

7704 Design of Steel Structures begins with a review of Design Concepts, Standards and Products. Topics include design of members and connections, tension members, bolted joints, welded joints, compression members, stability and effective length, flexural members, beams & beam-columns, plate girders, composite construction, introduction to serviceability, and deflections.
LH: at least four 2-hour sessions per semester
PR: ENGI 5706 or approval of the Discipline Chair

7706 Finite Element Structural Analysis includes a review of basic concepts required for FEA, basics of stiffness formulation, direct stiffness method, displacement method, one dimensional elements, trusses and frames. Topics include 1-D fluid and heat transfer elements, automated analysis and modelling concepts, higher order elements, two dimensional elements - plane stress and plane strain, introduction to 3D and other types. - introduction to advanced topics and isoparametric formulation.
LH: at least eight 2-hour sessions per semester
PR: ENGI 6705 or approval of the Discipline Chair

7707 Reliability and Environmental Loading on Offshore Structures begins with an introduction to natural phenomena that cause loading and influence the design of marine structures. Topics include the interpretation and utilization of field data for the determination of design loads for wind, waves currents and ice and case studies of load analysis for the design of offshore structures in Atlantic Canada.
PR: ENGI 5312

7713 Hydrology and Water Resources examines precipitation, snowmelt, infiltration, runoff and streamflow; statistical treatment of hydrologic data; hydrograph analysis and synthesis; evaporation; structure design floods; reservoir storage and flood routing; urban run-off and drainage.
LH: at least 6 hours per semester
PR: ENGI 5713, ENGI 6322

7716 Hydrotechnical Engineering examines the theory and application of steady gradually-varied flow in artificial and natural open channels together with an introduction to appropriate software; erosion protection and mobile-boundary hydraulics; problems with ice in rivers, the design of spillways, energy dissipaters, and culverts; physical scale models. There is an introduction to water hammer and surge tanks.
LH: at least four 3-hour sessions per semester
PR: ENGI 6713

7723 Geotechnical Engineering III examines soil investigation and site characterization; pile foundations; embankment dams; elements of geotechnical earthquake engineering; constitutive theories for soil materials; and numerical methods in geotechnical engineering. The students select two of the above topics on which they are interested in concentrating their efforts. Bi-weekly lectures are offered on the other topics at an informal level.
PR: ENGI 5723

7745 Highway Engineering examines design and construction of highways including driver, vehicle and road characteristics; highway location and geometric design; soil classification; subgrade and base materials; highway drainage; flexible and rigid pavement; and highway economics.
PR: completion of Term 6 of the Civil Engineering program

7748 Project Planning and Control includes an introduction to types of contracts, project delivery approaches, and prevailing contractual relationships. The course examines basic project management techniques for network planning and scheduling (CPM and PERT); principles of resource productivity databases, preliminary estimating, and detailed bid preparation; quantitative approaches for effective control of time, cost, resource, quality, and value of constructed facilities; use of computer software for scheduling, estimating, and control.
PR: completion of Term 6 of the Civil Engineering program

7803 Electrical Engineering Design Project I provides an opportunity for senior students to integrate the knowledge that they have acquired through the junior terms and apply it to solving an electrical engineering design problem. Students work in small teams with the assistance of a faculty mentor to define an appropriate design problem and propose a method of solution to the problem. The project is continued in ENGI 8853.
CR: the former ENGI 7800
LC: at least 10 lecture hours per semester
OR: weekly meetings with project supervisor
PR: completion of Term 6 of the Electrical Engineering program

7804 Computer Engineering Design Project I provides an opportunity for senior students to integrate the knowledge that they have acquired through the junior terms and apply it to solving a computer engineering design problem. Students work in small teams with the assistance of a faculty mentor to define an appropriate design problem and propose a method of solution to the problem. The project is continued in ENGI 8854.
CR: the former ENGI 7800
LC: at least 10 lecture hours per semester
OR: weekly meetings with project supervisor
PR: completion of Term 6 of the Computer Engineering program

