Minor Program Adjustment

Faculty: Energy Systems and Nuclear Science	**Date**: December 10, 2018
Program: Bachelor of Technology in Sustainable Energy Systems	
Undergraduate: ☒	**Graduate**: ☐

Minor Program Adjustments include: New required courses, Deletion of required courses, Other changes to degree requirements or program learning outcomes, New academic requirements or changes to existing requirements.

Proposal Brief

Summary of the proposed change (for pathways, please include details on the specific or unspecified transfer credits students will receive, if applicable)

This program adjustment primarily addresses comments made by other UOIT Faculties during the approval process for the Faculty of Energy Systems and Nuclear Science (FESNS) Bachelor of Technology in Sustainable Energy Systems (BTech SES). This includes the in/exclusion of specific courses, both core and elective. Specifically:

- Six (6) new courses are created, to replace existing **core** ENGR and NUCL courses. Minor changes have been made to improve applicability to the BTech program. This addresses concerns raised about potential impacts on CEAB accreditation of having non-engineering students take courses with engineering students.
- One (1) **core** COMM course is replaced with another COMM course that better suits the needs of our students and aligns with the practices of the Faculty of Social Science and Humanities (FSSH).
- One (1) **core** ENSY course is replaced with a new CHEM course developed specifically for the BTech SES program by the Faculty of Science (FS).
- Adjustments are made to the set of COMM **electives** available to BTech students, to better suit their needs and align with the practices of FSSH.
- Adjustments are made to the set of POSC **electives** available to BTech students, to better suit their needs.

Adjustments are made to the Bridge program, to address a missing pre-requisite course. One **elective** is removed, and a **core** course is added.

Finally, two courses (one **core** (ENSY 2210U), one **elective** (ENSY 4400U)) are modified to better align their content and learning outcomes with the program learning outcomes.

Description of the ways in which the proposed change will enhance the program and/or opportunities for students

Through additional consultation with members of the FSSH, we have identified courses that better suit the needs of our students, and better align with the course offerings of FSSH. Overall program learning outcomes are unchanged, but the revised course list will facilitate their achievement.

Replacing ENSY 1110U with CHEM 1110U has no impact on program learning outcomes, but will allow students additional access to experts in the FS and the use of existing chemistry laboratories.

The correction of the missing pre-requisite allows Bridge students to be successful in the program.

The modification of ENSY 2210U and ENSY 4400U provides a stronger learning experience in the area of electrical and power systems.

Process of consultation with other units if the change(s) involves students, staff, and/or faculty from other programs or courses

With a number of exceptions (as above), these changes have arisen from comments received from FS, FSSH and the Faculty of Engineering and Applied Science (FEAS) during the original development and approval process of the BTech SES. Following those initial comments, discussions were held with faculty members in the FSSH regarding Communications and Political Science, specifically, and with the FS. FESNS also consulted with FEAS.

Does this change include any indigenous content? ☐ **Yes** ☒ **No**
If yes, please ensure the consultation above includes the Indigenous Education Advisory Circle

Analysis of financial and enrolment implications

With the creation of six (6) new courses there will be staffing implications: Instructors will be required for these courses. Teaching assistant hours and laboratory costs are unaffected. With the switch from ENSY 1110U to CHEM 1110U, FESNS avoids the cost of an instructor, teaching assistant hours and laboratory costs.

There are no enrolment implications.

Proposed Implementation Date (state term, e.g. Fall 2017)

Fall 2019

Transition Plan (include a plan for all current students in the program, by year level) (If this change impacts students that are not new and/or 1st year students as of the start date, then a transition plan is required)

None. These changes are being made before students are enrolled in the program.

Calendar Copy and/or Program Maps (highlight revisions to existing curriculum)

As the program is not currently in the Calendar, no modifications to calendar copy.

Attachments
Updated program map; modifications highlighted in yellow.
New course proposals: ESNS 2140U, ESNS 3200U, ESNS 3380U, ESNS 3750U, ESNS 3740U, ESNS 4660U
Course change forms: ENSY 2210U, ENSY 4400U
CHEM 1110U course outline and new course proposal, as approved by FS

APPROVAL DATES

Curriculum Committee approval	December 13, 2018
Faculty Council approval	December 20, 2018
CPRC Approval	
Submission to Academic Council	

Bachelor of Technology in Sustainable Energy Systems

Faculty of Energy Systems and Nuclear Science
University of Ontario Institute of Technology

Program details and degree requirements – BTech (Hons)

Year 1

Semester 1

- MATH 1000U – Introductory Calculus
- PHY 1010U – Physics I
- ENSY 1000U – Introduction to Energy Systems
- COMM 1050U – Technical Communications
- ESNS 3200U – Technical Graphics and Design

Semester 2

- MATH 1020U – Calculus II
- MATH 2050U – Linear Algebra
- CHEM 1110U – Chemical Fundamentals
- ENVS 1000U – Environmental Science
- CSCI 1040U – Introduction to Programming for Scientists

Year 2

Semester 1

- ENSY 2210U – Electric Circuits for Energy Systems
- ENSY 2220U – Fluid Mechanics for Energy Systems
- ESNS 2140U – Problem Solving, Modelling and Simulation
- PHY 2050U – Thermodynamics and Heat Transfer
- BUSI 1700U – Introduction to Entrepreneurship

Semester 2

- ENSY 2330U – Mechanical Equipment and Systems
- ENSY 2410U – Low Carbon Technologies
- STAT 2800U – Statistics and Probability for Engineers
- ESNS 3380U – Strength of Materials
- SSCI 1470U – Impact of Science and Technology on Society

Year 3

Semester 1

- ESNS 3750U – Integrated Energy Laboratory
- ESNS 3740U – Scientific Instrumentation
- BUSI 2200U – Marketing Management
- *Choice of* Technology Course

