FACULTY OF ENGINEERING AND APPLIED SCIENCE

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www.mun.ca/engineering

Dean

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Up-to-date personnel listings are available at www.mun.ca/engineering/about/people.

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 Student Code of Conduct

Memorial University of Newfoundland expects that students will conduct themselves in compliance with University Regulations and Policies, Departmental Policies, and Federal, Provincial and Municipal laws, as well as codes of ethics that govern students who are members of regulated professions. The *Student Code of Conduct* outlines the behaviors which the University considers to be non-academic misconduct offences, and the range of remedies and/or penalties which may be imposed. Academic misconduct is outlined in ***UNIVERSITY REGULATIONS*** **- Academic Misconduct** in the University Calendar.

For more information about the *Student Code of Conduct*, see www.mun.ca/student.

For additional information and resources on academic and professional integrity in the Faculty of Engineering and Applied Science, see www.mun.ca/engineering/undergrad/academicintegrity.php.

3 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, and Doctor of Philosophy. The Faculty encompasses five academic departments: Civil Engineering, Electrical and Computer Engineering, Mechanical Engineering, Ocean and Naval Architectural Engineering, and Process Engineering. Through teaching, research and outreach, the Faculty of Engineering and Applied Science 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.mun.ca/engineering.

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

For information concerning fees and charges, see the Financial and Administrative Services website at www.mun.ca/finance/fees/.

For information concerning scholarships, bursaries and awards, see www.mun.ca/scholarships/scholarships.

3.1 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. The undergraduate programs offered by The Faculty of Engineering and Applied Science are fully accredited by The Canadian Engineering Accreditation Board (CEAB) of The Canadian Council of Professional Engineers (CCPE) to 2024.

3.2 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.

3.3 Academic and Professional Ethics

The Faculty of Engineering and Applied Science supports the highest standards of academic and professional ethics. Ethical behaviour encompasses integrity, conduct, respect, and professionalism, and also means that we will take responsibility for our learning and pursue academic goals in an honest and engaged manner. It is the principles, values, and expectations that we espouse as members of the Faculty and future professional engineers.

When participating in coursework or representing the Faculty on work-terms, in competitions, at conferences, and other research and academic activities, we consider ethical behaviour as important as our performance, conduct, and quality of work. In decision-making, teamwork, and individual expression, we seek to understand the significance of justice, fairness, individual rights, and care in striving to achieve our own personal best.

Guidelines for Academic Integrity and an Engineering Student Code of Conduct are available at the Faculty of Engineering and Applied Science website.

4 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.

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.

Courses of the Faculty are designated by the following abbreviations: CIV are courses offered by the Department of Civil Engineering; ECE are courses offered by the Department of Electrical and Computer Engineering; ENGI are non-departmental courses offered by the Faculty; ME are courses offered by the Department of Mechanical Engineering; ONAE are courses offered by the Department of Ocean and Naval Architectural Engineering; and PROC are courses offered by the Department of Process Engineering.

4.1 Program of Study

1. Courses in the engineering program are normally taken in Academic Terms 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 to six 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 as indicated under **Promotion Regulations, Promotion Status (Engineering One)**.
3. To be eligible for registration for ENGI 001W in the Spring semester after completing Engineering One, students are expected to successfully complete the prerequisite ENGI 200W in the Fall semester of Engineering One. All other Engineering One students are expected to successfully complete ENGI 200W in the Winter semester of Engineering One.
4. 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).
5. In these program regulations, including the program tables, wherever reference is made to Chemistry 1050, this course may be replaced by a course deemed equivalent by the relevant academic unit.
6. 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.
7. Upon entering Academic Term 6, students in the Computer Engineering and Electrical Engineering majors may choose to enter the Biomedical stream. Upon entering Academic Term 6, students in the Mechanical Engineering major choose one of five technical streams: Biomedical, Mechanics and Materials, Mechatronics, Petroleum, and Thermo-Fluids. Upon entering Academic Term 6, students in the Process Engineering major may choose one of two technical streams: Petroleum and Process.
8. Courses offered in the Faculty of Engineering and Applied Science 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; Engineering One for 1000 level courses). Other students will be admitted to these courses only with the approval of the Head of the appropriate Department for courses at the 3000 level and higher, or the Associate Dean (Undergraduate Studies) (or delegate) for ENGI courses.

   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.
9. Technical elective courses may be offered in terms other than those indicated in the program tables.
10. 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 Head of the appropriate Department. 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 Academic Terms as shown in the tables.
11. A minimum grade of 60% is required for credit to be given towards a student's engineering program for any course beyond Engineering One that is taken outside the normal Academic Terms as shown in the tables.
12. Transfer credit cannot be awarded for project or design courses in Academic Terms 7 or 8 of the Engineering program.
13. 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.

4.2 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:
   - One 3 credit hour course in English at the 1000 level;
   - Engineering 3101;
   - Engineering 4102 (which is a prerequisite for required courses in Term 6 in the Civil and Process majors, and for required courses in Term 7 in all other majors);
   - 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 8151, Engineering 8154, Engineering 8155, Sociology 2120, Sociology 4107, Philosophy 2330 or the former 2571, or the former 2801;
   - Engineering 8152;
   - 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 website www.mun.ca/engineering; and
   - 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 website www.mun.ca/engineering.
3. In order to be considered for graduation, the student must obtain an overall average of at least 60% in the 21 credit hours in **Complementary Studies** courses required in the program.

4.3 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.

4.3.1 Civil Engineering

www.mun.ca/engineering/civil

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.

4.3.2 Computer Engineering

www.mun.ca/engineering/ece

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. In Academic Term 6, students may choose to enter the Biomedical stream which provides focus on electives relevant to the field of biomedical engineering. Making use of their elective course choices, students in the Computer Engineering major also have the opportunity to undertake a minor in Physics.

4.3.3 Electrical Engineering

www.mun.ca/engineering/ece

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. In Academic Term 6, students may choose to enter the Biomedical stream which provides focus on electives relevant to the field of biomedical engineering. Making use of their elective course choices, students in the Electrical Engineering major also have the opportunity to undertake a minor in Physics.

4.3.4 Mechanical Engineering

www.mun.ca/engineering/mech

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, emphasizing solid mechanics, material science, dynamics, vibrations and machine component design; thermo-fluids, focussing on thermodynamics, heat transfer and fluid mechanics; mechatronics, dealing with electro-mechanical systems, control, robotics, and automation; and manufacturing/industrial, which encompasses CAD/CAM, production and operation management. In Academic Term 6, students select one of five Technical Streams, which provide focus to the wide range of electives in various specialty areas in Academic Terms 7 and 8.

4.3.5 Ocean and Naval Architectural Engineering

www.mun.ca/engineering/ona

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 in the Ocean and Naval Architectural Engineering major also have the opportunity to undertake a minor in Mathematics.

4.3.6 Process Engineering

www.mun.ca/engineering/process

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. In Academic Term 6, a student may select to continue in the Process Stream with emphasis on sustainable processing or in the Petroleum Stream with emphasis on upstream oil and gas including petroleum geology, drilling, reservoir and production engineering. 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.

4.4 Work Terms

www.mun.ca/coop/programs/engineering
www.mun.ca/coop

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 governed by the *Engineering Student Co-op Handbook* which is available at www.mun.ca/coop/programs/engineering/enghandbook.pdf. Any changes to the *Engineering Student Co-op Handbook* require the approval of the Committee on Undergraduate Studies.

A student must successfully complete 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. A student is expected to complete as many of these work terms as possible. A student who expects 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. A student 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 a student has successfully completed a minimum of four work terms.

4.4.1 General Information

- During work terms a student is brought into direct contact with the engineering profession, exposed to the work place setting, expected to assume ever-increasing responsibility in employment situations as the student's education advances, and introduced to experiences beyond the scope of those which could be provided in the classroom.
- A student is responsible for finding suitable work placements. The Office of Co-operative Education provides resources to assist in this process. A student who obtains a work placement outside the job competition must have that work placement approved by the Office of Co-operative Education prior to accepting it.
- A student who cannot meet the demands of the work term may be required by the Faculty to withdraw from the work term until the student can demonstrate an ability to continue in the program.
- Following the date of automatic registration for a work term, only a student who is registered for that work term will be permitted to continue in, or subsequently join, the job placement process and be approved to begin a work placement.
- A student in the job competition who refuses all job offers without the prior consent of the Office of Co-operative Education may be subject to penalties that may include the assignment of a grade of FAL (fail) for that work term.
- A student is not permitted to drop work terms without prior approval of the Committee on Undergraduate Studies, on the recommendation of the Office of Co-operative Education. A student who drops a work term without permission, or who fails to

honour an agreement to work with an employer, will be assigned a grade of FAL (fail) for that work term.

- A student who conducts him or herself in such a manner as to cause termination from the job, will normally be assigned a grade of FAL (fail) for that work term.
- A student who is registered for a work term and who does not opt out from that work term must complete that work term successfully as a requirement for graduation.
- A student who opts out from a work term is not permitted to work for a co-op employer during that work term.
- A student who opts out from a work term and who works for a co-op employer during that work term may be considered to have committed an academic offence and will be subject to the penalties listed under the ***UNIVERSITY REGULATIONS*****, Academic Offences**.
- A student in a work term who does not meet the deadlines stated by the Office of Co-operative Education for the submission of forms and documentation may be awarded a reduced grade for one or both components of that work term.
- The work term performance grade is assigned by the student's Coordinator based upon feedback from the employer and other information gathered from contact with the student.

4.4.2 Evaluation of Work Terms

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

4.5 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 through the Faculty of Engineering and Applied Science website.

5 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.

5.1 General Information

1. Entry to the Bachelor of Engineering program is competitive for a limited number of placements. Meeting the minimum admission requirements does not guarantee acceptance into the Engineering program.
2. The final decision on admission or readmission to the Bachelor of Engineering program rests with the Admissions Committee of the Faculty.
3. Admission or readmission to the University does not necessarily constitute admission or readmission to the Bachelor of Engineering program.
4. The primary criterion used in reaching decisions on applications for admission or readmission is the judgement of the Admissions Committee on the likelihood of an applicant succeeding in the program.
5. Up to three positions per year in the Faculty of Engineering and Applied Science may be designated for applicants of Indigenous ancestry who have met the admission requirements of the program. Applicants must send a letter of request at the time of application and provide documentation of Indigenous ancestry.
6. The Admissions Committee allocates majors to students after promotion or readmission to Academic Term 3 of the Bachelor of Engineering program. Information on promotion from Engineering One is available at **Promotion Regulations, Promotion Status (Engineering One)**.

5.2 Application Forms and Deadlines

Applications for admission or readmission to programs offered by the Faculty of Engineering and Applied Science must be submitted online at www.mun.ca/undergrad/admissions/apply and by the appropriate deadline date as indicated in the **Application for Admission Deadline Dates** table or the **Application for Readmission Deadline Dates** table below.

5.2.1 Admission

1. A student applying for admission to the Bachelor of Engineering program is required to submit an online application by the appropriate deadline date as indicated in the **Application for Admission Deadline Dates** table below.
2. Applications for admission to Engineering One may be considered for admission to any semester of the academic year.
3. Applications will be considered from Memorial University of Newfoundland students who have successfully completed or are currently registered for two or more of the following courses or their prerequisites: Chemistry 1050, Chemistry 1200, 3 credit hours in English at the 1000 level, Mathematics 1001, Mathematics 2050, Physics 1051.
4. Applications and documentation received after the relevant deadline may be considered as time and space permit. The Admissions Committee for the Faculty will only consider applications that are complete.

Application for Admission Deadline Dates

Semester	Deadline Date	Deadline for Receipt of all Documentation
Fall	March 1	July 31
Winter	October 1	It is strongly recommended that the required documentation be received on or close to the admission deadline.
Spring	February 1	It is strongly recommended that the required documentation be received on or close to the admission deadline.

5.2.2 Readmission

1. Applications for readmission to Academic Term 3 and beyond will only be considered for applicants who have been previously admitted to the Academic Term for which readmission is applied.
2. A student applying for readmission to the Bachelor of Engineering program is required to submit an online application by the appropriate deadline date as indicated in the **Application for Readmission Deadline Dates** table below.
3. Applicants will be considered for readmission to Academic Term 3 based on their **Promotion Status (Engineering One)**.
4. Applications and documentation received after the relevant deadline may be considered as time and space permit. The Admissions Committee for the Faculty will only consider applications that are complete.

Application for Readmission Deadline Dates

Academic Term	Semester	Deadline Date	Deadline for Receipt of all Documentation
Academic Term 3	Fall	March 1	July 31
Beyond Academic Term 3	Fall Winter Spring	June 1 October 1 February 1	It is strongly recommended that the required documentation be received on or close to the appropriate admission deadline.

5.3 Admission Requirements to the Faculty Program

An applicant must be eligible for admission or readmission to the University in a category as defined in the Calendar section ***UNIVERSITY REGULATIONS*** **- Admission/Readmission to the University (Undergraduate), Categories of Applicants, Admission Criteria and Other Information**. In addition to meeting these regulations, an applicant to the Bachelor of Engineering program in the following admission categories must meet the requirements as indicated below.

5.3.1 High School Applicants

1. The Faculty of Engineering and Applied Science encourages applications for admission to the Bachelor of Engineering program from high school students who are new to post-secondary education, have an interest in pursuing an engineering degree and have achieved a good academic performance during high school. In addition to meeting the requirements under ***UNIVERSITY REGULATIONS*** **- Admission/Readmission to the University (Undergraduate), Applicants Who Have Followed the High School Curriculum of Newfoundland and Labrador, Admission Criteria**, performance in advanced mathematics, chemistry, physics and English is of particular interest, and grades above 80% are normally required for consideration.
2. Applicants who have not successfully completed either chemistry or physics but who have performed well in the other subjects may be considered.
3. Applicants must meet the English language proficiency requirements as noted in **English Language Proficiency Requirements**.
4. An applicant who is not admitted to the Bachelor of Engineering program is encouraged to contact the University's Academic Advising Centre or the Office of the Associate Dean (Undergraduate Studies) to discuss an appropriate first-year program.

5.3.2 Memorial University of Newfoundland Applicants

1. To be eligible for consideration for admission to the Bachelor of Engineering program, a student who is attending or has previously attended this University must have a cumulative average of at least 70%, and obtained a grade of at least 70% in two or more of the following courses or their prerequisites: Chemistry 1050, Chemistry 1200, 3 credit hours in English at the 1000 level, Mathematics 1001, Mathematics 2050, Physics 1051.
2. Applicants must meet the English language proficiency requirements as noted in **English Language Proficiency Requirements**.