7811 Antennas examines the fundamentals of electromagnetic radiation; potentials; small antennas and antenna parameters; thin linear wire antennas and antenna arrays; antenna impedance and ground effects; Friis transmission formula; and aperture antennas.
LH: at least three 3-hour sessions per semester
PR: ENGI 6813

7814 Electromagnetics for Communications examines vector calculus; Green's, Stokes' and Gauss' theorems; Maxwell's differential and integral equations; steady-state and time-varying aspects of Maxwell's equations; uniform plane wave propagation in various media; and applications of electromagnetics in communications.
PR: ENGI 3424, ENGI 3821

7824 Introduction to Digital Signal Processing examines sampling theory; the discrete Fourier transform; the efficient fast Fourier transform algorithm; elementary discrete-time signals; the discrete-time Fourier series; the discrete-time Fourier transform; discrete-time linear and time-invariant systems; linear constant-coefficient difference equations; the convolution sum; the z-transform and frequency response of discrete-time systems; an introduction to digital filter design techniques; and digital signal processing applications.
PR: ENGI 6871

7825 Control Systems II examines state space models for multi-input/output systems; observability, controllability; state feedback without and with integral controller structure, state observers; quadratic optimal regulator and tracking control strategies; discrete-time state equations; and an introduction to optimal control.
CR: the former ENGI 6825

PR: ENGI 5821

7844 Power System Analysis begins with an introduction to electric power systems. Topics include per unit quantities; transmission line parameters; modelling of power system components; single line diagrams; network equations formulation; bus impedance and admittance matrices; load flow analysis and control; design of reactive power compensation for power system performance enhancement; tap changing, auto and control transformers for power system application; economic dispatch and optimal power flow studies.
LH: at least six 3-hour sessions per semester
PR: ENGI 6843

7854 Industrial Machine Vision is a senior undergraduate course in computer vision with an emphasis on techniques for automated inspection, object recognition, mechanical metrology, and robotics. Image processing courses typically focus for image enhancement, restoration, filtering, smoothing, etc. These topics will be covered to a certain degree but the main focus will be on image segmentation, feature extraction, morphological operators, recognition and photogrammetry. Issues related to the efficient software implementation of these techniques for real-time applications will also be addressed. While there is no prerequisite for this course non-computer engineering students must have reasonably strong programming skills.

7855 Communications Electronics begins with an introduction to communications systems components and a review of linear amplifiers. The course examines linear amplifier design and characteristics using s-parameters; power amplifiers; mixers; oscillators; modulator/demodulator circuits and subsystems; and the integration of subsystems into analog and digital communication systems.
LH: at least four 3-hour sessions per semester
PR: ENGI 5854, ENGI 6871

7856 Renewable Energy Systems examines the assessment of wind energy potential, wind turbine aerodynamics, types, modelling and control strategies; hybrid energy systems; energy storage; solar energy systems; photovoltaic, PV system engineering, stand-alone and grid connected systems, sizing and maximum power tracking; solar water pumping; micro-hydro systems and control; tidal power, wave energy converters, ocean thermal systems. Applications of hybrid energy system sizing software are also included in the course.
PR: ENGI 4841 or the former ENGI 5842

7894 Concurrent Programming surveys parallel and distributed architectures and examines patterns of concurrent program design; correctness of concurrent programs: safety and liveness properties, proof of properties; synchronization using locks, semaphores, and monitors; communication using message passing and remote procedures; parallelization for high-performance computation and advanced topics such as scientific applications, distributed systems, model checking, and transaction processing.
CR: the former ENGI 8893
PR: ENGI 6861, ENGI 6892

7901 Heat Transfer II examines advanced topics in heat transfer; multi-dimensional conduction: shape factors, numerical methods, moving heat sources; heat transfer equipment: heat exchangers, heat exchanger design principles; phase change heat transfer: melting, solidification, condensation, and boiling.
LH: at least one 3-hour session per semester
PR: ENGI 6901