Technologies Specialization

- *Choice of* Technology Course

Programs & Policies Specialization

- *Choice of* Program & Policy Course

Semester 2

- ENSY 3600U – Sustainable Energy Thesis Project I
- BUSI 2050U – Managerial Economics
- COMM 3350U – Environmental Communication
- *Choice of* Technology Course

Technologies Specialization

- *Choice of* Technology Course

Programs & Policies Specialization

- *Choice of* Program & Policy Course

Year 4

Semester 1

- ESNS 4660U – Risk Analysis Methods
- BUSI 3930U – Leadership, Negotiation and Teamwork
- *Choice of* Technology Course
- *Choice of* Program & Policy Course
- *Choice of* Program & Policy Course or Complementary Studies Elective

Semester 2

- ENSY 4610U – Community and Urban Design
- ENSY 4600U – Sustainable Energy Thesis Project II
- ENSY 4700U – Energy Policy, Standards and Safety
- *Choice of* Program & Policy Course or Complementary Studies Elective

Technologies Specialization

- *Choice of* Technology Course or Technical Elective

Programs & Policies Specialization

- *Choice of* Program & Policy Course

Technology Courses

- ENSY 3730U Solar Energy Technologies
- ENSY 3830U Wind Energy Systems
- ENSY 3840U Fuel Cell and Hydrogen Systems
- ENSY 4300U Environmental Protection Systems
- ENSY 4400U Electric Power Systems
- ENSY 4500U Geo-engineered systems
- ENSY 4530U Hydroelectric Power
- ENSY 4620U Smart Grids
- NUCL 4460U Nuclear Power Systems

Technical Electives

- GEOG-ERSC 2401T Environmental Geology
- GEOG 2460T The Global Climate System
- ENSY 4800U Energy Systems Analysis

Program & Policy Courses

- BUSI 1600U Management of the Enterprise
- BUSI 2550U Introduction to Project Management
- BUSI 2700U Entrepreneurial Finance
- BUSI 3730U Creative Problem Solving, Entrepreneurship & Imagination
- BUSI 3750U Lean Start-up
- COMM 2310U Advanced Professional Writing & Editing
- COMM 3310U Communications, Communities and Social Change

- ~~COMM 4510U Public Relations~~
- LGLS 3520U Law and Technology
- LGLS 4040U Law and Environment
- NUCL 5600G Future Role of Nuclear Energy
- POSC 1000U Introduction to Political Science
- POSC 2000U Canadian Politics
- POSC 2100U Global Politics
- ~~POSC 2200U Fundamentals of Policy Theory~~
- POSC 3300U Building Sustainable Communities

Complementary Studies Electives

- ANTH 1002T Applied Anthropology
- ANTH 2030T Technology and Humanity
- ANTH 2040T Law and Order in Ancient and Contemporary Culture
- BUSI 1520U Business Computer Applications
- BUSI 2000U Collaborative Leadership
- BUSI 2205U Principles of Marketing
- BUSI 2311U Organizational Behaviour
- BUSI 2603U Introduction to Operations Management
- BUSI 3330U Management of Change
- BUSI 3350U Developing Management Skills
- BUSI 3360U Occupational Health and Safety
- BUSI 3430U Personal Finance
- BUSI 3650U Innovation Management
- BUSI 3700U Strategic Management for Professionals
- BUSI 3710U Small Business Management
- COMM 1100U Introduction to Communication Studies
- COMM 2411U Media and Information Policy
- ENGL 1001T Truth, Lies and Story Telling
- ENVS 3110U Economics and Politics of the Environment
- HIST 1201T Western Civilization to 1789
- HIST 1701T World History to 1800
- HIST 1702T World History 1800 – Present
- LGLS 2100U Public Law
- LGLS 3230U Law and Globalization
- PHIL 1000T Introduction to Philosophy: Knowledge and reality
- PHIL 1200T Critical Thinking
- POSC 3000U Policy, Democracy and Governance
- POSC 3303U Policies for Sustainability
- PSYC 1000U Introduction to Psychology
- SOCI 1000U Introduction to Sociology

Program map – BTech (Hons)

Year	Course	Course	Course	Course	Course
1 – 1	MATH 1000U Introductory Calculus	PHY 1010U Physics I	ENSY 1000U Introduction to Energy Systems	COMM 1050U Technical Communications	ESNS 3200U Technical Graphics & Design

1 – 2	MATH 1020U Calculus II	MATH 2050U Linear Algebra	CHEM 1110U Chemical Fundamentals	ENVS 1000U Environmental Science	CSCI 1040U Introduction to Programming for Scientists
2 – 1	ENSY 2210U Electric Circuits for Energy Systems	ENSY 2220U Fluid Mechanics for Energy Systems	ESNS 2140U Problem Solving, Modelling & Simulation	PHY 2050U Thermodynamics and Heat Transfer	BUSI 1700U Introduction to Entrepreneurship
2 – 2	ENSY 2330U Mechanical Equipment and Systems	ENSY 2410U Low Carbon Technologies	STAT 2800U Statistics and Probability for Engineers	ESNS 3380U Strength of Materials	SSCI 1470U Impact of Science and Technology on Society
3 – 1	ESNS 3750U Integrated Energy Lab	ESNS 3740U Scientific Instrumentation	BUSI 2200U Marketing Management	Technology Course	*Technologies* Technology Course *Programs & Policies* Program & Policy Course
3 – 2	ENSY 3600U Sustainable Energy Thesis Project I	BUSI 2050U Managerial Economics	COMM 3350U Environmental Communication	Technology Course	*Technologies* Technology Course *Programs & Policies* Program & Policy Course
4 – 1	ESNS 4660U Risk Analysis Methods	BUSI 3930U Leadership, Negotiation and Teamwork	Technology Course	Program & Policy Course	Program & Policy Course or Complementary Studies Elective
4 – 2	ENSY 4610U Community and Urban Design	ENSY 4600U Sustainable Energy Thesis Project II	ENSY 4700U Energy Policy, Standards and Safety	Program & Policy Course or Complementary Studies Elective	*Technologies* Technology Course or Technical Elective *Programs & Policies* Program & Policy Course or Complementary Studies Elective