5.3.3 Transfer Applicants

1. An applicant seeking admission to the Bachelor of Engineering program through transfer from recognized post-secondary institutions must have achieved a minimum overall average of 70% or GPA of 3.0, or equivalent.
2. Applicants must have obtained a grade of at least 70% in two or more courses that have been deemed equivalent for transfer credit purposes to the following courses or their prerequisites: Chemistry 1050, Chemistry 1200, 3 credit hours in English at the 1000 level, Mathematics 1001, Mathematics 2050, Physics 1051.
3. Where it is determined, at the time of admission, that an applicant has met all the requirements for promotion from Engineering One, customized program requirements will be determined on an individual basis following transfer credit evaluation.
4. Applicants must meet the English language proficiency requirements as noted in **English Language Proficiency Requirements**.
5. A transfer applicant is advised that more than half of the total credit hours must be completed at this University as indicated under ***UNIVERSITY REGULATIONS*** **- Residence Requirements, First Degree and Second Degree**.

5.4 English Language Proficiency Requirements

Applicants who have not met the University specified requirements for study at an English Language Secondary or Post-Secondary Institution (see ***UNIVERSITY REGULATIONS*****, Admission/Readmission to the University (Undergraduate) - English Language Proficiency Requirements**) are required to:

1. Possess higher than University minimum scores in one of the following standardized tests:
    a. **Test of English as a Foreign Language (TOEFL)**. A minimum score of 90, with at least 20 in each of Reading and Listening, and no less than 25 in Speaking and Writing, is required on the TOEFL;
    b. **International English Language Testing System (IELTS)**. A minimum overall band score of 6.5, with at least band 6.5 in each of Writing and Speaking, and 6.0 in Reading and Listening is required on the IELTS;
    c. **Canadian Academic English Language Assessment (CAEL)**. A minimum overall score of 70, with at least 60 per band, and no less than 70 in Writing and Speaking is required on the CAEL; and
2. Successfully complete an e-proctored English test or an interview.

5.5 Other Information

1. The Faculty will notify each applicant of their admission decision by e-mail through the applicant's University-approved e-mail account.
2. Admission decisions may be deferred until grades are available for courses currently being completed.
3. A student admitted to the program in any term, without receiving credit for all courses required up to that level, must complete those courses successfully prior to graduation.
4. A student who has been admitted to one major offered by the Faculty and who wishes 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.
5. A student who declines an offer of admission or who fails to register for the appropriate courses during the term of admission will be considered withdrawn from the program. Such a student, if subsequently wishing 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.

6 Program Regulations

6.1 Civil Engineering Program Regulations

6.1.1 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 ENGI 1010, 1020, 1030, 1040 3 credit hours in English at the 1000 level Mathematics 1000, 1001, 2050 Physics 1050, 1051	Students who are expecting to successfully complete the Engineering One requirements by the end of the Winter semester may apply to undertake a work term during the Spring semester. In this case, the prerequisite course ENGI 200W is expected to be successfully completed during the Fall semester. All other students are expected to successfully complete ENGI 200W in the Winter semester of Engineering One.
In addition to meeting the requirements outlined below, a student must successfully complete four Complementary Studies courses as described under **Description of Program, Complementary Studies**.		
Fall Academic Term 3	CIV 3210, 3440, 3710, 3720 ENGI 3101 Mechanical Engineering 3301	
Winter	ENGI 001W or 002W	
Spring Academic Term 4	CIV 4220, 4310, 4450, 4610 ENGI 4421	
Fall	ENGI 001W or 002W or 003W	
Winter Academic Term 5	CIV 5110, 5230, 5320, 5460, 5510	
Spring	ENGI 002W or 003W or 004W	
Fall Academic Term 6	CIV 6120, 6330, 6470, 6520, 6810	
Winter	ENGI 003W or 004W or 005W (optional)	
Spring Academic Term 7	CIV 7130, 7530, 7730	6 credit hours from: CIV 7140, 7240, 7340, 7540, 7620, 7820 or other courses as specified by the Head of the Department of Civil Engineering
Fall	ENGI 004W or 005W (optional) or 006W (optional)	
Winter Academic Term 8	CIV 8000, 8830 ENGI 8152	9 credit hours from: CIV 8150, 8550, 8560, 8570, 8630 or other courses as specified by the Head of the Department of Civil Engineering

6.2 Computer Engineering Program Regulations

6.2.1 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**.
- The requirements for a minor in Physics in the Computer Engineering program are detailed under **Faculty of Science, Minor in Physics**. Students wishing to undertake a minor in Physics must obtain approval from the Head of the Department of Electrical and Computer Engineering for their course selection.

Table 2 Computer Engineering Major

Term	Required Courses	Elective Courses
Engineering One	Chemistry 1050 ENGI 1010, 1020, 1030, 1040 3 credit hours in English at the 1000 level Mathematics 1000, 1001, 2050 Physics 1050, 1051	Students who are expecting to successfully complete the Engineering One requirements by the end of the Winter semester may apply to undertake a work term during the Spring semester. In this case, the prerequisite course ENGI 200W is expected to be successfully completed during the Fall semester. All other students are expected to successfully complete ENGI 200W in the Winter semester of Engineering One.
In addition to meeting the requirements outlined below, a student must successfully complete four Complementary Studies courses as described under **Description of Program, Complementary Studies**.		
Fall Academic Term 3	ECE 3300, 3400, 3500 ENGI 3101, 3424 Physics 3000	
Winter	ENGI 001W or 002W	
Spring Academic Term 4	ECE 4110, 4300, 4400, 4500, 4600	
Fall	ENGI 001W or 002W or 003W	
Winter Academic Term 5	ECE 5010, 5100, 5200, 5400, 5500	
Spring	ENGI 002W or 003W or 004W	
Fall Academic Term 6	ECE 6400, 6500, 6600, 6610	**Students in the Biomedical Stream:** Human Kinetics and Recreation 2311 **All other students:** 3 credit hours from: ECE 6200 or other courses as specified by the Head of the Department of Electrical and Computer Engineering
Winter	ENGI 003W or 004W or 005W (optional)	
Spring Academic Term 7	ECE 7010, 7400, 7600	**Students in the Biomedical Stream:** Medicine 6250 3 credit hours from: ECE 7200, 7410, 7420, Mechanical Engineering 7204, other courses as specified by the Head of the Department of Electrical and Computer Engineering **All other students:** 6 credit hours from: ECE 7200, 7410, 7420, 7500, Mechanical Engineering 7204, other courses as specified by the Head of the Department of Electrical and Computer Engineering
Fall	ENGI 004W or 005W (optional) or 006W (optional)	
Winter Academic Term 8	ECE 8010, 8400 ENGI 8152	**Students in the Biomedical Stream:** Human Kinetics and Recreation 4703 6 credit hours from: ECE 8410, 8420, 8600, other courses as specified by the Head of the Department of Electrical and Computer Engineering **All other students:** One free elective which must be a 2000-level or higher course from any academic unit. Selection of a course must be approved by the Head of the Department of Electrical and Computer Engineering. 6 credit hours from: ECE 8210, 8410, 8420, 8600, 8620, 8900-8949, or other courses as specified by the Head of the Department of Electrical and Computer Engineering

6.3 Electrical Engineering Program Regulations

6.3.1 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 Head of the Department of Electrical and Computer Engineering for their course selection.

Table 3 Electrical Engineering Major

Term	Required Course	Elective Courses
Engineering One	Chemistry 1050 ENGI 1010, 1020, 1030, 1040 3 credit hours in English at the 1000 level Mathematics 1000, 1001, 2050 Physics 1050, 1051	Students who are expecting to successfully complete the Engineering One requirements by the end of the Winter semester may apply to undertake a work term during the Spring semester. In this case, the prerequisite course ENGI 200W is expected to be successfully completed during the Fall semester. All other students are expected to successfully complete ENGI 200W in the Winter semester of Engineering One.
In addition to meeting the requirements outlined below, a student must successfully complete four Complementary Studies courses as described under **Description of Program, Complementary Studies**.		
Fall **Academic Term 3**	ECE 3300, 3400, 3500 ENGI 3101, 3424 Physics 3000	
Winter	ENGI 001W or 002W	
Spring **Academic Term 4**	ECE 4300, 4500, 4600, 4800 ENGI 4430,	
Fall	ENGI 001W or 002W or 003W	
Winter **Academic Term 5**	ECE 5000, 5100, 5200, 5300, 5700	
Spring	ENGI 002W or 003W or 004W	
Fall **Academic Term 6**	ECE 6200, 6600, 6700, 6800	**Students in the Biomedical Stream:** Human Kinetics and Recreation 2311 **All other students:** 3 credit hours from: ECE 6610, 6810, or other courses as specified by the Head of the Department of Electrical and Computer Engineering
Winter	ENGI 003W or 004W or 005W (optional)	
Spring **Academic Term 7**	ECE 7000, 7600	**Students in the Biomedical Stream:** Medicine 6250 3 credit hours from: ECE 7200, 7410, Mechanical Engineering 7204, other courses as specified by the Head of the Department of Electrical and Computer Engineering 3 credit hours from: ECE 7200, 7210, 7410, 7800, 7810, Mechanical Engineering 7204, other courses as specified by the Head of the Department of Electrical and Computer Engineering **All other students:** 9 credit hours from: ECE 7200, 7210, 7410, 7620, 7800, 7810, Mechanical Engineering 7204, other courses as specified by the Head of the Department of Electrical and Computer Engineering
Fall	ENGI 004W or 005W (optional) or 006W (optional)	
Winter **Academic Term 8**	ECE 8000, 8610 ENGI 8152	**Students in the Biomedical Stream:** Human Kinetics and Recreation 4703 6 credit hours from: ECE 8410, 8600, other courses as specified by the Head of the Department of Electrical and Computer Engineering **All other students:** One free elective which must be a 2000-level or higher course from any academic unit. Selection of a course must be approved by the Head of the Department of Electrical and Computer Engineering. 6 credit hours from: ECE 5500, 8210, 8600, 8620, 8700, 8800, 8950-8999 or other courses as specified by the Head of the Department of Electrical and Computer Engineering

6.3.2 Minor in Applied Science - Electrical Engineering for Physics Majors and Honours

For Physics Majors and Honours students, a Minor in Applied Science - Electrical Engineering will consist of:

1. ECE 3300 (or the former ENGI 3821 or Physics 3550)
2. ECE 4300 (or the former ENGI 4854)
3. Physics 3000 and
4. 15 credit hours chosen from
   a. ECE 3500 (or the former ENGI 3861)
   b. ECE 4500 (or the former ENGI 4862)
   c. ECE 4600 (or the former ENGI 4823)
   d. ECE 4800 (or the former ENGI 4841)
   e. ECE 5000 (or the former ENGI 5800)
   f. ECE 6700 (or the former ENGI 6813 or Physics 4500)
   g. or other courses subject to approval by the Head of the Department of Physics and Physical Oceanography and the Head of the Department of Electrical and Computer Engineering.

Completion of the Minor in Applied Science - Electrical Engineering does not qualify persons to hold the designation "Professional Engineer" as defined by various provincial acts governing the Engineering Profession.

6.4 Mechanical Engineering Program Regulations

6.4.1 Mechanical Engineering Major

- The full-time 141 credit hour Bachelor of Engineering (Co-operative), Mechanical 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 4 Mechanical Engineering Major**.
- Work terms shall normally be taken in the order as set out in **Table 4 Mechanical Engineering Major**.

Table 4 Mechanical Engineering Major

Term	Required Courses	Elective Courses
Engineering One	Chemistry 1050 ENGI 1010, 1020, 1030, 1040 3 credit hours in English at the 1000 level Mathematics 1000, 1001, 2050 Physics 1050, 1051	Students who are expecting to successfully complete the Engineering One requirements by the end of the Winter semester may apply to undertake a work term during the Spring semester. In this case, the prerequisite course ENGI 200W is expected to be successfully completed during the Fall semester. All other students are expected to successfully complete ENGI 200W in the Winter semester of Engineering One.
In addition to meeting the requirements outlined below, a student must successfully complete four Complementary Studies courses as described under **Description of Program, Complementary Studies**.		
Fall Academic Term 3	ENGI 3101, 3424 ME 3101, 3102, 3301, 3401	
Winter	ENGI 001W or 002W	
Spring Academic Term 4	ENGI 4430 ME 4302, 4402, 4501, 4601	
Fall	ENGI 001W or 002W or 003W	
Winter Academic Term 5	ENGI 4421 ME 5103, 5201, 5502, 5602	
Spring	ENGI 002W or 003W or 004W	
Fall Academic Term 6	ME 6202, 6303, 6403, 6701, 6702	Students in the Biomedical Technical Stream must also take Human Kinetics and Recreation 2311 in Academic Term 6. Students in the Petroleum Technical Stream must also take Process Engineering 6202 in Academic Term 6
Winter	ENGI 003W or 004W or 005W (optional)	
Spring Academic Term 7	ME 7203, 7704	6 credit hours from **Technical Stream Required Courses**, Academic Term 7 For students in the Biomedical Technical Stream, one Technical Stream Required Course is replaced by Human Kinetics and Recreation 2311, taken in Academic Term 6. For students in the Petroleum Technical Stream, one Technical Stream Required Course is replaced by Process Engineering 6202, taken in Academic Term 6. 3 credit hours from **Technical Stream Elective Courses**. One free elective which must be a 2000-level or higher course from any academic unit. Selection of a course must be approved by the Head of the Department of Mechanical Engineering and must be completed before Academic Term 8.
Fall	ENGI 004W or 005W (optional) or 006W (optional)	
Winter Academic Term 8	ENGI 8152 ME 8705	3 credit hours from **Technical Stream Required Courses**, Academic Term 8 6 credit hours from **Technical Stream Elective Courses**

6.4.1.1 Technical Streams

- A student must select one of the Technical Streams in the areas of Biomedical, Mechanics and Materials, Mechatronics, Petroleum, and Thermo-Fluids.
- Technical Stream required courses must be chosen according to the student's stream as outlined below in the **Technical Stream Required Courses Table**.
- Technical Stream elective courses must be chosen according to the student's stream as outlined below in the **Technical Stream Elective Courses Table**.

  A student must choose one course in Academic Term 7 and two courses in Academic Term 8 according to the student's stream from the **Technical Stream Elective Courses Table** or other courses as approved by the Head of the Department of Mechanical Engineering.
- The selection of a course as a technical stream course from outside these lists requires the approval of the Head of the Department of Mechanical Engineering.

Technical Stream Required Courses Table

Stream	Academic Term 6	Academic Term 7	Academic Term 8
Biomedical	Human Kinetics and Recreation 2311	Medicine 6250	Human Kinetics and Recreation 4703
Mechanics and Materials		ME 7104 ME 7703	ME 8604
Mechatronics		ME 7205 ME 7703	ME 8305
Petroleum	Process Engineering 6202	Process Engineering 7291	Process Engineering 8290
Thermo-Fluids		ME 7404 ME 7405	ME 8406

Technical Stream Elective Courses Table

Stream	Elective Courses
Biomedical	Electrical and Computer Engineering 7410 Electrical and Computer Engineering 8410 ME 7204 ME 7205 ME 7603 ME 8504
Mechanics and Materials	ME 7105 ME 7603 ME 8106 ME 8304 ME 8605 ME 8606
Mechatronics	Electrical and Computer Engineering 7200 Electrical and Computer Engineering 7410 Electrical and Computer Engineering 8410 Electrical and Computer Engineering 8610 ME 7204 ME 8304
Petroleum	Civil Engineering 8580 ME 7405 ME 7503 ME 8106 Process Engineering 7171 Process Engineering 7292 Process Engineering 8276 Process Engineering 8294
Thermo-Fluids	ME 7503 ME 7603 ME 8407 ME 8504 ME 8505 ME 8506

6.5 Ocean and Naval Architectural Engineering Program Regulations

6.5.1 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 and order as set out in **Table 5 Ocean and Naval Architectural Engineering Major**.
- Work terms shall normally be taken in the order as set out in **Table 5 Ocean and Naval Architectural Engineering Major**.
- Ocean and Naval Architectural Engineering students may complete a minor in Mathematics as outlined under **Faculty of Science, Mathematics, Minor in Mathematics**.