7903 Mechanical Equipment examines performance characteristics of mechanical equipment; fluid power devices: pipes; valves; pumps; fans; blowers; compressors; storage tanks; heat transfer devices: heat exchangers; boilers; cooling towers; and pressure vessels.
LH: at least three 1.5-hour sessions per semester
PR: ENGI 6901

7911 Industrial Materials examines physical and mechanical properties; industrial materials; metals and metal alloys, ceramics and polymer, composite materials, failure modes and mechanisms, non-destructive testing and evaluation; damage tolerant materials; material treatments; and materials selection.
CR: the former ENGI 6972
LH: at least 20 hours per semester
PR: ENGI 5911

7926 Mechanical Design Project I is the first of two capstone design courses in the Mechanical Discipline. In this course mechanical students are organized into small groups or teams, which must complete a common design challenge. The project is presented as an open-ended problem statement with specific performance objectives. The system must be designed, prototyped and tested during the course of the term. Each team is a small consulting firm and is required to document its object planning as well as its design.
CR: the former ENGI 7936
LC: scheduled as required
LH: scheduled as required
PR: completion of Term 6 of Mechanical Engineering program

7928 Computer Aided Engineering Applications introduces a variety of Computer Aided Engineering (CAE) applications based on advanced 3D CAD modelling. The fundamentals of 3D modelling are covered including parametric and feature-based design. CAE applications include assembly modelling, mechanism animation and finite element analysis. Further applications include Computer Aided Manufacturing (CAM); model based inspection (i.e. Coordinate Measurement Machines); reverse engineering; document/drawing production; data exchange; and data management. The course has a significant lab component, which provides exposure to solid modelling and CAE applications based on an industrial CAD/CAM/CAE package.
CR: the former ENGI 7962
LH: at least ten 3-hour sessions per semester
PR: ENGI 1030, ENGI 6927

7934 Finite Element Analysis examines the basis of the finite element method. The course examines continuum mechanics applications; beam problems, fluid mechanics problems, and heat transfer problems. There are relevant computer laboratory exercises
LH: at least ten 2-hour sessions per semester
PR: ENGI 4430, ENGI 5931

7952 Robotics and Automation provides the fundamentals in robotic manipulators and arms. The course provides basic understanding in coordinate transformations for spatial description, both kinematical and kinetic analysis, forces and dynamics and finally trajectory generations and path planning.
CR: the former ENGI 7944
LH: at least three 3-hour sessions per semester
PR: ENGI 1040, ENGI 4430

9.8 Academic Term 8 Courses

8000 Ocean and Naval Architectural Engineering Project executes the design project selected and approved in Term 7. The project must illustrate the application of previous design related courses, i.e., decision methods, impact assessments and application of technology. The subject may be ship design, marine system, directed research or a unique design solution. Lectures will be scheduled as required.
LH: 3
PR: ENGI 7000

8003 Small Craft Design presents the fundamentals of naval architecture as practised in small craft design, and develops a methodology for a variety of craft: tenders, lifeboats, planning vessels, dinghies, coastal cruisers and large, state of the art racing yachts. The emphasis is on recreational craft of all sizes, with special emphasis on sailing vessels. Special topics, such as choice of material of construction, scantlings, performance prediction, seaworthiness, tank testing, modern construction materials and techniques are covered. Specific design problems unique to small craft will be covered such as; mast design and sail area determination, and the state of the art in performance prediction. Students will do a design of their choice over duration of the course. Small weekly design studies will be required.
LH: at least 12 hours per semester
PR: ENGI 7035 or the former ENGI 6030

8054 Advanced Marine Vehicles examines the concepts used in the design of advanced marine vehicles. Emphasis will be given to: structural design of craft constructed from fibre reinforced plastics; high speed marine vehicles (powering, structures, seakeeping and model testing); small craft.
LH: at least 9 hours per semester
PR: ENGI 5003