Program details and degree requirements – BTech (Hons) Bridge

Bridge

- ENSY 0101U – Calculus and Algebra for Energy Systems
- ENSY 0102U – Applied Heat Transfer
- CHEM 1110U – Chemical Fundamentals OR ENSY 0103U Materials for Energy Systems depending on diploma

Year 3

Semester 1

- ENSY 1000U – Introduction to Energy Systems
- ESNS 2140U – Problem Solving, Modelling and Simulation
- BUSI 1700U – Introduction to Entrepreneurship
- BUSI 2200U – Marketing Management
- *Choice of* Technology Course

Technologies Specialization

- *Choice of* Technology Course

Programs & Policies Specialization

- *Choice of* Program & Policy Course

Semester 2

- ENSY 2330U – Mechanical Equipment and Systems
- ENSY 2410U – Low Carbon Technologies
- ENVS 1000U – Environmental Science
- BUSI 2050U – Managerial Economics
- ~~COMM 2311U – Writing and Publishing in the Digital Age~~
- STAT 2800U – Statistics and Probability for Engineers
- SSCI 1470U – Impact of Science and Technology on Society

Year 4

Semester 1

- ESNS 4660U – Risk Analysis Methods
- BUSI 3930U – Leadership, Negotiation and Teamwork
- *Choice of* Technology Course
- *Choice of* Program & Policy Course
- *Choice of* Program & Policy Course or Complementary Studies Elective

Technologies Specialization

- *Choice of* Technology Course

Programs & Policies Specialization

- *Choice of* Program & Policy Course

Semester 2

- ENSY 4610U – Community and Urban Design
- ENSY 4600U – Sustainable Energy Thesis Project II
- ENSY 4700U – Energy Policy, Standards and Safety
- COMM 3350U – Environmental Communication
- *Choice of* Technology Course
- ~~*Choice of* Program & Policy Course or Complementary Studies Elective~~

Technologies Specialization

- *Choice of* Technology Course or Technical Elective

Programs & Policies Specialization

- *Choice of* Program & Policy Course or Complementary Studies Elective

Technology Courses
As above

Technical Electives
As above

Program & Policy Courses
As above

Complementary Studies Electives
As above

Program map – BTech (Hons) Bridge

Year	Course	Course	Course	Course	Course	Course
Bri-dge	ENSY 0101U Calculus and Algebra for Energy System	ENSY 0102U Applied Heat Transfer	CHEM 1110U Chemical Fundamentals OR ENSY 0103U Materials for Energy Systems			
3 – 1	ENSY 1000U Introduction to Energy Systems	ESNS 2140U Problem Solving, Modelling and Simulation	BUSI 2200U Marketing Management	BUSI 1700U Introduction to Entrepreneur-ship	Technology Course	*Technologies* Technology Course *Programs & Policies* Program & Policy Course
3 – 2	ENSY 2330U Mechanical Equipment and Systems	BUSI 2050U Managerial Economics	STAT 2800U Statistics and Probability for Engineers	ENSY 2410U Low Carbon Technologies	ENVS 1000U Environmental Science	SSCI 1470U Impact of Science and Technology on Society
4 – 1	ENSY 4660U Risk Analysis Methods	BUSI 3930U Leadership, Negotiation and Teamwork	Technology Course	Program & Policy Course	Program & Policy Course or Complement-ary Studies Elective	*Technologies* Technology Course *Programs & Policies* Program & Policy Course
4 – 2	ENSY 4610U Community and Urban Design	ENSY 4600U Sustainable Energy Thesis Project II	ENSY 4700U Energy Policy, Standards and Safety	COMM 3350U Environmental Communic-ation	Technology Course	*Technologies* Technology Course or Technical Elective *Programs & Policies* Program & Policy Course or Complement-ary Studies Elective

NEW COURSE TEMPLATE

For changes to existing courses see Course Change Template

Faculty: Science			
Full Course Title: Chemical Fundamentals			
Short Form Course Title (max 30 characters): Chemical Fundamentals			
Subject Code and Course number: CHEM 1110U	**Cross-listings:**	☒ **Core** ☐ **Elective**	**Credit weight: 3 cr. hrs.**
Is the course: ☒ Undergraduate ☐ Graduate ☐ Professional (e.g. some Education courses are classified as professional)			
Contact hours (please indicate number of total hours for each component): ☒ Lecture 3 hrs ☒ Lab 3 hrs. biweekly ☒ Tutorial 1.5 hrs. biweekly ☐ Other_____			

PROGRAM(S) IMPACTED [For a core course, please list all impacted programs including any applicable fields or specializations here and include this form with a program adjustment/proposal; for an elective course being inserted anywhere other than the Course Description section of the Academic Calendar, please list all impacted programs including any applicable fields or specializations and complete the Course Placement proposal in Curriculog (e.g. if the course will appear in a list of electives tied to a specific program).]

This course will be a core course for the Bachelor of Technology program.

CALENDAR DESCRIPTION

This course serves as an introduction to the field of chemistry, specifically fundamental chemistry concepts required for understanding and working with energy systems. These include: bonding and molecular structure of organic and inorganic substances; introduction to chemical thermodynamics; gases, liquids, solids and phase changes; equilibria, acid/base chemistry, introduction to electrochemistry; and reaction kinetics. The course outline and specifically the time distribution between certain topics of this basic chemistry course are designed to fit the requirements of the Bachelor of Technology program.