Table 5 Ocean and Naval Architectural Engineering Major

Term	Required Courses	Elective Courses
Engineering One	Chemistry 1050 ENGI 1010, 1020, 1030, 1040 3 credit hours in English at the 1000 level Mathematics 1000, 1001, 2050 Physics 1050, 1051	Students who are expecting to successfully complete the Engineering One requirements by the end of the Winter semester may apply to undertake a work term during the Spring semester. In this case, the prerequisite course ENGI 200W is expected to be successfully completed during the Fall semester. All other students are expected to successfully complete ENGI 200W in the Winter semester of Engineering One.
In addition to meeting the requirements outlined below, a student must successfully complete four Complementary Studies courses as described under **Description of Program, Complementary Studies**.		
Fall **Academic Term 3**	ENGI 3101 Mathematics 2000 Mechanical Engineering 3301, 3401 ONAE 3001, 3054	
Winter	ENGI 001W or 002W	
Spring **Academic Term 4**	Civil Engineering 4310 Mathematics 2260 ONAE 4007, 4011, 4020	
Fall	ENGI 001W or 002W or 003W	
Winter **Academic Term 5**	Mathematics 3202 ONAE 5020, 5022, 5034 Physics 3300	
Spring	ENGI 002W or 003W or 004W	
Fall **Academic Term 6**	ONAE 6002, 6005, 6036, 6046, 6055	
Winter	ENGI 003W or 004W or 005W (optional)	
Spring **Academic Term 7**	ONAE 7000, 7002, 7033, 7036	3 credit hours from ONAE 7003, 7046, Process Engineering 7171 or other courses as specified by the Head of the Department of Ocean and Naval Architectural Engineering
Fall	ENGI 004W or 005W (optional) or 006W (optional)	
Winter **Academic Term 8**	ENGI 8152 ONAE 8000	One free elective which must be a 2000-level or higher course from any academic unit. Selection of a course must be approved by the Head of the Department of Ocean and Naval Architectural Engineering. 9 credit hours from ENGI 8150, ONAE 8034, 8046, 8054, 8055, 8074, 8075, or other courses as specified by the Head of the Department of Ocean and Naval Architectural Engineering

6.6 Process Engineering Program Regulations

6.6.1 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 6 Process Engineering Major**.
- Beginning in Academic Term 6, a student will follow either the Process Stream or Petroleum Stream with elective course options as outlined in **Table 6 Process Engineering Major**.
- Work terms shall normally be taken in the order as set out in **Table 6 Process Engineering Major**.
- Process Engineering students may complete a minor in Chemistry as outlined under **Faculty of Science, Chemistry, Minor in Chemistry**.

Table 6 Process Engineering Major

Term	Required Courses	Elective Courses
Engineering One	Chemistry 1050 ENGI 1010, 1020, 1030, 1040 3 credit hours in English at the 1000 level Mathematics 1000, 1001, 2050 Physics 1050, 1051	Students who are expecting to successfully complete the Engineering One requirements by the end of the Winter semester may apply to undertake a work term during the Spring semester. In this case, the prerequisite course ENGI 200W is expected to be successfully completed during the Fall semester. All other students are expected to successfully complete ENGI 200W in the Winter semester of Engineering One.
In addition to meeting the requirements outlined below, a student must successfully complete four Complementary Studies courses as described under **Description of Program, Complementary Studies**.		
Fall **Academic Term 3**	Chemistry 1051 ENGI 3101, 3424 Mechanical Engineering 3101, 3401 PROC 3000	
Winter	ENGI 001W or 002W	
Spring **Academic Term 4**	ENGI 4430 PROC 4002, 4021, 4025, 4061	
Fall	ENGI 001W OR 002W OR 003W	
Winter **Academic Term 5**	ENGI 4421, Mechanical Engineering 5103 PROC 5001, 5002, 5071	
Spring	ENGI 002W or 003W or 004W	
Fall **Academic Term 6**	PROC 6021, 6031, 6061, 6071	3 credit hours from Technical Streams courses, Academic Term 6
Winter	ENGI 003W or 004W or 005W (optional)	
Spring **Academic Term 7**	PROC 7021, 7040, 7077	6 credit hours from Technical Streams courses, Academic Term 7
Fall	ENGI 004W or 005W (optional) or 006W (optional)	
Winter **Academic Term 8**	ENGI 8152 PROC 8040	One free elective which must be a 2000-level or higher course from any academic unit. Selection of a course must be approved by the Head of the Department of Process Engineering. 9 credit hours from Technical Streams courses, Academic Term 8

6.6.1.1 Technical Streams

- Technical Streams are available in the areas of **Petroleum** and **Process**.
- A student may experience scheduling difficulties if courses are selected from more than one Technical Stream.
- The selection of a course as a technical stream course from outside these lists requires the approval of the Head of the Department of Process Engineering.

Petroleum Technical Stream

Term	Required Courses	Elective Courses
Academic Term 6	PROC 6202	
Academic Term 7 A student must choose two courses from Academic Term 7.	PROC 7292	PROC 7171, 7291
Academic Term 8 A student must choose three courses from Academic Term 8.	PROC 8290, 8294	PROC 8270, 8276

Process Technical Stream

Term	Required Courses	Elective Courses
Academic Term 6	PROC 6151	
Academic Term 7 A student must choose two courses from Academic Term 7.	PROC 7123, 7171	
Academic Term 8 A student must choose three courses from Academic Term 8.	PROC 8151, 8191	Mechanical Engineering 8106 PROC 8270, 8294

6.6.2 Minor in Applied Science - Process Engineering for Chemistry Majors and Honours

For Chemistry Majors or Honours students, a Minor in Applied Science - Process Engineering will consist of

1. Chemistry 1051;
2. PROC 3000 (or the former ENGI 3600)
3. PROC 4021 (or the former ENGI 4621)
4. PROC 4002 (or the former ENGI 4602 or Chemistry 2301)
5. PROC 4025 (or the former ENGI 4625)
6. PROC 4061 (or Mechanical Engineering 4501 or the former ENGI 4661 or the former ENGI 4961) and
7. 6 credit hours chosen from:
   a. PROC 5001 (or the former ENGI 5601)
   b. PROC 6021 (or the former ENGI 6621)
   c. PROC 6031 (or the former ENGI 6631)
   d. PROC 6151 (or the former ENGI 6651)
   e. PROC 7021 (or the former ENGI 7621)
   f. PROC 7171 (or the former ENGI 8671).

Completion of the Minor in Applied Science - Process Engineering does not qualify persons to hold the designation "Professional Engineer" as defined by various provincial acts governing the Engineering Profession.

6.7 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).

7 Promotion Regulations

7.1 Promotion Status (Engineering One)

Promotion from Engineering One to Academic Term 3 depends on available capacity in the six Engineering majors; promotion from Engineering One does not guarantee admission to a student's preferred major. Capacity limits for Engineering majors are set by the Faculty.

1. Engineering One consists of nine 1000-level courses common to all Engineering majors: Chemistry 1050 (or Chemistry 1200), ENGI 1010, ENGI 1020, ENGI 1030, ENGI 1040, 3 credit hours in English at the 1000 level, Mathematics 1001, Mathematics 2050, and Physics 1051. Students are responsible for identifying and completing any needed prerequisites.
2. The minimum requirements for promotion from Engineering One to Academic Term 3 are:
   a. promotion average of at least 65% in the nine Engineering One courses;
   b. a grade of at least 55% or transfer credit in each Engineering One course; and
   c. submission of a Major Preference Form, indicating preferences for Engineering majors in rank order, no later than the last day of classes in the Spring term.
3. Meeting the minimum Engineering One promotion requirements does not guarantee promotion to Academic Term 3.
4. A student promoted to Academic Term 3 with an Engineering One promotion average of 75% or greater is guaranteed their preferred major.
5. A student who meets the promotion requirements with a promotion average of less than 75% will be promoted as Faculty capacity permits.
6. If a student fails an Engineering One course more than once, that student will be withdrawn from the Engineering program.
7. Students must complete the requirements for Engineering One within two academic years. A student who is not promoted at the end of the academic year following the academic year of admission will be withdrawn from the Engineering program.
8. The Faculty reserves the right to guarantee admission into a particular major, subject to meeting minimum promotion requirements, at the time of admission into the Engineering program.

7.2 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. In order to be considered for promotion a student must complete all courses required in that Academic term. Promotion from each academic term 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 required courses completed in the academic term excluding complementary studies 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 academic term in one of the following three categories:

7.2.1 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.

7.2.2 Probationary Promotion

A student who is not eligible for **Clear Promotion** from an academic term 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 an academic term the student must satisfy the Faculty of competence in the subject of the Engineering program course(s) (courses with any of the prefixes CIV, ECE, ENGI, ME, ONAE, PROC) in which the student has failed to achieve 50%.This will normally entail re-examination(s) prescribed by the Faculty as a condition of probation, after which the student will be declared to have passed or failed a test of competence in the subject(s) concerned. No numerical grade will be assigned in a re-examination. Upon passing a re-examination, the original grade submitted for the course will be changed to PAS, but the promotion average will not change and a note of the original grade will remain on the transcript.
5. Re-examination will be at a time determined by the Faculty, normally in the first week of the subsequent academic term. A re-examination is cumulative in nature, covers the entire course and, as such, may be different in scope from the original final examination for that course.
6. In order to qualify for a re-examination in a failed Engineering program course, a student must obtain a grade of at least 40% in that course and must have completed any laboratory and/or project work in that course. Re-examinations are not normally available for senior project courses or for other courses in which the final examination is worth less than 40% of the grade.
7. A student who has failed the communications component of a work term and who, in the opinion of the Office of Co-operative Education, 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 academic term, to complete the requirements of the work term.
8. A student will be permitted to write a maximum of four re-examinations for the duration of the student's program.
9. To change Probationary Promotion to **Clear Promotion** for an academic term the student must repeat successfully any non-Engineering program course(s) which count towards the promotion average and in which the student has failed to achieve 50%.
10. A student may apply for a deferred re-examination on a similar basis to the deferral of a final examination.

11. A student with Probationary Promotion who does not complete a prescribed re-examination will be deemed to have failed that re-examination. Upon failing a prescribed re-examination the original course grade will be retained and a comment confirming failure of the re-examination will be added to the transcript.
12. A student with Probationary Promotion who fails in the re-examination(s) or who does not qualify for the re-examination(s) must repeat the corresponding failed course(s) successfully in order to change the Probationary Promotion to **Clear Promotion**.
13. A student with Probationary Promotion from any of Academic Terms 3 to 7 who does not meet the requirements for Clear Promotion by the end of the registration period for the subsequent academic term must withdraw from the program. Permission to register for Engineering program courses to be repeated may be subject to the approval of the Head of the appropriate Department. Such students may apply for readmission to the Bachelor of Engineering program when they have satisfied the requirements for **Clear Promotion**.

7.2.3 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 academic term.

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 work term may be repeated only once, and not more than two work terms may be repeated in the entire program.
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. In addition, the Admissions Committee may design a remedial program to address the student's specific area(s) of weakness. 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 who is denied promotion from an academic term may not continue to the subsequent work term unless both the employer and the Office of Co-operative Education grant permission.
7. 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**.

7.3 Other Information

1. The appropriate Department 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 the four mandatory work terms and any elective work terms undertaken 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. A student is permitted one failure only in each of the courses required in Engineering One.
10. No course required in any of Academic Terms 3 to 8 of the program may be attempted more than twice.
11. A student may be required to withdraw from their program at any time, if, in the opinion of the Faculty, the student is unlikely to benefit from continued attendance.

8 Graduation

Upon meeting the qualifications for the program, students must apply to graduate on the prescribed "Application for Graduation" form. This form may be obtained on-line at the Memorial Self Service at www.mun.ca/regoff/stuweb.htm. The deadlines for application submission are July 15 for Fall (October) convocation, January 3 for Winter (February In-Absentia) convocation, and January 15 for Spring (May) convocation. Applications received after these dates will be processed as time and resources permit. Additional information is available from the Office of the Registrar at www.mun.ca/regoff/graduation. Information regarding Convocation, including the dates of the ceremony, is available at www.mun.ca/convocation.

9 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. Medical documentation should normally be in the form of the Student Health Certificate, available at www.mun.ca/regoff/forms.php.
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 Head of the appropriate Department.

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.

10 Appeal of Regulations

10.1 General Information

In accordance with ***UNIVERSITY REGULATIONS*** **- General Academic Regulations (Undergraduate), Appeal of Decisions**, the Appeals Committee of the Faculty of Engineering and Applied Science considers appeals of promotion, admission and readmission decisions related to undergraduate programs offered by the Faculty of Engineering and Applied Science. A student wishing to appeal related decisions should review the **General Academic Regulations (Undergraduate), Appeal of Decisions** carefully. Individual course grades may not be appealed as a student will normally have had the opportunity of contesting grades immediately after notification as outlined under ***UNIVERSITY REGULATIONS*** **- General Academic Regulations (Undergraduate), Appeal of Decisions, Route for Questioning Grades**.

All appeals must be directed to the Secretary of the Appeals Committee, c/o the Undergraduate Studies Office of the Faculty of Engineering and Applied Science. All letters of appeal must state clearly and fully the grounds for the appeal and the resolution being sought.

10.2 Appeals of Admission Decisions

An appeal of a decision concerning admission or readmission must be made in writing within fourteen days of the date of notification of the decision to the Secretary of the Appeals Committee, c/o the Undergraduate Studies Office of the Faculty of Engineering and Applied Science.

10.3 Appeals of Promotion Decisions

1. Appeals of promotion decisions must be submitted to the Secretary of the Appeals Committee, c/o the Undergraduate Studies Office of the Faculty of Engineering and Applied Science within one month of the notification by the Faculty of the promotion decision. Appeal submissions shall contain the following:
   - Student name,
   - Current address and telephone number,
   - Memorial University of Newfoundland e-mail address,
   - Student ID number,
   - A copy of the decision giving rise to the appeal,
   - A description of the matter under appeal,
   - The grounds of appeal,
   - Supporting documentation; and
   - The resolution being sought.
2. When a student has requested a re-read of an examination paper which may affect an appeal, that appeal must nevertheless be submitted within one month of the issue of the original decision and consideration of the appeal will be delayed until the result of the re-read is available.
3. A student may request additional time to gather supporting documentation. Such a request will not be unreasonably denied.
4. For assistance in the appeals process, a student is advised to consult with the Associate Dean (Undergraduate Studies) whose advice shall include the provision of a list of others within the Faculty and elsewhere in the University who can advise the student during the appeals process.
5. A student is encouraged to review ***UNIVERSITY REGULATIONS*** **- General Academic Regulations (Undergraduate) - Appeal of Decisions, Information Required in Letters of Appeal**.
6. The terms of reference for the Appeals Committee of the Faculty of Engineering and Applied Science, including procedures followed by the Committee, are posted on the Faculty website at www.mun.ca/engineering.