8058 Submersible Design examines the formulation of mission statement, promotes understanding of various design constraints and reviews the historical developments of submersibles design. The course studies the hydrostatics principles of floatation, stability and control of submersibles. Students will perform resistance and propulsion calculations. The course examines maneuvering and control equations, a survey of different materials and their selection criteria, the design of pressure hulls, the structural design of submersibles and a study of various support systems.
LH: at least 12 hours per semester
PR: ENGI 3054

8074 Arctic Ocean Engineering (same as the former ENGI 8674) examines marine ice as an environmental load factor in the context of ships and engineered structures designed for ice covered waters. Topics include types of naturally occurring ice; sea ice formation and characteristics; mechanical strength of sea ice under common modes of ice failure; modes of ice interaction with ships and marine structures; estimation of ice forces on offshore structures; powering requirements for ice breaking ships; regulations and standards for design of ships and offshore structures in arctic environments.
CR: the former ENGI 8674
LH: at least four 3-hour sessions per semester
PR: ENGI 3934, ENGI 4312

8090-8099 Special Topics in Ocean and Naval Architectural Engineering will have topics to be studied announced by the Faculty.

8601-8610 Special topics in Process Engineering will have topics to be studied announced by the Faculty.

8640 Process Engineering Project II is a design project that illustrates the application of previous engineering science and design related courses. Projects will be done by teams of students with individuals concentrating their participation in their own engineering discipline. The project topic will be from the process industry which includes the offshore oil and gas industry, mining and metal processing industry and chemical process industry.
LC: scheduled as required
PR: ENGI 7640

8650 Offshore Oil and Gas Engineering Project II is a multidisciplinary design project that illustrates the application of previous engineering science and design related courses. The project will be done by teams of students with individuals concentrating their participation in their own engineering discipline. The project topic will be from the offshore oil and gas engineering industry. Lectures will be scheduled as required.
CR: the former ENGI 8600
LC: 1
PR: ENGI 7650

8670 Reliability Engineering is an introduction to reliability engineering; physics of failure and failure mechanism, reliability measures and assessment; reliability of components and parts; complex system reliability and availability analysis; and field reliability assessment. The course includes case studies and a project.
PR: completion of Academic Term 6

8671 Safety and Risk Engineering begins with an overview of safety and risk issues in the offshore oil and gas industry. The course examines regulatory requirements; hazards and structured analysis tools; risk terminology and quantified risk analysis (QRA) techniques; and safety assessment studies. The course includes project and case studies.
PR: completion of Academic Term 6

8673 Subsea Pipeline Engineering provides an introduction to subsea pipeline engineering with a focus on the mechanical design of offshore pipelines. Stress-based, design-based and limit-states design for strength and stability are examined. Other fundamental pipeline engineering design issues such as materials specification, flow assurance and installation are reviewed. Principles of geotechnical engineering and pipeline/soil interaction analysis techniques are investigated. Special topics are also reviewed.
LH: 2
PR: one of ENGI 5312, ENGI 5931 or ENGI 6003

8676 Design of Natural Gas Handling Equipment covers process description, design methods, operating procedures, and troubleshooting aspects of gas production facilities including inlet separation operations, hydrate prevention and control, gas dehydration, NGL recovery and dew point control, gas transmission and pipeline design and transportation systems.
PR: completion of Academic Term 6

8677 Process Plant Design and Economics will provide a comprehensive picture of the availability and design of both traditional and current process equipment. Economic and optimization issues relevant to investment, product-cost estimation, and profitability analysis will also be addressed. The course will provide students with tools to evaluate the economics of process industries reflecting current economic criteria, and provide helpful guidelines to approaching, defining, and solving optimization problems.
PR: ENGI 7623