Prerequisites	Grade 12 Chemistry	☐ **With concurrency?**
Co-requisites		
Credit restrictions	**CHEM 1800U** **CHEM 1010U** **CHEM 1020U**	☐ **Equivalency*** ☐ **Equivalency***
Grading scheme	☒ **letter grade** ☐ **pass/fail**	

***Equivalency:** If it is equivalent, students can retake either course. If it is not equivalent, students are not allowed to register in the restricted course.

LEARNING OUTCOMES (this section is required)

At the end of this course, successful students will

- Identify the chemical formula and structure of common organic compounds;
- Describe the molecular structure and bonding of various material types;
- Calculate the heat of combustion of a substance;
- Describe chemical equilibrium and how it may be applied in energy systems.
- Analyze electrochemical systems; and
- Calculate and explain reaction rates.

COURSE INSTRUCTIONAL METHOD

(check all that may apply) ☒ **CLS (in-class)** ☒ **HYB (in-class and online)**
☒ **IND (individual studies)** ☐ **OFF (off-site)**
☐ **WB1 (synchronous online delivery)**
☐ **WEB (asynchronous online delivery)**

TEACHING AND ASSESSMENT METHODS

Teaching will consist of lectures, tutorials, and laboratory sessions. Lectures will be delivered in form of presentations of topics, results, and discussion of the topic as a class. Laboratories will provide students with the opportunity to run, analyze, and discuss the results of basic chemical experiments. Tutorial sessions will be focused on solving of typical chemical problems related to the course material. Some presentations might be delivered online. Assessment may consist of regular assignments, midterms, and the final exam.

CONSULTATION AND FINANCIAL IMPLICATIONS, WHERE APPROPRIATE

This course was developed in consultation between the Faculty of Science and the Faculty of Energy Systems and Nuclear Science and it is focused to fit the best the requirements of the new Bachelor of Technology program. Faculty of Science is going to cover the costs of the course as per institutional policy around service courses.

DOES THIS COURSE CONTAIN ANY INDIGENOUS CONTENT? ☐ **Yes** ☒ **No**

If yes, please ensure the consultation above includes the Indigenous Education Advisory Circle

EFFECTIVE SEMESTER (Specify First Active Term e.g. Fall 2017)

Fall 2019

APPROVAL DATES

Curriculum Committee approval	***November 13, 2018***
Faculty Council approval	***December 4, 2018***
Submission to CPRC/GSC	

NEW COURSE TEMPLATE

For changes to existing courses see Course Change Template

Faculty: Energy Systems and Nuclear Science			
Full Course Title: Problem Solving, Modelling and Simulation			
Short Form Course Title (max 30 characters): Problem Solving			
Subject Code and Course number: ESNS 2140U	**Cross-listings:** N/A	☒ **Core** ☐ **Elective**	**Credit weight:** 3 cr
Is the course: ☒ Undergraduate ☐ Graduate ☐ Professional (e.g. some Education courses are classified as professional)			
Contact hours (please indicate number of total hours for each component): ☒ Lecture 3 ☐ Lab _____ ☒ Tutorial 1.5 (bi-weekly) ☐ Other _____			

PROGRAM(S) IMPACTED [For a core course, please list all impacted programs including any applicable fields or specializations here and include this form with a program adjustment/proposal; for an elective course being inserted anywhere other than the Course Description section of the Academic Calendar, please list all impacted programs including any applicable fields or specializations and complete the Course Placement proposal in Curriculog (e.g. if the course will appear in a list of electives tied to a specific program).]

The course is to be included in the Bachelor of Technology Sustainable Energy Systems program. It is replacing an almost identical course: ENGR 2140U.

CALENDAR DESCRIPTION

Students will explore processes and skills needed to define, evaluate and develop a range of solutions to design problems while working alone or as members of a group. Topics include: methods for estimating and verifying the results and levels of accuracy of alternate designs; mathematical modelling of simple processes and equipment; computer programs for solving systems of equations; use of simulation in the design and visualization of continuous and discrete process.

Prerequisites	**Without concurrency:** CSCI 1040U, MATH 1020U, ENSY 2210U ☐ **With concurrency?**
Co-requisites	N/A
Credit restrictions	ENGR 2140U ☐ **Equivalency***
Grading scheme	☒ **letter grade** ☐ **pass/fail**

***Equivalency:** If it is equivalent, students can retake either course. If it is not equivalent, students are not allowed to register in the restricted course.

LEARNING OUTCOMES (this section is required)

Upon successful completion of this course, students will be able to:

- State the steps of problem solving: definition, generation, decision, implementation, evaluation
- Explain and apply methods for estimating and verifying results including statistical analysis and levels of accuracy; Visual display of quantitative information
- Undertake experimental Design
- Simulate simple systems and apply Computational Modelling
- Complete mathematical modelling of processes
- Program with MATLAB
- Apply problem solving techniques to analyze a complex problem

COURSE INSTRUCTIONAL METHOD

(check all that <u>may</u> apply) ☒ **CLS (in-class)** ☐ **HYB (in-class and online)**
☐ **IND (individual studies)** ☐ **OFF (off-site)**
☐ **WB1 (synchronous online delivery)**
☐ **WEB (asynchronous online delivery)**

TEACHING AND ASSESSMENT METHODS

The teaching and learning of the course content will be supported with the use of practical exercises and case studies. A wide range of techniques will be used to enhance and verify that the learning outcomes have been achieved, including assignments, group problem solving, quizzes and a final exam.

CONSULTATION AND FINANCIAL IMPLICATIONS, WHERE APPROPRIATE

An instructor will be required for this course. There are no implications for teaching assistant or laboratory resources.