10.4 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 Decisions**.

11 Course Descriptions

11.1 Civil Engineering

Civil Engineering courses are identified by a four-digit numbering system, the first two digits signifying the following:

The first digit denotes the academic term during which the course is normally offered.

The second digit denotes the primary areas of study, namely:
0: Capstone courses
1: Hydrotechnical & Water Resources
2: Geotechnical courses
3: Mechanics & Structural Analysis
4: Mathematics and Science
5: Design and Civil cross-disciplinary courses
6: Environmental courses
7: Highways and Construction Materials
8: Construction
9: Special Topics

Civil Engineering courses are designated by CIV.

Non-departmental Engineering courses are designated by ENGI.

3210 Earth Sciences for Civil Engineering (same as the former ENGI 3610) is an introduction to basic concepts in geology with emphasis on applications in Civil, Geological, Mining and Environmental Engineering through the study of basic concepts and case histories. It includes the study of rocks, minerals, sediments and their physical properties in laboratory exercises.
CR: the former ENGI 3610
LH: 3

3440 Mathematics for Civil Engineering I (same as the former ENGI 3425) 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
CR: the former ENGI 3425
LC: 4
OR: tutorial 1 hour per week
PR: Mathematics 1001 and 2050

3710 Surveying and Geomatics (same as the former ENGI 3703) includes distance, elevation, and angle measurements; horizontal curves; plane survey calculations; area and volume computations; introduction to photogrammetry; global positioning (GPS) 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.
CR: the former ENGI 3703
LH: nine 3-hour sessions per semester
OR: 18 hours of field school which occurs in the first two weeks of the semester

3720 Materials for Construction (same as the former ENGI 3731) 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; wood and wood products.
CR: the former ENGI 3731
LH: nine 3-hour sessions per semester

4220 Geotechnical Engineering I (same as the former ENGI 4723) includes an introduction to soil as a three-phase material and examines physical and mechanical properties; particle size distribution; soil plasticity and 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.
CR: the former ENGI 4723
LH: 3
OR: twelve 1-hour tutorials per semester
PR: CIV 3210 or the former ENGI 3610

4310 Mechanics of Solids I (same as the former ENGI 4312) 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.
CR: Mechanical Engineering 4601, the former ENGI 4312, the former ENGI 4934
LH: four 1-hour sessions per semester
LH: up to ten 1-hour tutorials per semester
PR: ENGI 1010

4450 Mathematics for Civil Engineering II (same as the former ENGI 4425) 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, the former ENGI 4425
LC: 4
OR: tutorial 1 hour per week
PR: CIV 3440 or the former ENGI 3425

4610 Applied Environmental Science and Engineering (same as the former ENGI 4717) examines the nature and scope of environmental problems; concept of sustainable development; basic concepts of environmental quality parameters and standards; water and wastewater treatment; solid and hazardous wastes; atmospheric, water and noise, pollution, their measurements, and mitigation control.
CR: the former ENGI 4717
LH: six 3-hour sessions per semester
OR: two 3-hour tutorials per semester
PR: Chemistry 1050, CIV 3210 or the former ENGI 3610

5110 Fluid Mechanics (same as the former ENGI 5713) examines fluid properties; fluid statics; buoyancy and stability; kinematics; pressure measurement; continuity, energy and momentum principles; control volume analysis; energy and hydraulic grade lines; free jets; laminar and turbulent flow; dimensional analysis; drag on immersed bodies; flow measurement; head loss in pipes; and an introduction to flow in pipe systems.
CR: Mechanical Engineering 4501, the former ENGI 4913, the former ENGI 4961, the former ENGI 5713, the former ENGI 5961
LH: five 2-hour sessions per semester
OR: twelve 1-hour tutorials per semester
PR: CIV 4450 or the former ENGI 4425

5230 Geotechnical Engineering II (same as the former ENGI 5723) examines shear strength of soil; types of laboratory and in-situ soil shear strength tests; lateral earth pressure on retaining structures; slope stability analysis; soil bearing capacity for shallow foundations; introduction to pile foundations and limit state design in geotechnical engineering.
CR: the former ENGI 5723, the former ENGI 6723
LH: 3
OR: twelve 1-hour tutorials per semester
PR: CIV 4220 or the former ENGI 4723

5320 Mechanics of Solids II (same as the former ENGI 5312) includes a review of earlier concepts; strain transformation; failure theories; deflections of beams; energy methods; buckling of columns and the inelastic behaviour of beam cross-sections.
CR: the former ENGI 5312
LH: four 3-hour sessions per semester
OR: twelve 1 hour tutorials per semester
PR: CIV 4310 or the former ENGI 4312

5460 Applied Mathematical Analysis (same as the former ENGI 5434) 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.
CR: the former ENGI 5434
PR: CIV 4450 or the former ENGI 4425

5510 Design of Concrete Structures (same as the former ENGI 5706) begins with a review of mechanical properties of concrete. Topics include design methods and requirements, strength of reinforced concrete 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; members in compression and bending; short columns.
CR: the former ENGI 5706
LH: five 3-hour sessions per semester
OR: twelve 1-hour tutorials per semester
PR: CIV 4310 or the former ENGI 4312

6120 Hydraulics (same as the former ENGI 6713) 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.
CR: the former ENGI 6713
LH: four 3-hour sessions per semester
PR: ENGI 4102, CIV 5110 or the former ENGI 5713

6330 Structural Analysis I (same as the former ENGI 6705) examines structure classification and loads, building code provisions, the analysis of statically determinate frames, arches and cables, stability and determinacy of planar structures, shear and moment diagrams for frames, influence lines for statically determinate structures, the force method of analysing indeterminate structures, the slope deflection method, and moment distribution method.
CR: the former ENGI 6705
LH: six 3-hour sessions per semester
OR: twelve 1-hour tutorials per semester
PR: CIV 5320 or the former ENGI 5312

6470 Thermal Sciences (same as the former ENGI 6322) 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, the former ENGI 6322
PR: CIV 5320 or the former ENGI 5312

6520 Design of Concrete and Masonry Structures (same as the former ENGI 6707) examines the design of slender columns, design methods for reinforced concrete two-way slabs, two-way slabs supported on walls and stiff beams, direct design method, design of foundation systems, footing design, design of concrete retaining walls, engineered masonry, mortar

stress, analysis and design of flexural members, axial load and bending in unreinforced and reinforced walls.
CR: the former ENGI 6707
LH: 2
OR: twelve 1-hour tutorials per semester
PR: CIV 5510 or the former ENGI 5706

6810 Construction Planning Equipment and Methods (same as the former ENGI 6749) 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 6749, the former ENGI 8749
PR: ENGI 4102, completion of Academic Term 5 of the Civil Engineering program

7130 Hydrology and Water Resources (same as the former ENGI 7713) examines basic hydrometeorological processes, evapotranspiration, precipitation, intensity-duration-frequency (IDF) analysis and development, snowmelt, infiltration, runoff and streamflow; statistical treatment of hydrologic data; hydrograph analysis and synthesis; design storms and design floods; reservoir storage and flood routing; urban run-off and drainage; use of hydrologic modelling software.
CR: the former ENGI 7713
LH: four 2-hour sessions per semester
PR: CIV 5110 or the former ENGI 5713

7140 Hydrotechnical Engineering (same as the former ENGI 7716) 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. There is an introduction to water hammer and surge tanks.
CR: the former ENGI 7716
LH: four 3-hour sessions per semester
PR: CIV 6120 or the former ENGI 6713

7240 Geotechnical Engineering III (same as the former ENGI 7723) 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.
CR: the former ENGI 7723
PR: CIV 5230 or the former ENGI 5723

7340 Finite Element Structural Analysis (same as the former ENGI 7706) 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.
CR: the former ENGI 7706
LH: at least eight 2-hour sessions per semester
PR: CIV 6330 or the former ENGI 6705 or approval of the Head of the Department

7530 Design of Steel Structures (same as the former ENGI 7704) 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 including beams & beam-columns, plate girders, composite beams, introduction to serviceability through deflections of beams.
CR: the former ENGI 7704
LH: five 3-hour sessions per semester
OR: twelve 1-hour tutorials per semester
PR: CIV 5510 or the former ENGI 5706 and CIV 5320 or the former ENGI 5312, or approval of the Head of the Department

7540 Reliability and Environmental Loading on Offshore Structures (same as the former ENGI 7707) 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.
CR: the former ENGI 7707
PR: CIV 5320 or the former ENGI 5312

7620 Environmental Geotechniques (same as the former ENGI 6718, the former ENGI 7718) 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 6718, the former ENGI 7718
OR: six 1-hour tutorials per semester
PR: CIV 5230 or the former ENGI 5723

7730 Highway Engineering (same as the former ENGI 7745) examines highways transportation systems including driver, vehicle and road characteristics; geometric design of highways; subgrade and base materials; highway drainage features; design of flexible and rigid pavement; fundamentals of traffic flow and queuing theory; traffic control and analysis of signalized intersections; travel demand and traffic forecasting.
CR: the former ENGI 7745
LH: four 3-hour sessions per semester
PR: CIV 3710 or the former ENGI 3703, CIV 5230 or the former ENGI 5723

7820 Project Planning and Control (same as the former ENGI 7748) 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.
CR: the former ENGI 7748
PR: completion of Academic Term 6 of the Civil Engineering program

8000 Civil Engineering Project (same as the former ENGI 8700) 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.
CR: the former ENGI 8700
LC: scheduled as required
OR: 1 client meeting per week, 1 tutorial per week
PR: completion of Term 7 of the Civil Engineering program

8150 Municipal Engineering (same as the former ENGI 8713) 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.
CR: the former ENGI 8713
PR: CIV 7140 or the former ENGI 7716

8550 Structural Building Systems (same as the former ENGI 8705) examines geometries, loads, safety and serviceability, procedure of using the national building code for evaluating the governing loads on structural members; approximate analysis of structures; structural forms for low rise structures; design of low rise and steel buildings; lateral load-resisting elements and bracing systems.
CR: the former ENGI 8705
LH: 2
OR: 1 hour tutorial per week
PR: CIV 7530 or the former ENGI 7704

8560 Offshore Structural Design (same as the former ENGI 8708) 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.
CR: the former ENGI 8708
PR: CIV 7540 or the former ENGI 7707

8570 Coastal and Ocean Engineering (same as the former ENGI 8751) 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.
CR: the former ENGI 8751
PR: CIV 6120 or the former ENGI 6713

8580 Subsea Pipeline Engineering (same as the former ENGI 8673) 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.
CR: the former ENGI 8673
LH: 2
PR: one of CIV 5320, the former ENGI 5312, Mechanical Engineering 5602, the former ENGI 5931, Ocean and Naval Architectural Engineering 7002, the former ENGI 6003 or the former ENGI 7002

8630 Environmental Assessment, Monitoring and Control (same as the former ENGI 8717) 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.
CR: the former ENGI 8717
LH: at least ten 3-hour lab sessions per semester
PR: CIV 4610 or the former ENGI 4717

8830 Contract Law and Labour Relations (same as the former ENGI 8740) 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, the former ENGI 8740
PR: completion of Term 7 of the Civil Engineering program

8900-8999 Special Topics in Civil Engineering will have topics to be studied announced by the Department.

11.2 Complementary Studies and Interdisciplinary

In accordance with Senate's *Policy Regarding Inactive Courses*, the course descriptions for courses which have not been offered in the previous three academic years and which are not scheduled to be offered in the current academic year have been removed from the following listing. For information about any of these inactive courses, please contact the Associate Dean (Undergraduate Studies) of the Faculty.

Engineering Complementary Studies and Interdisciplinary Courses are designated by ENGI.

3101 Engineering Professionalism I examines issues associated with professional engineering practice and with functioning effectively in the workplace. Topics include communication, workplace and professional ethics, information literacy, equity, gender, diversity, and occupational health and safety (including first-aid). This is a writing-intensive course with a critically-reflective component. Current accreditation graduate attributes are introduced for further development throughout the program.
PR: Science 1807 and Science 1808

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

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.

4421 Probability and Statistics includes probability, probability distributions, probability densities, sampling distribution, hypothesis testing, regression and correlation.
CR: the former ENGI 3423, Statistics 2550, the former Statistics 2510
OR: tutorial 1 hour per week
PR: Mathematics 1001

4430 Advanced Calculus for Engineering iincludes 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

8102-8149 Special Topics in Engineering will have topics to be studied announced by the Faculty.

8150 Engineering Entrepreneurship (same as the former ENGI 8607) is an introduction to the concepts, issues, and themes related to business planning, strategy, and entrepreneurship, with an overview of the functional activities in a typical business venture. Business analysis and planning skills are developed. The course explores the business planning and strategic management issues of technology-driven enterprises in the early stages of development and focuses on the engineer as an entrepreneur.
CR: the former ENGI 8607
PR: completion of Academic Term 6

8151 Technology, Sustainable Society and International Development (same as the former ENGI 8977) examines multidisciplinary planning on technical international development projects through the conceptual frameworks of international development and project implementation theory. Emphasis is placed on analysis of the complex relationships between society, culture, economic, environmental and political factors, and technology to achieve sustainable international development objectives.
CR: the former ENGI 8977
PR: ENGI 3101

8152 Engineering Professionalism II (same as the former ENGI 7102) examines the demands upon the 21st Century engineer. Topics include the roles and responsibilities of the professional engineer in society, the Engineering Code of Ethics, sustainable development, environmental stewardship, the place of technology in society and the nature of technological decisions. Students will reflect on their entire course of studies, in the context of current accreditation graduate attributes. This is a writing-intensive course with a critically-reflective component.
CO: one of Civil Engineering 8000, Electrical and Computer Engineering 8000, Electrical and Computer Engineering 8010, Mechanical Engineering 8705, Ocean and Naval Architectural Engineering 8000, Process Engineering 8040 or one of the former ENGI 8000, 8640, 8650, 8700, 8853, 8854, or 8926
CR: the former ENGI 5101, the former ENGI 7102
PR: ENGI 004W

8154 Critical Thinking about Technology, Science and Engineering (same as the former ENGI 8104) is an introduction to the study of "science, technology and society" (STS) in the context of engineering. We examine how society, politics, culture and values affect scientific research, technological innovation, and the practice of engineering. Topics may include transhumanism, geoengineering, artificial intelligence, and emerging technologies. Issues will be examined through various lenses such as technological progressivism, feminist theories, and actor network theory. This is a research and writing-intensive course, with an emphasis on critical reflection.
CR: the former ENGI 8104

8155 Ethics in a Technological World (same as the former ENGI 8105) examines ethical issues and dilemmas that arise primarily in engineering work, but also in relationship to broader technological systems. Through case study analyses and facilitated discussion, various decision-making processes will be explored to address moral and ethical issues spanning from common workplace dilemmas, to whistleblowing, to major engineering disasters. This is a research and writing-intensive course, with an emphasis on critical reflection.
CR: the former ENGI 8105

11.3 Electrical and Computer Engineering

In accordance with Senate's *Policy Regarding Inactive Courses*, the course descriptions for courses which have not been offered in the previous three academic years and which are not scheduled to be offered in the current academic year have been removed from the following listing. For information about any of these inactive courses, please contact the Head of the Department. (or the Associate Dean (Undergraduate Studies) of the Faculty in the case of ENGI courses).