8680 Process Control and Instrumentation begins with an introduction to feedback and feedforward control systems, regulatory and servo control. Topics include modelling thermal, gas, liquid and chemical processes; sensors and transmitters, control valve sizing for liquids and gases, industrial feedback controllers; design of feedback control loops, tuning of feedback controllers; cascade, ratio, override and selective control; feedforward control; multivariable process control; piping and instrumentation diagrams, and control system documentation.
LH: at least four 3-hour sessions per semester.
PR: ENGI 5821

8690 Reservoir Engineering examines fluid pressure regimes, oil recovery factors, calculation of hydrocarbon volumes, reservoir rock characteristics, reservoir fluid properties, porosity and permeability, material balance, and well test analysis.
PR: completion of Academic Term 6

8691 Petroleum Production Engineering examines the procedures and equipment necessary for preparing a well to produce hydrocarbons and maximizing flow rate during the life of the well; techniques for well productivity analysis in under-saturated, saturated, and natural gas reservoirs; well completion configuration tubulars; packers and subsurface flow control devices; completion and work over fluids; perforating oil and gas wells; formation damage; surfactants for well treatment; hydraulic fracturing; acidizing; scale deposition, removal, and prevention; work over and completion rigs; and artificial lift.
PR: completion of Academic Term 6

8692 Drilling Engineering for Petroleum Exploration & Production covers both offshore and onshore drilling operations and includes: rotary drilling rig operations, well construction sequence, drill string, drill bits, well bore hydraulics, casing and well heads, cementing, well control, directional and horizontal drilling, well planning and fishing operations, and extended reach, horizontal and multilateral well drilling techniques.
PR: completion of Academic Term 6

8693 Petroleum Facilities Engineering - inactive course.

8694 Downstream Processing includes: oil and natural gas processing, oil and gas storage facilities and their design, oil and gas separation processes, petroleum refining processes, and de-bottle necking.
PR: completion of Academic Term 6

8696 Petroleum Refining Engineering will cover crude and refinery products properties and specifications, process description, design methods, operating procedures, and troubleshooting aspects of modern petroleum refining. It also includes hydrorefining, catalytic reforming, hydrocracking, isomerisation, refinery machinery, and utilities.
PR: completion of academic term 6 of the process engineering program

8700 Civil Engineering Project is a practically oriented design project integrated over the five areas in which Civil programs are offered. Students will operate in consultant groups and will complete a design for a typical Civil Engineering undertaking.
LC: scheduled as required
OR: 1 client meeting per week, 1 tutorial per week
PR: completion of Term 7 of the Civil Engineering program

8705 Structural Building Systems examines geometries, loads, safety and serviceability, procedure of using the national building code for evaluating the governing loads on structural members;.design of low rise concrete, timber and steel buildings; lateral load-resisting elements and bracing systems; design of foundation systems, footing design, pile cap design, pile group analysis using elastic centre method and inclined pile analysis; prestressed concrete concepts: strength of flexural members, and shear reinforcement for prestressed concrete beams.
LH: at least nine 3-hour sessions per semester
PR: ENGI 6707

8708 Offshore Structural Design examines guidelines and international codes and standards for offshore structural design; understanding design constraints and concepts of offshore fixed and floating structures; design consideration for fixed offshore concrete platform; design consideration for offshore platform and floating production system design, and analysis of various support systems of the offshore structure.
PR: ENGI 7707

8713 Municipal Engineering includes water supply system overview; water consumption estimation; groundwater and surface water sources; oxygen demand and transfer; water treatment processes; water distribution systems and design software; sewer systems and design software; wastewater treatment processes; sludge handling; decentralized and on-site wastewater treatment.
PR: ENGI 7716

8717 Environmental Assessment, Monitoring and Control covers statistical analysis; pollution monitoring, and sampling network design; water quality and air quality modelling; environmental risk assessment; environmental impact assessment; site remediation and hazardous waste management. There are relevant field trips and case studies.
LH: at least ten 3-hour lab sessions per semester
PR: ENGI 4717