DOES THIS COURSE CONTAIN ANY INDIGENOUS CONTENT? ☐ **Yes** ☒ **No**

If yes, please ensure the consultation above includes the Indigenous Education Advisory Circle

EFFECTIVE SEMESTER (Specify First Active Term e.g. Fall 2017)

Fall 2020

APPROVAL DATES

Curriculum Committee approval	
Faculty Council approval	
Submission to CPRC/GSC	

NEW COURSE TEMPLATE

For changes to existing courses see Course Change Template

Faculty: Energy Systems and Nuclear Science			
Full Course Title: Technical Graphics and Design			
Short Form Course Title (max 30 characters): Technical Graphics and Design			
Subject Code and Course number: ESNS 3200U	**Cross-listings:** N/A	☒ **Core** ☐ **Elective**	**Credit weight:** 3 cr
Is the course: ☒ Undergraduate ☐ Graduate ☐ Professional (e.g. some Education courses are classified as professional)			
Contact hours (please indicate number of total hours for each component): ☒ Lecture 3 ☒ Lab 1.5 ☒ Tutorial 1.5 ☐ Other _____			

PROGRAM(S) IMPACTED [For a core course, please list all impacted programs including any applicable fields or specializations here and include this form with a program adjustment/proposal; for an elective course being inserted anywhere other than the Course Description section of the Academic Calendar, please list all impacted programs including any applicable fields or specializations and complete the Course Placement proposal in Curriculog (e.g. if the course will appear in a list of electives tied to a specific program).]

The course is to be included in the Bachelor of Technology Sustainable Energy Systems program. It is replacing an almost identical course: ENGR 3200U.

CALENDAR DESCRIPTION

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

Prerequisites	N/A	☐ **With concurrency?**
Co-requisites	N/A	
Credit restrictions	ENGR 1025U, ENGR 3200U	☐ **Equivalency***
Grading scheme	☒ **letter grade** ☐ **pass/fail**	

***Equivalency:** If it is equivalent, students can retake either course. If it is not equivalent, students are not allowed to register in the restricted course.

LEARNING OUTCOMES (this section is required)

After successfully completing this course, students will be able to:

- Describe the Engineering Design Process
- Read and generate visual aspects of technical design

- Sketch and draw freehand
- Identify key elements of graphics standards that are being used by ASME, Canadian (CSA) and USA (ANSI) organizations
- Complete design and sketching using computer programs
- Apply solid modeling and CAD techniques in individual and group environments
- Create practical technical drawings and technical communications
- Demonstrate the use of project management software in the planning, reporting and control of a group project

COURSE INSTRUCTIONAL METHOD

(check all that may apply) ☒ **CLS (in-class)** ☒ **HYB (in-class and online)**
☐ **IND (individual studies)** ☐ **OFF (off-site)**
☐ **WB1 (synchronous online delivery)**
☐ **WEB (asynchronous online delivery)**

TEACHING AND ASSESSMENT METHODS

The teaching and learning of the course content will be supported with the use of practical exercises and case studies. A wide range of techniques will be used to enhance and verify that the learning outcomes have been achieved, including labs, assignments, a group project, and midterm and final exams.

CONSULTATION AND FINANCIAL IMPLICATIONS, WHERE APPROPRIATE

An instructor will be required for this course. There are no implications for teaching assistant or laboratory resources.

DOES THIS COURSE CONTAIN ANY INDIGENOUS CONTENT? ☐ **Yes** ☒ **No**

If yes, please ensure the consultation above includes the Indigenous Education Advisory Circle

EFFECTIVE SEMESTER (Specify First Active Term e.g. Fall 2017)

Fall 2019

APPROVAL DATES

Curriculum Committee approval	
Faculty Council approval	
Submission to CPRC/GSC	

NEW COURSE TEMPLATE

For changes to existing courses see Course Change Template

Faculty: Energy Systems and Nuclear Science			
Full Course Title: Strength of Materials			
Short Form Course Title (max 30 characters): Strength of Materials			
Subject Code and Course number: ESNS 3380U	**Cross-listings:** N/A	☒ **Core** ☐ **Elective**	**Credit weight:** 3 cr
Is the course: ☒ Undergraduate ☐ Graduate ☐ Professional (e.g. some Education courses are classified as professional)			
Contact hours (please indicate number of total hours for each component): ☒ Lecture 3 ☒ Lab 2 (bi-weekly) ☒ Tutorial 1 ☐ Other _____			

PROGRAM(S) IMPACTED [For a core course, please list all impacted programs including any applicable fields or specializations here and include this form with a program adjustment/proposal; for an elective course being inserted anywhere other than the Course Description section of the Academic Calendar, please list all impacted programs including any applicable fields or specializations and complete the Course Placement proposal in Curriculog (e.g. if the course will appear in a list of electives tied to a specific program).]

The course is to be included in the Bachelor of Technology Sustainable Energy Systems program. It is replacing an almost identical course: ENGR 3380U.

CALENDAR DESCRIPTION

Principles of statics as applied to deformable solid bodies; stress and strain; Hooke's law, elastic behaviour of simple members under axial force, tension, compression, shear, torsion; bending and deflection of beams; design of beams, trusses, frames and shafts; column loads and buckling; impact loading; stability of structures.

Prerequisites	CHEM 1110U, PHY 1010U ☐ **With concurrency?**
Co-requisites	N/A
Credit restrictions	ENGR 3380U ☐ **Equivalency***
Grading scheme	☒ **letter grade** ☐ **pass/fail**

***Equivalency:** If it is equivalent, students can retake either course. If it is not equivalent, students are not allowed to register in the restricted course.