Electrical and Computer Engineering courses are identified by a four-digit numbering system, the first two digits signifying the following:

The first digit denotes the academic term during which the course is normally offered.

The second digit denotes the primary areas of study, namely:
0: Design
1: Mathematics
2: Controls
3: Circuits
4: Software
5: Digital Hardware
6: Signals & Communications
7: Electromagnetism
8: Power & Machines
9: Special Topics

Electrical and Computer Engineering courses are designated by ECE.

Non-departmental Engineering courses are designated by ENGI.

3300 Circuit Analysis (same as the former ENGI 3821) begins with a review of basic circuit analysis including dependent sources, then considers wye-delta transformation, bridge circuits, transient analysis of first- and second -order circuits, sinusoidal steady state analysis, phasor diagrams,

sinusoidal steady-state power, complex power and maximum power transfer.
CO: ENGI 3424. Students completing a **Minor in Applied Science - Electrical Engineering** may successfully complete Mathematics 2260 as the co-requisite instead of ENGI 3424.
CR: Physics 3550, the former ENGI 3821
LH: eight 3-hour sessions per semester
OR: tutorial 1 hour per week
PR: ENGI 1040, Mathematics 1001, Mathematics 2050. Students completing a **Minor in Applied Science - Electrical Engineering** may complete Physics 2055 as the prerequisite instead of ENGI 1040.

3400 Foundations of Programming (same as the former ENGI 3891) introduces fundamental concepts in object-oriented programming and develops vocational programming skills in C++. Topics include abstraction, types, contracts, object-oriented design, C++ language features including key elements of the standard library and practical programming and debugging skills.
CR: Computer Science 2510, the former ENGI 3891
LH: at least four 2-hour sessions per semester
OR: tutorial one hour per week
PR: ENGI 1020

3500 Digital Logic (same as the former ENGI 3861) 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 units (ALUs); digital system design of small systems.
CR: the former Computer Science 3723, the former ENGI 3861
LH: six 3-hour sessions per semester
OR: twelve 1-hour tutorial sessions per semester
PR: ENGI 1040. Students completing a **Minor in Applied Science - Electrical Engineering** may successfully complete Physics 2055 as the prerequisite instead of ENGI 1040.

4110 Discrete Mathematics for Computer Engineering (same as the former ENGI 4424) 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: Computer Science 1002, or the former Computer Science 2740, the former ENGI 3422, the former ENGI 4424, Mathematics 2320
OR: tutorial 1 hour per week
PR: Mathematics 2050

4300 Electronic Circuits I (same as the former ENGI 4854) 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; Miller's theorem; frequency response of discrete amplifiers; practical applications including power supplies, amplifiers and switching circuits. CAD tools are used to illustrate the analysis and design of electronic circuits.
CR: the former ENGI 4854
LH: eight 3-hour sessions per semester
OR: tutorial 1 hour per week
PR: ECE 3300 or the former ENGI 3821, Physics 3000. Students completing a **Minor in Applied Science - Electrical Engineering** may successfully complete Physics 3550 as the prerequisite instead of ECE 3300.

4400 Data Structures (same as the former ENGI 4892) examines fundamental data structures; recursive structures and generic programming techniques; modularity and reusability; time complexity and efficient data structures; procedural abstraction; data abstraction and precise documentation of data structures.
CO: ECE 4110 or the former ENGI 4424
CR: the former ENGI 4892
OR: tutorial 1 hour per week
PR: ECE 3400 or the former ENGI 3891

4500 Microprocessors (same as the former ENGI 4862) includes 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.
CR: the former ENGI 4862
LH: eight 3-hour sessions per semester
OR: nine 1-hour tutorial sessions per semester
PR: ECE 3500 or the former ENGI 3861

4600 Introduction to Systems and Signals (same as the former ENGI 4823) 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; Laplace transforms with application to filtering, communications, and controls.
CR: the former ENGI 4823
OR: tutorial 1 hour per week
PR: ECE 3300 or the former ENGI 3821, ENGI 3424. Students completing a **Minor in Applied Science - Electrical Engineering** may successfully complete Physics 3820 as a prerequisite instead of ENGI 3424 and may successfully complete Physics 3550 as a prerequisite instead of ECE 3300.

4800 Electromechanical Devices (same as the former ENGI 4841) includes an introduction to fundamental principles of energy conversion; review of single-phase AC circuits; three-phase AC circuits; magnetic fields and circuits; transformer models, performance and applications; basic concepts of rotating machines; performance and control of DC motors.
CR: the former ENGI 4841, the former ENGI 5842
LH: six 3-hour sessions per semester
OR: tutorial 1 hour per week
PR: ECE 3300 or the former ENGI 3821, ENGI 3424. Students completing a **Minor in Applied Science - Electrical Engineering** may successfully complete Physics 3820 as a prerequisite instead of ENGI 3424 and may successfully complete Physics 3550 as a prerequisite instead of ECE 3300.

5000 Electrical Engineering Design (same as the former ENGI 5800) students work, normally in pairs, on small design projects that require them to follow a hierarchical design process including general product definition, specifications and requirements, functional-block diagrams, 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 culminates in a large design project.
CO: ECE 5200 or the former ENGI 5821, ECE 5300 or the former ENGI 5854. There is no co-requisite for students completing a minor in Applied Science - Electrical Engineering.
CR: the former ENGI 5800
LC: 18 lecture hours per semester
LH: ten 3-hour sessions per semester
OR: meetings with project supervisor as required
PR: ECE 4300 or the former ENGI 4854, ECE 4500 or the former ENGI 4862, ECE 4800 or the former ENGI 4841

5010 Software Design (same as the former ENGI 5895) 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.
CR: the former ENGI 5895
LC: 25 lecture hours per semester
LH: six 3-hour sessions per semester
OR: meetings with project supervisor as required
PR: ECE 4400 or the former ENGI 4892

5100 Probability and Random Processes (same as the former ENGI 5420) includes basic concepts in probability, random variables, multiple random variables, descriptive statistics, random processes and selected applications for engineering.
CR: the former ENGI 5420
PR: ECE 4600 or the former ENGI 4823

5200 Control Systems I (same as the former ENGI 5821) includes an introduction to control systems with negative feedback; mathematical modelling and transfer functions of electromechanical systems; block diagram and signal flow graphs; controller realization; 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; digital implementations of analog compensators; and an introduction to PID controller tuning methods.
CR: the former ENGI 5821
LH: four 3-hour sessions per semester
OR: six 1-hour tutorials per semester
PR: ECE 4600 or the former ENGI 4823

5300 Electronic Circuits II (same as the former ENGI 5854) 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.
CR: the former ENGI 5854
LH: eight 3-hour sessions per semester
OR: tutorial 1 hour per week

PR: ECE 4300 or the former ENGI 4854, ECE 4600 or the former ENGI 4823

5400 Algorithms: Correctness and Complexity (same as the former ENGI 5892, the former ENGI 6892) 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); tractability and intractability of computational problems.
CR: the former ENGI 5892, the former ENGI 6892
OR: tutorial one hour per week
PR: ECE 4110 or the former ENGI 4424, ECE 4400 or the former ENGI 4892

5500 Digital Systems (same as the former ENGI 5865) 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.
CR: the former ENGI 5865
LH: ten 3-hour sessions per semester
PR: ECE 3400 or the former ENGI 3891, ECE 4500 or the former ENGI 4862

5700 Basic Electromagnetics (same as the former ENGI 5812) 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 and Ampère's law.
CR: the former ENGI 5812, Physics 3500
OR: tutorial 1 hour per week
PR: ECE 3300 or the former ENGI 3821, ENGI 4430

6200 Industrial Controls and Instrumentation (same as the former ENGI 6855) 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 6855, the former ENGI 7858
LH: at least eight 3-hour sessions per semester
PR: ECE 5200 or the former ENGI 5821

6400 Software Development Practice (same as the former ENGI 6893) introduces the student to software development processes, practices, and tools. It includes software project management using agile processes; development tools and practices; architectural level design; deployment and operations; and verification via static analysis, formal verification, and testing.
CR: the former ENGI 6893
LH: six 3-hour sessions per semester
PR: ECE 5010 or the former ENGI 5895, ECE 5400 or the former ENGI 5892

6500 Computer Architecture (same as the former ENGI 6861) 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.
CR: the former ENGI 6861
OR: tutorial 1 hour per week
PR: ECE 5500 or the former ENGI 5865

6600 Communication Principles (same as the former ENGI 6871) 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.
CR: the former ENGI 6871
LH: four 3-hour sessions per term
PR: ECE 4600 or the former ENGI 4823, ECE 5100 or the former ENGI 5420

6610 Communication Networks (same as the former ENGI 6876) is an introduction to communication networks such as the telephone and computer networks. Topics include circuit and packet switching, network protocols and layered architecture, physical layer, data link layer, network layer, error control; local area networks, and internetworking.
CR: the former ENGI 6876
PR: ECE 5100 or the former ENGI 5420

6700 Electromagnetic Fields (same as the former ENGI 6813) is a continuation of the topics started in ECE 5700, including a review of electrostatics and magnetostatics, Maxwell's equations, Lorentz force, Poynting's theorem, plane waves, and applications including two-wire transmission lines.
CR: the former ENGI 6813, Physics 4500
OR: tutorial 1 hour per week
PR: ECE 5700 or the former ENGI 5812. Students completing a **Minor in Applied Science - Electrical Engineering** may successfully complete Physics 3500 as the prerequisite instead of ECE 5700.

6800 Rotating Machines (same as the former ENGI 6843) 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; introduction to permanent magnet machines; introduction to AC motor drives.
CR: the former ENGI 6843
LH: six 3-hour sessions per semester
OR: eight 1-hour tutorial sessions per semester
PR: ECE 4800 or the former ENGI 4841

6810 Power Electronics (same as the former ENGI 6856) 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; gate and base drive circuits; design of driver and snubber circuits; thermal models and heat sink design.
CR: the former ENGI 6856, the former ENGI 7846
LH: eight 3-hour sessions per semester
OR: eight 1-hour tutorial sessions per semester
PR: ECE 5300 or the former ENGI 5854

7000 Electrical Engineering Design Project I (same as the former ENGI 7803) 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 ECE 8000.
CR: the former ENGI 7800, the former ENGI 7803
LC: at least 10 lecture hours per semester
OR: weekly meetings with project supervisor
PR: ENGI 4102, completion of Academic Term 6 of the Electrical Engineering program

7010 Computer Engineering Design Project I (same as the former ENGI 7804) 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 ECE 8010.
CR: the former ENGI 7800, the former ENGI 7804
LC: at least 10 lecture hours per semester
OR: weekly meetings with project supervisor
PR: ENGI 4102, completion of Academic Term 6 of the Computer Engineering program

7200 Control Systems II (same as the former ENGI 7825) 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, the former ENGI 7825
PR: ECE 5200 or the former ENGI 5821

7210 Process Control and Instrumentation (same as the former ENGI 8680) begins with an introduction to feedback control systems, and instrumentation. Topics include modelling thermal, gas, liquid and chemical processes; sensors and transmitters, controller design and simulation in Matlab /Simulink, industrial feedback controllers; design of feedback control loops, tuning of feedback controllers; cascade, ratio, digital controller design; feedforward control; multivariable process control; fuzzy logic control and tuning, instrumentation electronics design, and process system identification using Matlab /Simulink.
CR: the former ENGI 8680
LH: twelve 3-hour sessions per semester
PR: ECE 5200 or the former ENGI 5821

7400 Concurrent Programming (same as the former ENGI 7894) 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 7894, the former ENGI 8893
PR: ECE 5400 or the former ENGI 5892 or the former ENGI 6892, ECE 6500 or the former ENGI 6861

7410 Image Processing and Applications (same as the former ENGI 7854) presents fundamental theoretical and practical concepts of image processing and analysis. These concepts include image enhancement and filtering, frequency domain analysis, morphological image operations, image segmentation, and feature extraction. The course enables the use of these concepts to automatically process and analyze images and videos from various real-world applications such as biomedical imaging, visual surveillance, and robotics.
CR: the former Computer Science 4756, the former ENGI 7854
LH: at least four 3-hour sessions per semester

7420 Computer Security (same as the former ENGI 7864) introduces students to key computer security concepts for applications, hosts, networks and the Web. Students will learn to employ the primitives provided by programming languages, cryptography, operating systems and network protocols for protecting engineered systems and their users.
CO: ECE 7400 or the former ENGI 7894
CR: the former ENGI 7864
PR: ECE 6500 or the former ENGI 6861, ECE 6610 or the former ENGI 6876

7500 Introduction to VLSI Design (same as the former ENGI 8863) 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.
CR: the former Computer Science 4725, the former ENGI 8863
LH: nine 3-hour sessions per semester
OR: eight 1-hour tutorial sessions per semester
PR: ECE 5500 or the former ENGI 5865

7600 Introduction to Digital Signal Processing (same as the former ENGI 7824) examines sampling theory; elementary discrete-time signals; discrete-time linear and time-invariant systems; linear constant-coefficient difference equations; the convolution sum; the discrete-time Fourier series; the discrete-time Fourier transform; the z-transform; the frequency response of discrete-time systems; the discrete Fourier transform; the efficient fast Fourier transform algorithm; an introduction to digital filter design techniques; and digital signal processing applications.
CR: the former ENGI 7824
OR: tutorial 1 hour per week
PR: ECE 6600 or the former ENGI 6871

7610 Communications Electronics - inactive course.

7620 Digital Communications (same as the former ENGI 8879) 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.
CR: the former ENGI 8879
PR: ECE 6600 or the former ENGI 6871

7800 Power System Analysis (same as the former ENGI 7844) 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.
CR: the former ENGI 7844
LH: six 3-hour sessions per semester
PR: ECE 6800 or the former ENGI 6843

7810 Renewable Energy Systems (same as the former ENGI 7856) 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.
CR: the former ENGI 7856
LH: eight 3-hour sessions per semester
PR: ECE 6800 or the former ENGI 6843

8000 Electrical Engineering Design Project II (same as the former ENGI 8853) continues ECE 7000 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 ECE 7000.
CR: the former ENGI 8800, the former ENGI 8853
LC: 0
OR: weekly meetings with project supervisor
PR: ECE 7000 or the former ENGI 7803

8010 Computer Engineering Design Project II (same as the former ENGI 8854) continues ECE 7010 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 ECE 7010.
CR: the former ENGI 8800, the former ENGI 8854
LC: 0
OR: weekly meetings with project supervisor
PR: ECE 7010 or the former ENGI 7804