8740 Contract Law and Labour Relations is an introduction to law as it applies to engineering activity; the nature of law and legal processes, including standard forms; liens, bonds and insurances; the labour movement in North America; examination of union philosophies and managerial attitudes; labour law and collective bargaining; disputes and settlements.
CR: the former ENGI 6740
PR: completion of Term 7 of the Civil Engineering program

8751 Coastal and Ocean Engineering examines the coastal and ocean environment; ocean circulation and properties; waves and tides; instrumentation and measurement. Additional topics will be drawn from the areas of hydraulic, geotechnical and structural engineering. Relevant field exercises will be conducted.
PR: ENGI 6713

8790-8799 Special Topics in Civil Engineering will have topics to be studied announced by the Faculty.

8801-8805 (Excluding 8804) Special Topics in Computer Engineering will have topics to be studied announced by the Faculty.

8806-8809 Special Topics in Electrical Engineering will have topics to be

studied announced by the Faculty.

8821 Design of Digital Signal Processing Systems is a review of introductory digital signal processing (DSP) principles, including sampling theory and discrete-time systems and signals. Topics include transform analysis of DSP systems; issues in the implementation of DSP systems; design of IIR and FIR digital filters; computable transforms and their use in the frequency analysis of digital signals; and design of DSP systems for current and emerging applications of digital signal processing.
PR: ENGI 7824

8826 Filter Synthesis begins with an introduction to analog filters. The course examines descriptive terminology, transfer functions and frequency response of filters; design of first order passive and active filters; design and analysis of biquad circuit, Sallen key circuit, multiple feedback circuit and state variable filter; RC-CR transformation; inductance simulation circuit; cascade design principle; design of filters with maximally flat magnitude response; design of filters with equal ripple magnitude response; design of Bessel-Thomson filters; analysis and design of switched capacitor filters; and the use of Matlab for design of analog filters.
LH: at least four 3-hour sessions per semester
PR: ENGI 5854

8845 Power System Operation examines symmetrical components; power system fault analysis; power system stability; and power system protection.
LH: at least four 3-hour sessions per semester
PR: ENGI 7844

8853 Electrical Engineering Design Project II continues ENGI 7803 and provides an opportunity for senior students to integrate the knowledge that they have acquired through the junior terms and apply it to solving an electrical engineering design problem. Students work in small teams with the assistance of a faculty mentor to complete detailed design, implementation and testing of an electrical engineering system to solve the problem as defined in 7803.
CR: the former ENGI 8800
LC: 0
OR: weekly meetings with project supervisor
PR: 7803

8854 Computer Engineering Design Project II continues ENGI 7804 and provides an opportunity for senior students to integrate the knowledge that they have acquired through the junior terms and apply it to solving a computer engineering design problem. Students work in small teams with the assistance of a faculty mentor to complete detailed design, implementation and testing of an computer engineering system to solve the problem as defined in 7804.
CR: : the former ENGI 8800
LC: 0
OR: weekly meetings with project supervisor
PR: 7804

8863 Introduction to LSI Design (same as Computer Science 4725) is an introduction to ASICs and ASIC design methodology and includes basic concepts of digital logic design tools and ASIC technology libraries; partitioning for logic synthesis and VHDL coding; constraining designs, synthesizing, simulation and optimization; design for testability; layout and post-layout optimization and SDF generation; and static timing analysis.
LH: at least eight 3-hour sessions per semester
PR: ENGI 5865

8868 Computer and Communications Security examines the techniques used to provide security in communication networks and computer systems. The course focuses on topics in cryptography required to provide privacy, authentication, and integrity, including symmetric key ciphers, public key ciphers, message authentication, and digital signature schemes.
PR: ENGI 6876