LEARNING OUTCOMES (this section is required)

Upon successfully completing this course, students will be able to:

- Apply Problem Solving Skills in Statics and Mechanics of Materials
- Identify Units, conversion factors, resolving forces in 2D and 3D;
- Determine Force Vectors and Force System Resultants
- Determine Equilibrium of a Rigid Body and Analyse a Structure

- Analyse Trussed Structures and Frames and Machines
- Describe Geometric Properties and Distributed Loads
- Calculate Shear Force and Bending Moment
- Describe Mechanical Properties of Materials
- Describe Material Properties: Stress and strain, tensile testing
- Determine the Impacts of Axial Load, Torsion, Bending, Transverse Shear, and Stress and Strain Transformation.
- Design Beams and Shafts
- Calculate the Shear force and bending moment in a beam;
- Describe Tensile and torsion testing
- Analyse Stress systems in a thin cylinder

COURSE INSTRUCTIONAL METHOD

(check all that may apply) ☒ **CLS (in-class)** ☐ **HYB (in-class and online)**
☐ **IND (individual studies)** ☐ **OFF (off-site)**
☐ **WB1 (synchronous online delivery)**
☐ **WEB (asynchronous online delivery)**

TEACHING AND ASSESSMENT METHODS

The teaching and learning of the course content will be supported with the use of practical exercises and case studies. A wide range of techniques will be used to enhance and verify that the learning outcomes have been achieved, including assignments, laboratories, and midterm and final exams.

CONSULTATION AND FINANCIAL IMPLICATIONS, WHERE APPROPRIATE

An instructor will be required for this course. There are no implications for teaching assistant or laboratory resources.

DOES THIS COURSE CONTAIN ANY INDIGENOUS CONTENT? ☐ **Yes** ☒ **No**

If yes, please ensure the consultation above includes the Indigenous Education Advisory Circle

EFFECTIVE SEMESTER (Specify First Active Term e.g. Fall 2017)

Winter 2021

APPROVAL DATES

Curriculum Committee approval	
Faculty Council approval	
Submission to CPRC/GSC	

NEW COURSE TEMPLATE

For changes to existing courses see Course Change Template

Faculty: Energy Systems and Nuclear Science			
Full Course Title: Scientific Instrumentation			
Short Form Course Title (max 30 characters): Scientific Instrumentation			
Subject Code and Course number: ESNS 3740U	**Cross-listings:** N/A	☒ **Core** ☐ **Elective**	**Credit weight:** 3 cr

Is the course:

☒ Undergraduate ☐ Graduate ☐ Professional (e.g. some Education courses are classified as professional)

Contact hours (please indicate number of total hours for each component):

☒ Lecture 3 ☒ Lab 3 (bi-weekly) ☒ Tutorial 1 ☐ Other _____

PROGRAM(S) IMPACTED [For a core course, please list all impacted programs including any applicable fields or specializations here and include this form with a program adjustment/proposal; for an elective course being inserted anywhere other than the Course Description section of the Academic Calendar, please list all impacted programs including any applicable fields or specializations and complete the Course Placement proposal in Curriculog (e.g. if the course will appear in a list of electives tied to a specific program).]

The course is to be included in the Bachelor of Technology Sustainable Energy Systems program. It is replacing an almost identical course: NUCL 3740U.

CALENDAR DESCRIPTION

This course is designed to instruct students how to set, use and analyze the appropriate sensor technology (transducers) for measurements related to energy technology. In the course the student will learn how to perform experimental data analysis, how various components of sensing devices inter-relate (for example, relationships between amplifiers, transformers, filters, etc.), the operating principles of transducers for physical measurements, including, but not limited to: ionizing radiation, displacement and area, pressure, flow, temperature, force, torque, strain, motion, vibration, and air pollution. The student will learn both analog and digital techniques for data analysis, including multiplexing, data conversion and error detection and correction. The laboratory exercises will give the student hands-on experience designing measurement systems. Proper data reporting techniques will also be emphasized.

Prerequisites	ENSY 2210U, STAT 2800U	☐ **With concurrency?**
Co-requisites		
Credit restrictions	NUCL 3740U	☐ **Equivalency***
Grading scheme	☒ **letter grade** ☐ **pass/fail**	

***Equivalency:** If it is equivalent, students can retake either course. If it is not equivalent, students are not allowed to register in the restricted course.

LEARNING OUTCOMES (this section is required)

After successfully completing this course, students will be able to:

- Describe the operation of instruments commonly used in energy systems
- Explain electric circuits used in scientific instrumentation
- Describe and practice measurement techniques and technologies
- Practice uncertainty calculations and apply to measurement devices
- Describe flow, level, pressure, temperature, strain, and radiation measurement methods and technologies
- Design and put together a measurement system
- Use both analog and digital measurement devices
- Describe transducer technologies and their use in measurement
- Practice data analysis techniques, including multiplexing
- Select, use and analyze the appropriate sensor technology for measurements related to energy technology
- Practice basic experiments on temperature, filter, and thermal measurements
- Use instruments as part of control systems using LabView software and design basic control programs

COURSE INSTRUCTIONAL METHOD

(check all that may apply) ☒ **CLS (in-class)** ☐ **HYB (in-class and online)**
☐ **IND (individual studies)** ☐ **OFF (off-site)**
☐ **WB1 (synchronous online delivery)**
☐ **WEB (asynchronous online delivery)**

TEACHING AND ASSESSMENT METHODS

The teaching and learning of the course content will be supported with the use of practical exercises and examples. A wide range of techniques will be used to enhance and verify that the learning outcomes have been achieved, including lab reports, assignments, a project, and in-class activities, as well as midterm and final examinations.

CONSULTATION AND FINANCIAL IMPLICATIONS, WHERE APPROPRIATE

An instructor will be required for this course. There are no implications for teaching assistant or laboratory resources.