8210 Supervisory Control and Data Acquisition (same as the former ENGI 7680) 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.
CR: the former ENGI 7680
LH: at least four 3-hour sessions per semester
PR: ECE 5200 or the former ENGI 5821

8400 Real-time Operating Systems (same as the former ENGI 8894) 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: Computer Science 4721, the former ENGI 7863, the former ENGI 8894
LH: four 3-hour sessions per semester
PR: ECE 7400 or the former ENGI 7894

8410 Computer Vision (same as Computer Science 4301, the former ENGI 8814) studies how to develop methods that enable a machine to "understand" or analyze images. The course introduces the fundamental problems in computer vision and the state-of-the-art approaches that address them. Topics include feature detection and matching, geometric and multi-view vision, structure from X, segmentation, object tracking and visual recognition.
CR: Computer Science 4301, the former ENGI 8814
LH: six 3-hour sessions per semester
PR: Computer Science 3301 or ECE 7410 or the former ENGI 7854 or permission of the instructor

8420 Cryptography (same as the former ENGI 8868) 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.
CR: the former ENGI 8868
PR: ECE 6610 or the former ENGI 6876

8600 Design of Digital Signal Processing Systems (same as the former ENGI 8821) 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.
CR: the former ENGI 8821
PR: ECE 7600 or the former ENGI 7824

8610 Filter Synthesis (same as the former ENGI 8826) introduces analog filters. Topics include transfer functions and frequency response of filters; design of first order passive and active filters; design and analysis of filter circuits such as biquad circuit, Sallen-Key circuit, multiple feedback circuit and state variable filter; RC-CR transformation; cascade design principle; design of Butterworth, Chebyshev and elliptic filters, Bessel-Thomson filters, switched capacitor filters; and the use of Matlab for design of analog filters.
CR: the former ENGI 8826
LH: at least four 3-hour sessions per semester
PR: ECE 5300 or the former ENGI 5854

8620 Wireless and Mobile Communications (same as the former ENGI 8804, the former ENGI 8877) 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, the former ENGI 8877
PR: ECE 6600 or the former ENGI 6871, ECE 6610 or the former ENGI 6876

8700 Antennas (same as the former ENGI 7811) 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.
CR: the former ENGI 7811
LH: three 3-hour simulation and demonstration sessions per semester
OR: tutorial 1 hour per week
PR: ECE 6700 or the former ENGI 6813

8800 Power System Operation (same as the former ENGI 8845) examines symmetrical components; power system fault analysis; power system stability; and power system protection.
CR: the former ENGI 8845
LH: four 3-hour sessions per semester
PR: ECE 7800 or the former ENGI 7844

8900-8949 Special Topics in Computer Engineering will have topics to be studied announced by the Department.

8950-8999 Special Topics in Electrical Engineering will have topics to be studied announced by the Department.

11.4 Engineering One

Engineering One courses are designated by ENGI.

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).

11.5 Mechanical Engineering

Mechanical Engineering courses are identified by a four-digit numbering system, the first two digits signifying the following:

The first digit denotes the academic term during which the course is normally offered.

The second digit denotes the primary areas of study, namely:
1: Materials Science
2: Mechatronics
3: Dynamics
4: Thermal Science
5: Fluid Mechanics
6: Solid Mechanics
7: Design/Project courses
8: Other regular courses
9: Special Topics

Non-departmental Engineering courses are designated by ENGI.

Mechanical Engineering courses are designated by ME.

3101 Chemistry and Physics of Engineering Materials I (same as the former ENGI 3911) 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, the former ENGI 3911
LH: at least four 3-hour sessions per semester
OR: tutorial 1 hour per week
PR: Chemistry 1050

3102 Production Technology (same as the former ENGI 3941) 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; design for manufacture.
CR: the former ENGI 3941
LH: at least eight 3-hour sessions per semester

3301 Dynamics (same as the former ENGI 3934) 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, the former ENGI 3934
OR: tutorial 1 hour per week
PR: ENGI 1010, Mathematics 1001

3401 Thermodynamics I (same as the former ENGI 3901) 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; and an introduction to simple thermodynamic cycles.
CR: the former ENGI 3901
OR: tutorial 1 hour per week
PR: Mathematics 1001

4302 Mechanisms and Machines (same as the former ENGI 4932) includes an overview of mechanisms within machines; analytical and computer-aided methods for position, velocity, and acceleration analysis of moving mechanisms; power transmission; kinematics and kinetics of planar mechanisms; static and dynamic loads on mechanisms and an introduction to mechanism synthesis. Students will complete an analysis project.
CR: the former ENGI 3933, the former ENGI 4932
LH: two or three 2-hour computer simulation laboratory sessions per semester
OR: tutorial 1 hour per week
PR: ME 3301 or the former ENGI 3934

4402 Thermodynamics II (same as the former ENGI 4901) examines thermodynamic cycles: power and refrigeration applications; human comfort and air conditioning: mixture of gases and vapours, humidity, psychrometrics; chemically reacting mixtures and combustion; exergy analysis.
CR: the former ENGI 4901
LH: at least three 1.5-hour sessions per semester
OR: tutorial 1 hour per week
PR: ME 3401 or the former ENGI 3901

4501 Fluid Mechanics I (same as the former ENGI 4961, the former ENGI 5961) 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 4661, the former ENGI 4913, the former ENGI 4961, the former ENGI 5961
LH: five 1-hour sessions per semester
OR: tutorial 1 hour per week
PR: ME 3301 or the former ENGI 3934, ME 3401 or the former ENGI 3901

4601 Mechanics of Solids I (same as the former ENGI 4934) examines stress and strain analysis applied to bars and beams in axial, torsion and bending; beam deflection, plane stress and strain, stress and strain transformations in two dimensions and Mohr's circle.
CR: the former ENGI 4312, the former ENGI 4934
LH: at least four 1-hour sessions per semester
OR: tutorial 1 hour per week
PR: ENGI 1010

5103 Chemistry and Physics of Engineering Materials II (same as the former ENGI 5911) 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, the former ENGI 5911
LH: at least four 3-hour sessions per semester
OR: tutorial 1 hour per week
PR: ME 3101 or the former ENGI 3911

5201 Mechatronics I (same as the former ENGI 5952) involves modelling of electro-mechanical systems and introduction to basic analog and digital electronic devices. Topics covered include lumped-parameter modelling of electro-mechanical systems, basic electronic components and semiconductors, introduction to op amps, digital logic and number systems, microcontroller technology and interfacing (switches, LEDs, steppers, solenoids, A/D and D/A conversion).
CR: the former ENGI 4951, the former ENGI 5952
LH: five 3-hour sessions per semester
OR: tutorial 1 hour per week
PR: ENGI 1040, ENGI 3424

5502 Fluid Mechanics II (same as the former ENGI 5962) examines differential analysis of fluid motion; conservation of mass: continuity equation; conservation of momentum: Navier-Stokes equations; conservation of energy; basic film lubrication theory, boundary layer flows; compressible flows.
CR: the former ENGI 5913, the former ENGI 5962, the former ENGI 6661, the former ENGI 6961
LH: at least three 1-hour sessions per semester
OR: tutorial 1 hour per week
PR: ME 4501 or the former ENGI 4961 or the former ENGI 5961

5602 Mechanics of Solids II (same as the former ENGI 5931) examines stresses due to combined loads, asymmetric bending, transformation of stresses and strains, principal stresses and strains (in two and three dimensions), static failure theories, stress concentration, energy methods, method of superposition, buckling of columns, thin- and thick-walled pressure vessels and contact stresses.
CR: the former ENGI 5312, the former ENGI 5931
LH: at least four 1-hour sessions per semester
OR: tutorial 1 hour per week
PR: ME 4601 or the former ENGI 4934

6202 Control Systems I (same as the former ENGI 6951) examines modeling, analysis and design of feedback control systems using classical controller design methods. Topics covered include linear system modelling using Laplace transforms, control system stability, time domain analysis - root locus design, frequency domain analysis - bode diagram and Nyquist design, PID Control.
CR: the former ENGI 6925, the former ENGI 6951
LH: at least three 1-hour sessions per semester
OR: 1-hour tutorial per week
PR: ME 5201 or the former ENGI 5951 or the former ENGI 5952

6303 Mechanical Vibrations (same as the former ENGI 6933) examines single degree of freedom systems: free vibration, energy methods, response to harmonic excitation, response to arbitrary inputs, rotating unbalance, vibration isolation; two degree of freedom systems: natural frequencies and mode shapes, vibration absorption.
CR: the former ENGI 5932, the former ENGI 6933
LH: at least four 2-hour sessions per semester
PR: ME 3301 or the former ENGI 3934

6403 Heat Transfer I (same as the former ENGI 6901) 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; radiation: principles, properties, exchange factors, black body radiation, and enclosures, radiation shields.
CR: the former ENGI 5602, the former ENGI 6901
LH: at least one 3-hour session per semester
OR: tutorial 1 hour per week
PR: ME 4402 or the former ENGI 4901, ME 5502 or the former ENGI 5962

6701 Computer Aided Engineering Applications (same as the former ENGI 6928, the former ENGI 7928) introduces a variety of Computer Aided Engineering (CAE) applications based on advanced 3D CAD modelling. The fundamentals of 3D modelling are covered. CAE include assembly modelling, mechanism animation and finite element analysis. Applications include Computer Aided Manufacturing (CAM); model based inspection; reverse engineering; document/drawing production; data exchange; and data management. Lab exercises provide exposure to solid modelling and CAE applications using CAD/CAM/CAE tools.
CR: the former ENGI 6928, the former ENGI 7928, the former ENGI 7962
LH: at least ten 2-hour computer laboratory sessions per semester
PR: ENGI 1030, ME 3102 or the former ENGI 3941

6702 Mechanical Component Design I (same as the former ENGI 5927, the former ENGI 6929) examines adequacy assessment and synthesis of machine elements with a focus on failure prevention, safety factors, and strength; static failure and fatigue analysis of components. Topics include the design of power screws, bolted connections, welds, and shafts.
CR: the former ENGI 5926, the former ENGI 5927, the former ENGI 6929
LH: at least four 3-hour computer laboratory sessions per semester
PR: ME 5602 or the former ENGI 5931

7104 Industrial Materials (same as the former ENGI 7911) includes metals and alloy systems, strengthening mechanisms of metals, iron-carbon alloys, corrosion resistant alloys, light metals and their alloys, copper and nickel base alloys, super alloys, the function of alloying elements in metals, heat treatments, surface hardening, and surface modification.
CR: the former ENGI 6972, the former ENGI 7911
LH: at least five 3-hour laboratory sessions per semester
PR: ME 5103 or the former ENGI 5911

7105 Welding and Joining Processes (same as the former ENGI 8971) introduces modern welding and joining processes for metallic materials, polymers, and ceramics. Fundamentals of materials joining processes and the impact of the process parameters on the weld geometry, mechanical properties, and quality are discussed. Laboratory exercises will provide hands-on experience with some industrially significant welding processes.
CR: the former ENGI 8971
LH: seven 3-hour sessions per semester
PR: ME 4601 or the former ENGI 4934, ME 5103 or the former ENGI 5911

7203 Instrumentation and Experimental Design (same as the former ENGI 7930) involves analysis and design of mechanical measurement systems and multi factor experiments. Topics covered include static and dynamic characteristics of sensors, Fourier transforms, sampling theorem and signal conditioning, uncertainty analysis of sensors, sensors for motion control, load sensing and process control, one factor vs multi factor experiments, factorial design and analysis, partial factorial design and blocking, response surface methodology (RSM).
CR: the former ENGI 7930
LH: at least four 3-hour sessions per semester
OR: tutorial 1 hour per week
PR: ENGI 4421 or Statistics 2550, ME 6202 or the former ENGI 6951

7204 Robotics and Automation (same as the former ENGI 7952) 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, the former ENGI 7952
LH: at least three 3-hour sessions per semester
PR: ENGI 4430

7205 Mechatronics II (same as the former ENGI 7953) emphasizes the integration of the core technologies on which contemporary, mechatronic designs are based. Topics covered include combinational logic circuit design, sequential logic circuit design, modelling and control of servo motors, selection, sizing, and modelling of servo valves and hydraulic actuators, microcontroller technology and interfacing (relays, timers, PWM control, interrupts, digital communication).
CR: the former ENGI 5951, the former ENGI 7953
LH: five 3-hour sessions per semester
OR: tutorial 1 hour per week
PR: ME 6202 or the former ENGI 6951

7404 Heat Transfer II (same as the former ENGI 7901) examines advanced topics in heat transfer; multidimensional heat conduction: shape factors, numerical methods, moving heat sources; phase change heat transfer: melting, solidification, condensation, and boiling; natural convection: external flows, internal flows; multimode heat transfer; and environmental radiation.
CR: the former ENGI 7901
LH: at least three 2-hour computer laboratory sessions per semester
PR: ME 6403 or the former ENGI 6901

7405 Mechanical Equipment (same as the former ENGI 7903) examines performance characteristics of mechanical equipment; fluid power devices: pipes; valves; turbomachinery: pumps; fans; blowers; compressors; heat transfer devices: heat exchangers; boilers, and cooling towers.
CR: the former ENGI 7903
LH: at least four 1.5-hour sessions per semester
PR: ME 6403 or Process Engineering 5002 or the former ENGI 5602 or the former ENGI 6901

7503 Gas Dynamics (same as the former ENGI 8970) begins with an introduction to compressible gas flows, then considers fundamental laws of compressible fluid flow; wave propagation in compressible fluids; isentropic flow of a perfect gas; normal and oblique shock waves; Prandtl-Meyer flows; external compressible flows; flow in ducts, flow with friction (Fanno) and heat transfer (Rayleigh); imperfect gas effects; and measurement of compressible flows.