8877 Wireless and Mobile Communications (same as the former ENGI 8804) covers the fundamentals and main concepts of wireless and mobile communication systems focusing on the system level design and performance. Main topics to be covered include Introduction to Wireless Communication Systems, Wireless Channel Models, Frequency Reuse Concept, Wireless Multiple Access Techniques (TDMA, FDMA, CDMA), Orthogonal Frequency Division Multiplexing (OFDM), Wireless Systems (GSM, 3G, LTE, etc.).
CR: the former ENGI 8804
PR: ENGI 6871, ENGI 6876

8879 Digital Communications is a review of baseband transmission and basic digital modulation schemes, detection (optimum receiver, matched filter, correlator), error performance, intersymbol interference (ISI), equalization, the concept of information and entropy, source coding including Huffman coding and linear predictive coding, channel coding including block and convolutional error correcting codes, modulation and coding trade-offs, bandwidth and power efficiency.
PR: ENGI 6871

8894 Real-time Operating Systems examines real-time process scheduling; memory and device management; I/O communications; real-time systems; operating system and hardware concurrency issues; kernel architectures; device drivers; and a survey of available real-time operating systems and embedded platforms.
CR: the former ENGI 7863, Computer Science 4721
PR: ENGI 7894

8903 Mechanical Systems examines mechanical systems design; system simulation, control, and optimization; design optimization and system performance evaluation; design case studies and equipment for overall system design.
PR: ENGI 6901

8911 Corrosion and Corrosion Control examines forms of corrosion; the electrochemical nature of the corrosion process; the mixed potential theory, Purbaix diagrams and Evan diagrams; corrosion testing, control use by use of materials, selection, cathodic protection, inhibitors, and coatings. There are case studies of selected corrosion problems.
CR: the former ENGI 8962
LH: at least five 3-hour sessions per semester
PR: ENGI 7911

8926 Mechanical Design Project II is the second of two capstone design courses in the Mechanical Discipline. Building on skills acquired in the first, student teams each choose a unique design challenge and then proceed to generate a solution. The problem statements are often drawn from industry and, where possible, interdisciplinary interaction is encouraged (for example, with business, computer science, or other engineering disciplines). In most cases, the problem proponent will act as the “client” and the team is expected to manage the client interaction process as well. Significant emphasis is placed on both oral and written communication of both the process and results. Wherever possible, each system or a critical component of it, will be prototyped and tested.
CR: the former ENGI 8936
LC: scheduled as required
LH: scheduled as required
PR: ENGI 7926

8933 Fatigue and Fracture Mechanics - inactive course.

8935 Pressure Component Design - inactive course.

8937 Machine Dynamics begins with a review of Newton's Law, planar rigid body kinematics and kinetics. Topics include three-dimensional kinematics and kinetics: orientation angles, rotation matrices, Euler’s equations. Lagrange's and Hamilton's equations, constraints, dynamic simulation of linkages, mechanism loads, balancing, engine dynamics. There is a student analysis project.
CR: the former ENGI 7945
LH: at least eight 1-hour sessions per semester
PR: ENGI 4932, 6933

8945 Production & Operations Management is an overview of production and operations management, and an examination of decision making and operations strategy; process design and improvement, process flow analysis/simulation, capacity planning; design of value chains, lean systems, plant layout and process planning; operating value chains, MIS systems, inventory and resource management; Relevant computer laboratory exercises are conducted.
CR: the former ENGI 7943
PR: ENGI 6901

8964 Fluid Structure Interactions examines structural vibrations generated by fluid flow. These vibrations can be transient or they can take the form of instability or resonance. The course deals with the following fluid structure interactions: (1) Flow induced vibration of structures (2) Unsteady flow in pipe networks (3) Water wave interactions with structures.
CR: the former ENGI 8904
LH: at least three 3-hour sessions per semester
PR: ENGI 6961, ENGI 6933

8970-8979 Special Topics in Mechanical Engineering will have topics to be studied announced by the Faculty.