DOES THIS COURSE CONTAIN ANY INDIGENOUS CONTENT? ☐ **Yes** ☒ **No**

If yes, please ensure the consultation above includes the Indigenous Education Advisory Circle

EFFECTIVE SEMESTER (Specify First Active Term e.g. Fall 2017)

Fall 2021

APPROVAL DATES

Curriculum Committee approval	
Faculty Council approval	
Submission to CPRC/GSC	

NEW COURSE TEMPLATE

For changes to existing courses see Course Change Template

Faculty: Energy Systems and Nuclear Science			
Full Course Title: Integrated Energy Laboratory			
Short Form Course Title (max 30 characters): Integrated Energy Lab			
Subject Code and Course number: ESNS 3750U	**Cross-listings:** N/A	☒ **Core** ☐ **Elective**	**Credit weight:** 3 cr
Is the course: ☒ Undergraduate ☐ Graduate ☐ Professional (e.g. some Education courses are classified as professional)			
Contact hours (please indicate number of total hours for each component): ☒ Lecture 1 ☒ Lab 3 ☐ Tutorial _____ ☐ Other _____			

PROGRAM(S) IMPACTED [For a core course, please list all impacted programs including any applicable fields or specializations here and include this form with a program adjustment/proposal; for an elective course being inserted anywhere other than the Course Description section of the Academic Calendar, please list all impacted programs including any applicable fields or specializations and complete the Course Placement proposal in Curriculog (e.g. if the course will appear in a list of electives tied to a specific program).]

The course is to be included in the Bachelor of Technology Sustainable Energy Systems program. It is replacing an almost identical course: ENGR 3750U.

CALENDAR DESCRIPTION

A project based approach to hands-on experiences that cover multidisciplinary topics in energy systems. Course material integrates knowledge in chemistry, fluid mechanics, heat transfer, materials, and structural analysis. Topics include: Advanced design, drawings, systems interfaces, numerical coding, Fortran coding, integral control, overpressure protection, pressure waves, water hammer, plant ageing phenomena, component performance. Practical applications will be obtained through both experimental and numerical/simulation laboratories.

Prerequisites	ESNS 2140U, ESNS 3200U, ESNS 3380U	☐ **With concurrency?**
Co-requisites		
Credit restrictions	ENGR 3750U	☐ **Equivalency***
Grading scheme	☒ **letter grade** ☐ **pass/fail**	

***Equivalency:** If it is equivalent, students can retake either course. If it is not equivalent, students are not allowed to register in the restricted course.

LEARNING OUTCOMES (this section is required)

After successfully completing this course, students will be able to:

- perform experimental studies to capture and to analyze multidisciplinary information

- explain individual phenomena and their integrated effect upon an outcome
- create a numerical/analytical/coded model that incorporates different phenomena to study integrated effects
- describe the interdisciplinary effects of heat transfer, fluid mechanics, stress, vibration, materials, chemistry, control theory and instrumentation
- properly document observations and findings from numerical and experimental investigation
- describe the documentation approach for design in terms of drawings, description, interfaces, and advanced integrated engineering phenomenon
- work individually and as team to design and build solutions to integrated energy design problems

COURSE INSTRUCTIONAL METHOD

(check all that may apply) ☒ **CLS (in-class)** ☐ **HYB (in-class and online)**
☐ **IND (individual studies)** ☐ **OFF (off-site)**
☐ **WB1 (synchronous online delivery)**
☐ **WEB (asynchronous online delivery)**

TEACHING AND ASSESSMENT METHODS

The teaching and learning of the course content will be supported with the use of practical exercises. A wide range of techniques will be used to enhance and verify that the learning outcomes have been achieved, including lab reports, a quiz, a project, a presentation and a final exam.

CONSULTATION AND FINANCIAL IMPLICATIONS, WHERE APPROPRIATE

An instructor will be required for this course. There are no implications for teaching assistant or laboratory resources.

DOES THIS COURSE CONTAIN ANY INDIGENOUS CONTENT? ☐ **Yes** ☒ **No**

If yes, please ensure the consultation above includes the Indigenous Education Advisory Circle

EFFECTIVE SEMESTER (Specify First Active Term e.g. Fall 2017)

Fall 2021

APPROVAL DATES

Curriculum Committee approval	
Faculty Council approval	
Submission to CPRC/GSC	

NEW COURSE TEMPLATE

For changes to existing courses see Course Change Template

Faculty: Energy Systems and Nuclear Science			
Full Course Title: Risk Analysis Methods			
Short Form Course Title (max 30 characters): Risk Analysis Methods			
Subject Code and Course number: ESNS 4660U	**Cross-listings:** N/A	☒ **Core** ☐ **Elective**	**Credit weight:** 3 cr
Is the course: ☒ Undergraduate ☐ Graduate ☐ Professional (e.g. some Education courses are classified as professional)			
Contact hours (please indicate number of total hours for each component): ☒ Lecture 3 ☐ Lab _____ ☒ Tutorial 1 ☐ Other _____			

PROGRAM(S) IMPACTED [For a core course, please list all impacted programs including any applicable fields or specializations here and include this form with a program adjustment/proposal; for an elective course being inserted anywhere other than the Course Description section of the Academic Calendar, please list all impacted programs including any applicable fields or specializations and complete the Course Placement proposal in Curriculog (e.g. if the course will appear in a list of electives tied to a specific program).]

The course is to be included in the Bachelor of Technology Sustainable Energy Systems program. It is replacing an almost identical course: ENGR 4660U.

CALENDAR DESCRIPTION

Students will apply probability theory to discrete and continuous events. Topics include: random variables; decision theory, including Bayes' Theorem, the likelihood principle, prior posterior and predictive distributions and survival models. Students will also study chemical, physical, biological hazards; recognition, evaluation, prevention and control of hazards; industrial hygiene and occupational health; analysis, assessment, characterization and communication of risks.

Prerequisites	STAT 2800U	☐ **With concurrency?**
Co-requisites		
Credit restrictions	ENGR 4660U	☐ **Equivalency***
Grading scheme	☒ **letter grade** ☐ **pass/fail**	

***Equivalency:** If it is equivalent, students can retake either course. If it is not equivalent, students are not allowed to register in the restricted course.