CR: the former ENGI 8970
PR: ME 5502 or the former ENGI 5962

7603 Finite Element Analysis (same as the former ENGI 7934) 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 1D fluid and heat transfer elements, automated analysis and modelling concepts, higher order elements, two dimensional elements - plane stress and plane strain, introduction to 3D elements, introduction to advanced topics and isoparametric formulation.
CR: the former ENGI 7934
LH: 2
OR: tutorial 1 hour per week
PR: ENGI 4430, ME 5602 or the former ENGI 5931

7703 Mechanical Component Design II (same as the former ENGI 6927, the former ENGI 7929) is a continuation of the ME 6702 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, the former ENGI 6927, the former ENGI 7929
LH: at least five 3-hour computer laboratory sessions per semester
PR: ME 6702 or the former ENGI 5927 or the former ENGI 6929

7704 Mechanical Design Project I (same as the former ENGI 7926) is the first of two capstone design courses in Mechanical Engineering. In this course mechanical students are organized into small groups or teams, which must complete a 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 semester. Each team is a small consulting firm and is required to document its object planning as well as its design.
CR: the former ENGI 7926, the former ENGI 7936
LC: minimum of 2 lecture hours per week
LH: at least three 2-hour sessions per semester
PR: ENGI 4102, completion of Term 6 of the Mechanical Engineering Program

8106 Corrosion and Corrosion Control (same as the former ENGI 8911) 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, the former ENGI 8911
LH: at least four 3-hour sessions per semester
PR: ME 5103 or Ocean and Naval Architectural Engineering 4007 or the former ENGI 4007 or the former ENGI 5911

8304 Machine Dynamics (same as the former ENGI 8937) reviews mechanism kinematics and inverse dynamics (prediction of unknown forces and torques required to create a known motion) and continues with forward dynamic analysis of mechanisms (predicting unknown motion due to applied forces and torques) using student-generated computer code and commercial software. Practical applications of dynamics are explored, such as engine shaking forces, balancing of machinery, shaft vibration, design of flywheels, and gyroscopic effects.
CR: the former ENGI 7945, the former ENGI 8937
PR: ME 4302 or the former ENGI 4932, ME 6303 or the former ENGI 6933

8305 Modelling and Simulation of Dynamic Systems (same as the former ENGI 8946) emphasizes interdisciplinary system models, equation formulation and structure, and model complexity. The bond graph modelling language will be introduced to simulate systems containing mechanical, electrical, thermal, hydraulic, and magnetic components.
CR: the former ENGI 8946
PR: ME 5201 or the former ENGI 5952, ME 6303 or the former ENGI 6933

8406 Design of Thermal Systems (same as the former ENGI 8903) examines thermal system design; modeling of thermal systems; steady and transient system simulation; single and multi-variable optimization; overall system performance; thermodynamic optimization; selected design case studies.
CR: the former ENGI 8903
PR: ME 7404 or the former ENGI 7901, ME 7405 or the former ENGI 7903

8407 Sustainable Energy Systems (same as the former ENGI 8984) examines thermo-fluid features of energy conversion and storage technologies. Topics include nuclear power, wind power, biorenewable and nonconventional fuels, fuel cells, carbon capture and sequestration, photovoltaics, solar thermal, energy storage, and hydroelectric power systems.
CR: the former ENGI 8984
PR: ME 4402 or the former ENGI 4901, ME 7404 or the former ENGI 7901

8504 Computational Fluid Dynamics (same as the former ENGI 8947) begins with a review of the equations governing viscous fluid flows and heat transfer. The course includes heat conduction, convection-diffusion, and fluid flow equations; gridding, dependent variable interpolation, discretized equations, solution of the discretized equations, transients and nonlinearities; testing and validation of CFD codes, standard test problems.
CR: the former ENGI 8947
PR: ME 5502 or the former ENGI 5962 or the former ENGI 6961, ME 7404 or the former ENGI 7901

8505 Fluid Structure Interactions (same as the former ENGI 8964) 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, the former ENGI 8964
LH: at least three 3-hour sessions per semester
PR: ME 5502 or the former ENGI 5962 or the former ENGI 6961, ME 6303 or the former ENGI 6933

8506 Advanced Fluid Dynamics (same as the former ENGI 8965) includes fluid kinematics; equations of fluid dynamics: Navier-Stokes equations, Euler's equations, Stokes' equations, vorticity transport; advanced topics in: low Reynolds flows, unsteady viscous flows, boundary layer analysis, potential flows; introduction to turbulent flow; free shear flows.
CR: the former ENGI 8965
PR: ME 5502 or the former ENGI 5962 or the former ENGI 6961

8604 Fatigue and Fracture Mechanics (same as the former ENGI 8933) is an introduction to fatigue and fracture analysis of metallic components, failure mechanisms, fracture mechanisms, effects of cracks, notches, collapse; linear elastic fracture mechanic analysis; design of components to avoid fracture; fatigue crack propagation, fracture initiation, crack arrest; and fracture toughness measurements.
CR: the former ENGI 8933
OR: tutorial 1 hour per week
PR: ME 5602 or the former ENGI 5931

8605 Pressure Component Design (same as the former ENGI 8935) includes pressure vessel design philosophy; membrane theory of shells; stress categories; discontinuous stresses; design of pressure vessel components according to ASME Boiler and pressure vessel and piping codes. There is a design project involving pressure vessel components.
CR: the former ENGI 8935
OR: at least 1 tutorial hour per week
PR: ME 5602 or the former ENGI 5931, ME 6702 or the former ENGI 6929

8606 Mechanical Behaviour of Composites (same as the former ENGI 8982) includes stress-strain behaviour of composites, properties of matrix and reinforcing materials, mechanics of fibre-reinforced composites, lamina and laminate analysis, and an introduction to manufacturing methods.
CR: the former ENGI 8982
OR: tutorial 1 hour per week
PR: ME 5602 or the former ENGI 5931

8705 Mechanical Design Project II (same as the former ENGI 8926) is the Mechanical Engineering capstone project, building on skills acquired in ME 7704. Student teams choose a unique design challenge and proceed to generate a solution. Problems are often drawn from industry and, where possible, interdisciplinary interaction is encouraged. The problem proponent will act as the “client” and the team is expected to generate a solution. Emphasis is placed on oral and written communication and technical aspects. Wherever possible, elements should be prototyped and tested.
CR: the former ENGI 8926, the former ENGI 8936
LC: scheduled as required
LH: scheduled as required
PR: ME 7704 or the former ENGI 7926

8801 Production & Operations Management (same as the former ENGI 8945) 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, the former ENGI 8945
PR: ME 6403 or the former ENGI 6901

8900-8999 Special Topics in Mechanical Engineering will have topics to be studied announced by the Department.

11.6 Ocean and Naval Architectural Engineering

Ocean and Naval Architectural Engineering courses are identified by a four-digit numbering system, the first two digits signifying the following:

The first digit denotes the academic term during which the course is normally offered.

AR = Attendance requirement; CH = Credit hours are 3 unless otherwise noted; CO = Co-requisite(s); CR = Credit can be retained for only one course from the set(s) consisting of the course being described and the course(s) listed; LC = Lecture hours per week are 3 unless otherwise noted; LH = Laboratory hours per week; OR = Other requirements of the course such as tutorials, practical sessions, or seminars; PR = Prerequisite(s); UL = Usage limitation(s).

The second digit denotes the primary areas of study, namely:
0: Regular courses
9: Special Topics courses

Non-departmental Engineering courses are designated by ENGI.

Ocean and Naval Architectural Engineering courses are designated by ONAE.

3001 Ocean/Naval Design (same as the former ENGI 3001) introduces design and operation for ships and marine structures. Technology evolution in ship and offshore structures is reviewed, emphasizing service needs. Structural concepts, materials and construction methods are examined, including design for manufacturing. The design spiral and trade-offs between design characteristics are explored and modelling methods as tools in the design process are introduced. There is a minimum of six laboratory sessions including ship tours, a design project or research paper.
CR: the former ENGI 3001
LH: at least six 3-hour sessions per semester

3054 Ocean Engineering Hydrostatics (same as the former ENGI 3054) 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.
CR: the former ENGI 3054
LH: at least nine 3-hour sessions per semester
PR: ENGI 1010

4007 Marine Materials (same as the former ENGI 4007) examines the properties and uses of steel, aluminum and composite materials in marine applications. Topics include: review of mechanics of materials, Hooke's Law, material failure models; carbon steel - fundamentals, processes, preparation, design, drawings, certification; joining of aluminum; riveting and welding; corrosion phenomena; composites - classification, production, and mechanical properties.
CR: the former ENGI 4007, the former ENGI 7007
LH: at least 4 three-hour sessions per semester
PR: Chemistry 1050

4011 Resistance and Propulsion (same as the former ENGI 4011) examines ship resistance and some factors considered in the design of marine screw propellers. Topics include the resistance due to friction, wave making, form appendage, wind and waves, squat, blockage, shallow water effects, and the estimation of powering using methodical series and statistical methods. Topics considered in the design of marine screw propellers 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 4011, the former ENGI 5011
LH: 3
OR: tutorial 1 hour per week
PR: ONAE 3054 or the former ENGI 3054

4020 Marine Fluid Dynamics (same as the former ENGI 4020) 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 vs. internal flow; dimensional analysis and scaling; fluid-structure interaction concepts; potential flow theory, lift and Kutta-Joukowski theorem; viscous flow, boundary layers and drag.
CR: the former ENGI 4020
LH: at least four 3-hour sessions per semester
OR: tutorial 1 hour per week
PR: ONAE 3054 or the former ENGI 3054

5020 Marine Propulsion (same as the former ENGI 5020) is a second course in marine propellers and ship powering. Design and analysis of marine screw propellers and other propulsion devices are covered. Conventional and unconventional propulsion systems are introduced. Methods and philosophy of propeller design are included. Design of fixed-pitch propellers based on lifting line theory and the design of ducted propellers are emphasized. Design of other propulsion systems such as waterjets and sails is also incorporated.
CR: the former ENGI 5020, the former ENGI 6020
LH: at least two 3-hour sessions per semester
PR: ONAE 4020 or the former ENGI 4020

5022 Probability and Random Processes in Ocean Engineering (same as the former ENGI 5022) 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. A probabilistic approach to ship damage, representation of ocean waves (in time and frequency domains), Response Amplitude Operators (RAO), and acceptable levels of risk for design are introduced and applied.
CR: the former ENGI 5022
OR: tutorial one hour per week
PR: ONAE 4020 or the former ENGI 4020, Mathematics 2260 or the former Mathematics 3260

5034 Marine Vibrations (same as the former ENGI 5034) provides an introduction to mechanical vibration with a focus on vibration of marine machinery and on the dynamic response of marine structures. Topics include: single degree of freedom systems – free vibration, energy methods, response to harmonic excitation, response to arbitrary inputs; multi degree of freedom systems – natural frequencies and mode shapes, response to harmonic excitation; frequency response functions; on-board sources of vibration, vibration measurement techniques and instrumentation.
CR: the former ENGI 5034, the former ENGI 5932, the former ENGI 6933, Mechanical Engineering 6303
LH: at least four 2-hour sessions per semester
PR: Mechanical Engineering 3301 or the former ENGI 3934

6002 Ship Structures I (same as the former ENGI 6002) 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. Laboratory sessions cover use of analysis software to illustrate structural behaviour concepts.
CR: the former ENGI 5003, the former ENGI 6002
LH: at least five 3-hour sessions per semester
PR: Civil Engineering 4310 or the former ENGI 4312

6005 Floating Ocean Structures Design (same as the former ENGI 6005) 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 6005, the former ENGI 7005
LH: 1
PR: ONAE 3054 or the former ENGI 3054

6036 Dynamics of Ocean Vehicles (same as the former ENGI 6036) examines applications of the linearized equations of motion to ocean vehicle problems with single and multiple degrees of freedom in waves; dynamics of marine vehicles: motions in waves; hydrodynamics effects such as added mass, radiation and viscous damping; strip theory; irregular seaway and motions.
CR: the former ENGI 6030, the former ENGI 6036, the former ENGI 7035
LH: at least two 3-hour sessions per semester
OR: 1 tutorial hour per week
PR: ONAE 3054 or the former ENGI 3054, ONAE 4020 or the former ENGI 4020

6046 Marine Engineering Systems (same as the former ENGI 6046, the former ENGI 7045) 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
CR: the former ENGI 6046, the former ENGI 7045
LC: 4
LH: 1
PR: Mechanical Engineering 3401 or the former ENGI 3901, ONAE 5034 or the former ENGI 5034

6055 Marine Cybernetics (same as the former ENGI 6055) 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.
CR: the former ENGI 6055
LH: at least four 2-hour sessions per semester
PR: ONAE 4011 or the former ENGI 4011

7000 Ocean Systems Design (same as the former ENGI 7000) develops concept design methods for marine systems from need definition through to solution selection, including weight, cost and power requirements estimating, selection of principal design characteristics and evaluation of alternative solutions. Students develop a proposal for a marine system design project which will include a statement of requirements, a parametric study, a work plan and schedule. This design project will be completed as a full design in ONAE 8000.
CR: the former ENGI 7000, the former ENGI 7052
LH: 3

PR: ONAE 3001 or the former ENGI 3001, ONAE 3054 or the former ENGI 3054, ENGI 4102

7002 Ship Structures II (same as the former ENGI 7002) 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. Laboratory exercises include structural analysis software and physical experiments.
CR: the former ENGI 6003, the former ENGI 7002
LH: at least five 3-hour sessions per semester
PR: ONAE 6002 or the former ENGI 6002

7003 Small Craft Design (same as the former ENGI 7003, the former ENGI 8003) presents fundamentals of naval architecture and design methodology for small craft. Emphasis is on recreational craft, with special emphasis on sailing vessels. Construction materials, scantlings, performance prediction and seaworthiness are covered. Design problems unique to small craft such as mast design, sail area determination and performance prediction are covered. Students will do a small craft design of their choice. Small weekly design studies will be required.
CR: the former ENGI 7003, the former ENGI 8003
PR: ONAE 6036 or the former ENGI 6036 or the former ENGI 7035

7033 Marine Hydrodynamics (same as the former ENGI 7033) 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.
CR: the former ENGI 7033
LH: at least one 3-hour session per semester
OR: one tutorial hour per week
PR: ONAE 4020 or the former ENGI 4020

7036 Manoeuvring of Ocean Vehicles (same as the former ENGI 7036) examines manoeuvrability of ocean vehicles; derivation of linear and nonlinear equations of motion and hydrodynamic coefficients; stability of motion; standard maneuvers such as turning circle, turning spiral, and PMM test; modelling and simulations of engine, propulsion, rudder and transmission systems during manoeuvring; systems for course keeping, autopilot, motion control and dynamic positioning.
CR: the former ENGI 6030, the former ENGI 7035, the former ENGI 7036
LH: at least two 3-hour sessions per semester
OR: 1 tutorial hour per week
PR: ONAE 6036 or the former ENGI 6036

7046 Marine Economics and Ship Construction (same as the former ENGI 7046) examines the macro-economics of the marine transportation industry and identifies and examines the stages of project definition. The basic techniques of project management needed for large scale industrial marine projects, such as ship construction and transportation of natural resources, are introduced. This course examines methods for estimating labour hours, materials, fabrication facilities required and schedule for ship construction. The legal and social aspects of large projects are also examined.
CR: the former ENGI 7046
PR: ENGI 4102

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

8034 Applied Acoustics (same as the former ENGI 8034) provides an introduction to acoustic engineering. Topics include: sound in fluids and solids, wave phenomena, mathematical models of sound waves, sources of sound, frequency analysis, levels and decibels, introduction to psychoacoustics, sound waves in rooms, reverberation time, sound absorbers, sound insulation, room acoustical design, introduction to underwater acoustics, acoustic measurement techniques and instrumentation.
CR: the former ENGI 8034
LH: at least four 3-hour sessions per semester
PR: ONAE 5034 or the former ENGI 5034

8046 Marine Engineering II (same as the former ENGI 8046) builds on the fundamental marine engineering aspects covered in ONAE 6046 to include engineering factors onboard the ship, such as electrical generation, lighting, heating and air conditioning, as well as special systems needed on board the ship for operation, cargo management and navigation.
CR: the former ENGI 8046
PR: ONAE 6046 or the former ENGI 6046

8054 Advanced Marine Vehicles (same as the former ENGI 8054) 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.
CR: the former ENGI 8054
LH: at least 9 hours per semester
PR: ONAE 6002 or the former ENGI 5003 or the former ENGI 6002

8055 Design and Control of Unmanned Marine Vehicles (same as the former ENGI 8055) examines the formulation of mission statement and design constraints of unmanned marine vehicles, surface and underwater. Major subsystems, including propulsion, power, communication, navigation and control, are introduced. Principles of navigation and control as they pertain to unmanned systems are examined. This course includes hands on experimentation including the design of a small unmanned platform for tank experiments.
CR: the former ENGI 8055
LH: at least 12 hours per semester
PR: ONAE 3054 or the former ENGI 3054

8074 Arctic Ocean Engineering (same as the former ENGI 8074, the former ENGI 8674) examines marine ice load on ships and marine 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 8074, the former ENGI 8674
LH: at least four 3-hour sessions per semester
PR: Civil Engineering 4310 or the former ENGI 4312, Mechanical Engineering 3301 or the former ENGI 3934

8075 Finite Element Analysis of Marine Structures (same as the former ENGI 8075) examines application of the finite element method (FEM) to the design and assessment of marine hull structures. Simulation of static, quasi-static, and impact loads on hull structures is discussed. Linear and nonlinear analyses are explored. Practical considerations for finite element model design are discussed.
CR: the former ENGI 8075
LH: 12 weekly 3-hour lab sessions
PR: ONAE 4007 or the former ENGI 4007, ONAE 7002 or the former ENGI 7002

8900-8999 Special Topics in Ocean and Naval Architectural Engineering will have topics to be studied announced by the Department.

11.7 Process Engineering

In accordance with Senate's *Policy Regarding Inactive Courses*, the course descriptions for courses which have not been offered in the previous three academic years and which are not scheduled to be offered in the current academic year have been removed from the following listing. For information about any of these inactive courses, please contact the Head of the Department. (or the Associate Dean (Undergraduate Studies) of the Faculty in the case of ENGI courses).

Process Engineering courses are identified by a four-digit numbering system, the first two digits signifying the following:

The first digit denotes the academic term during which the course is normally offered.

The second digit denotes the primary areas of study, namely:

0: Process Engineering courses common to both technical streams
1: Process Stream
2: Petroleum Stream
9: Special Topics

Non-departmental Engineering courses are designated by ENGI.

Process Engineering courses are designated by PROC.

3000 Introduction to Process Engineering (same as the former ENGI 3600) familiarizes students with the principles and the practical aspects of organic, inorganic, and biochemical processes including the major unit operations and equipment used. It emphasizes process flow sheeting, process variable identification, component and overall material balances, and process design. The course uses extensive examples from industrial processes. In laboratory sessions students are introduced to the laboratory scale process equipment and use HYSYS software to study process characteristics.
CO: Chemistry 1051
CR: the former ENGI 3600
LH: at least five 2-hour sessions per semester

4002 Process Engineering Thermodynamics (same as the former ENGI 4602) extends the study started in Mechanical Engineering 3401 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: the former Chemistry 2300, the former Chemistry 3300, the former ENGI 4602
PR: Mechanical Engineering 3401 or the former ENGI 3901

4021 Process Mathematical Methods (same as the former ENGI 4621) introduces numerical methods in chemical engineering processes, solution of sets of linear algebraic equations, solution of non-linear equations, curve fitting and interpolation, numerical integration, numerical differentiation, first order and higher order ordinary differential equations, boundary value problems and partial differential equations. It provides applications of the methods to different aspects of process engineering such as reactor design, separation, process modeling, equipment design and analysis.

CO: PROC 4025 or the former ENGI 4625
CR: the former ENGI 4621
LH: eight 2.5-hour sessions per semester
PR: ENGI 3424 (or Mathematics 2000, Mathematics 2050, and Mathematics 2260)

4025 Process Engineering Calculations (same as the former ENGI 4625) 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: PROC 4002 or the former ENGI 4602. There is no co-requisite for students completing a minor in Applied Science - Process Engineering.
CR: the former ENGI 4625
PR: Mechanical Engineering 3401 or the former ENGI 3901. Students completing a minor in Applied Science - Process Engineering must successfully complete Chemistry 2301 as the prerequisite instead of Mechanical Engineering 3401.

4061 Process Fluid Dynamics I (same as the former ENGI 4661) provides process engineering students with fundamentals of fluid mechanics/ dynamics. Topics covered include fluid properties; Newtonian and non-Newtonian fluids; pressure; hydrostatics; control volume and system representation; mass and momentum conservation laws; Euler and Bernoulli equations; viscous fluid flows; laminar and turbulent flow; flow through conduits and pipes; pipe networks; flow measurement devices; momentum devices; concept of boundary layers; dimensional analysis; lift and drag on objects; fluid transportation (pumps and compressors).

CR: the former ENGI 4661, the former ENGI 4913, the former ENGI 4961, the former ENGI 5961
LH: five 1-hour sessions per semester

5001 Mass Transfer (same as the former ENGI 5601) covers diffusive as well as convective mass transfer, mass transfer correlations, and the application to absorption and membrane separations.

CR: the former ENGI 5601
LH: at least seven 2-hour sessions per semester
PR: PROC 4002 or the former ENGI 4602 (or Chemistry 2301)

5002 Process Heat Transfer (same as the former ENGI 5602) is a study of concepts involved in heat transfer. Topics include applications of continuity and energy equations, fundamentals of heat transfer, modes of heat transfer, conduction, convection and radiation heat transfer, boiling and condensation, evaporation, and heat exchanger analysis and design.

CR: the former ENGI 5602, the former ENGI 6901
LH: one 3-hour session per semester
PR: PROC 4002 or the former ENGI 4602, PROC 4061 or the former ENGI 4661 or Mechanical Engineering 4501 or the former ENGI 4961 or the former ENGI 5961

5071 Process Equipment Design I (same as the former ENGI 5671) 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: PROC 5001 or the former ENGI 5601
CR: the former ENGI 5671
LH: at least six 3-hour sessions per semester
PR: PROC 4021 or the former ENGI 4621, PROC 4025 or the former ENGI 4625

6021 Process Modelling and Analysis (same as the former ENGI 5621, the former ENGI 6621) is designed to introduce the concepts of process model building and its application in design and process operations. 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 also introduces model linearization, degrees of freedom analysis, stability, stiffness, observability, and controllability.

CR: the former ENGI 5621, the former ENGI 6621
LH: five 3-hour sessions per semester
PR: PROC 4021 or the former ENGI 4621, PROC 4025 or the former ENGI 4625

6031 Chemical Reaction Engineering (same as the former ENGI 6631) 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 an overview of non-ideal reactors and an introduction to bio reactors.

CR: the former ENGI 6631
LH: four 2-hour sessions per semester
PR: PROC 4021 or the former ENGI 4621, PROC 4061 or the former ENGI 4661 or Mechanical Engineering 4501 or the former ENGI 4961 or the former ENGI 5961

6061 Process Fluid Dynamics II (same as the former ENGI 6661) builds upon the materials introduced in Process Fluid Dynamics I. The course covers important aspects of fluid dynamics principles and applications in process engineering, including; continuity equation; differential governing equations of fluid momentum; conservation laws in chemical/process engineering; ideal and non-ideal flow; compressible and incompressible flow; boundary layer theory for laminar and turbulent flow; multiphase flow; introduction to CFD; turbomachinery; fluid flow features of unit operations.

CR: the former ENGI 5913, the former ENGI 5962, the former ENGI 6661, the former ENGI 6961
LH: three 1-hour sessions per semester
PR: PROC 4061 or the former ENGI 4661 or Mechanical Engineering 4501 or the former ENGI 4961 or the former ENGI 5961

6071 Process Equipment Design II (same as the former ENGI 6671) 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. This course will use HYSIS and other process equipment design tools.

CR: the former ENGI 6671
LH: at least four 2-hour sessions per semester
PR: PROC 5001 or the former ENGI 5601, PROC 5071 or the former ENGI 5671

6151 Sustainable Engineering in Processing Industries (same as the former ENGI 6651) 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.

CR: the former ENGI 6651
PR: PROC 4025 or the former ENGI 4625, PROC 5001 or the former ENGI 5601

6202 Offshore Petroleum Geology and Technology (same as the former ENGI 6602) introduces basic concepts in geology and geophysics, 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 the offshore oil and gas industry in harsh environment, platforms and structures, exploration phase of offshore oil development, production drilling and completion, and oil and gas transportation system

CR: the former ENGI 6602
PR: completion of Academic Term 5

7021 Process Dynamics and Control (same as the former ENGI 7621) 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.

CR: the former ENGI 7621
LH: at least six 2-hour sessions per semester
PR: PROC 6021 or the former ENGI 6621 or the former ENGI 5621

7040 Process Engineering Project I (same as the former ENGI 7640) gives students the opportunity to apply the knowledge gained in previous design and technical courses to complete a high-level design of a process plant or major modification to a process plant. The goal is to expose students to process design, practical design issues, and to provide experience in the complete design process as applied to real devices. Students will work in groups to design a process system. This course is a precursor to PROC 8040.

CR: the former ENGI 7640
LC: scheduled as required
PR: ENGI 4102, completion of academic term 6 of the Process

Engineering program

7077 Process Plant Design and Economics (same as the former ENGI 8677) 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.
CR: the former ENGI 8677
PR: PROC 6071 or the former ENGI 6671

7123 Process Simulation (same as the former ENGI 7623) 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.
CR: the former ENGI 7623
LH: at least nine 2-hour sessions per semester
PR: PROC 6021 or the former ENGI 5621 or the former ENGI 6621, PROC 6071 or the former ENGI 6671

7171 Safety and Risk Engineering (same as the former ENGI 8671) 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.
CR: the former ENGI 8671
PR: completion of Academic Term 6 or registration in the Minor in Applied Science - Process Engineering

7291 Petroleum Production Engineering (same as the former ENGI 8691) examines the procedures and equipment necessary for preparing a well to produce hydrocarbons, 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; artificial lift.
CR: the former ENGI 8691
PR: completion of Academic Term 6

7292 Drilling Engineering (same as the former ENGI 8692) 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.
CR: the former ENGI 8692
LH: 2
PR: completion of Academic Term 6

8040 Process Engineering Project II (same as the former ENGI 8640) 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.
CR: the former ENGI 8640
LC: scheduled as required
PR: PROC 7040 or the former ENGI 7640

8151 Industrial Pollution Prevention and Control (same as the former ENGI 7651) 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.
CR: the former ENGI 7651
PR: PROC 6151 or the former ENGI 6651, PROC 6071 or the former ENGI 6671

8191 Mining and Metallurgical Process Engineering (same as the former ENGI 7691) 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.
CR: the former ENGI 7691
LH: at least four 2-hour sessions per semester
PR: completion of academic term 6 of the Process Engineering program

8270 Reliability Engineering (same as the former ENGI 8670) 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.
CR: the former ENGI 8670
PR: completion of Academic Term 6

8276 Natural Gas Engineering (same as the former ENGI 8676) 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.
CR: the former ENGI 8676
PR: completion of Academic Term 6

8290 Reservoir Engineering (same as the former ENGI 8690) 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.
CR: the former ENGI 8690
PR: completion of Academic Term 6

8293 Petroleum Facilities Engineering - inactive course.

8294 Downstream Processing (same as the former ENGI 8694) 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.
CR: the former ENGI 8694
PR: completion of Academic Term 6

8296 Petroleum Refining Engineering (same as the former ENGI 8696) covers 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.
CR: the former ENGI 8696
PR: completion of academic term 6 of the Process Engineering program

8900-8999 Special Topics in Process Engineering will have topics to be studied announced by the Department.

11.8 Work Terms and Non-Credit

Engineering work terms and non-credit courses are designated by ENGI.

001W Engineering Work Term 1 provides opportunity for an introductory experience in an engineering 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. They are expected to learn the basics of technical writing and to become familiar with the various communications tools used in an engineering work environment.
CH: 0
LC: 0
PR: ENGI 200W

002W Engineering Work Term 2 requires students, under supervision, to contribute positively to the engineering and problem solving processes practised in the work environment. They are expected to set objectives, take direction, work independently as required, learn professional behaviours, and function as effective team members. An ability to investigate work-related concepts should be demonstrated. Students should become better familiarized with the use of engineering tools, data analysis, prioritization of assignments, and effective communication of technical information.
CH: 0
LC: 0
PR: ENGI 001W, ENGI 3101

003W Engineering Work Term 3 requires greater participation in the students' engineering discipline. They become more experienced and proficient in problem solving and use of appropriate design processes. They should demonstrate speed and accuracy in their work, accept greater responsibility and be able to function with less direct supervision. Good judgement, increased initiative and improved analytical skills are expected to develop at this stage. Students should better appreciate the attitudes, responsibilities, and ethics expected of engineers.
CH: 0
LC: 0
PR: ENGI 002W

004W Engineering Work Term 4 requires students to engage in complex facets of engineering. Participation in their selected engineering discipline is expected. Students should be able to contribute independently to design and/or problem solving processes, understand their responsibility to society and the environment, understand project management strategies, think critically, and use engineering tools appropriately. The level of responsibility should reflect their academic background and experience. Good teamwork skills are expected and leadership skills may be developed.

AR = Attendance requirement; CH = Credit hours are 3 unless otherwise noted; CO = Co-requisite(s); CR = Credit can be retained for only one course from the set(s) consisting of the course being described and the course(s) listed; LC = Lecture hours per week are 3 unless otherwise noted; LH = Laboratory hours per week; OR = Other requirements of the course such as tutorials, practical sessions, or seminars; PR = Prerequisite(s); UL = Usage limitation(s).

CH: 0
LC: 0
PR: ENGI 003W

005W Engineering Work Term 5 requires students to continue to engage in advanced facets of engineering. Participation in their selected engineering discipline is expected. Students should apply skills independently in engineering analysis, contribute to a safe work environment, and utilize engineering tools while understanding their limitations. They will contribute significantly to design and/or problem solving processes, and demonstrate project management and leadership abilities. The level of responsibility should be commensurate with their academic background and experience.
CH: 0
LC: 0
PR: ENGI 004W

006W Engineering Work Term 6 requires students to further engage in various advanced facets of engineering. Participation in their selected engineering discipline is expected. Students should gain further appreciation of the use and importance of acquired analytical skills in engineering analysis, and significantly contribute to design and/or problem solving processes. The level of responsibility should be commensurate with their academic background and experience. Work scope should be mostly independent, with longer timelines, and with the possibility of leadership opportunities.
CH: 0
LC: 0
PR: ENGI 005W

200W Work Term Preparation and Professional Development introduces the Co-operative Education process and professional development, and prepares the student for work terms. This course is designed to assist students to apply for, interview and obtain the first work term, as well as to be prepared for a professional work environment. It is a one semester course offered during the Fall and Winter semesters of Engineering One, prior to a student's first work term competition. This course is graded PAS or FAL.
AR: attendance is required
CH: 0
LC: as scheduled