LEARNING OUTCOMES (this section is required)

After successfully completing this course, students will be able to:

- Identify and analyze hazards and evaluate impacts on humans, facilities, the environment, and society
- Explain probability concepts, random variables, and statistical distributions

- Practice probabilistic risk assessment (PRA) methods
- Investigate accident scenarios and causation models
- Explain Dynamic Flowgraph Method (DFM), and Multilevel Flow Modelling (MFM) methods and their use for fault propagation modeling
- Practice fault tree and event tree analysis methods
- Explain failure, common cause, and dependent models
- Model fail and repair states, and use Markov Models
- Use risk analysis to design and verify risk reduction and safety systems
- Practice availability and reliability calculation methods
- Practice reliability block diagrams, and voting mechanisms
- Analyze human errors, and practice human reliability analysis methods, and link to fault tree analysis

COURSE INSTRUCTIONAL METHOD

(check all that may apply) ☒ **CLS (in-class)** ☐ **HYB (in-class and online)**
☐ **IND (individual studies)** ☐ **OFF (off-site)**
☐ **WB1 (synchronous online delivery)**
☐ **WEB (asynchronous online delivery)**

TEACHING AND ASSESSMENT METHODS

The teaching and learning of the course content will be supported with the use of practical exercises and case studies. A wide range of techniques will be used to enhance and verify that the learning outcomes have been achieved, including assignments and projects, as well as midterm and final exams.

CONSULTATION AND FINANCIAL IMPLICATIONS, WHERE APPROPRIATE

An instructor will be required for this course. There are no implications for teaching assistant or laboratory resources.

DOES THIS COURSE CONTAIN ANY INDIGENOUS CONTENT? ☐ **Yes** ☒ **No**

If yes, please ensure the consultation above includes the Indigenous Education Advisory Circle

EFFECTIVE SEMESTER (Specify First Active Term e.g. Fall 2017)

Fall 2022

APPROVAL DATES

Curriculum Committee approval	
Faculty Council approval	
Submission to CPRC/GSC	

COURSE CHANGE TEMPLATE

For new courses see New Course Template

Faculty: Energy Systems & Nuclear Science	
Program: Bachelor of Technology Sustainable Energy Systems	
Subject Code and Course Number: ENSY 2210U	**Current Full Course Title:** Electric Circuits for Energy Systems
☒ **Core** ☐ **Elective**	**Current Short-Form Course Title (max. 30 characters):** Electric Circuits ES

COURSE CHANGES (check all that apply)

☒	Course title (include new short form title)	☐	Credit weighting
☒	Course description	☐	Contact hours
☐	Course number	☐	Prerequisites
☐	Subject code	☐	Co-requisites
☐	Grade Mode (N – alpha grade, P – Pass/Fail)	☐	Cross-listings
☒	Learning outcomes	☐	Credit restrictions
☐	Course Instructional Method (CLS, HYB, WB1, WEB)	☐	Delete course from Program only (attach this form to program modification)
☐	Delete course from Academic Calendar	☐	Teaching and assessment methods
☐	Supplementary Fees	☐	Term Change
☐	Other (please specify)		

DESCRIPTION AND/OR REASON FOR CHANGE AND WAYS IN WHICH IT MAINTAINS/ENHANCES COURSE/PROGRAM OBJECTIVES

Minor updates to course title and description to improve organization and clarity and to ensure students are well-prepared for subsequent courses. Learning outcomes are updated to better reflect the competencies students need to attain through the course.

CHANGE TO CALENDAR DESCRIPTION (if required)

Current	Proposed
Electric Circuits for Energy Systems (Electric Circuits ES) Basic concepts of electricity, magnetism and electric circuits. Electric charge and Coulomb's law; electric field, electric flux, Gauss' law; electrostatic potential, capacitance; DC circuits and Kirchoff's Laws. Magnetic forces and magnetic field, Biot-Savart law, Ampere's law, magnetic flux, Faraday's law, inductance; Electromagnetic waves, wave propagation, waves in matter; Series and parallel circuits; Ohm's Law, Thevenin Theorem, Norton Theorem, voltage divider, Wheatstone bridge; AC circuits; operation of electrical	**Principles of Electrical Systems (Princip Electrical Sys)** Basic concepts of electricity, magnetism and electric circuits. Electric charge; Coulomb's law; electric field; electric flux; Gauss' law; electrostatic potential; capacitance; magnetic forces and magnetic field; Biot-Savart law; Ampere's law; magnetic flux; Faraday's law; inductance; magnetic circuits. DC circuits; Kirchoff's Laws; series and parallel circuits; Ohm's Law; Thevenin Theorem; Norton Theorem; voltage/current divider; Wheatstone bridge; DC power. AC circuits; response to step functions; response to sinusoidal functions and

equipment such as instruments, motors, generators; response to step functions; response to sinusoids, steady state AC, resonance, parallel resonance, AC power; introduction to magnetic circuits: coils, solenoids, transformers; basics of electronics: diodes, transistors, operational amplifiers.	steady state analysis; resonance; AC power; three phases; filters; principles of electrical equipment such as instruments, motors, and generators; solenoids; transformers. Basics of electronics: diodes, transistors, and operational amplifiers.

CHANGE TO CONTACT HOURS (if applicable, indicate changes to total contact hours; changes to frequency (e.g. 1x3 hours to 2X1.5 hours) not required):

Lecture	Lab
Tutorial	Other

OTHER CHANGES (if applicable)

Prerequisites	☐ **With concurrency?**
Co-requisites	
Credit restrictions	☐ **Equivalency***
Grading scheme	☐ **letter grade** ☐ **pass/fail**

***Equivalency:** If it is equivalent, students can retake either course. If it is not equivalent, students are not allowed to register in the restricted course.

CHANGES TO LEARNING OUTCOMES (if applicable)

After successful completion of this course, students will be able to:

- describe fundamental concepts of electricity;
- analyze and design DC/AC electric circuits;
- calculate power in DC/AC circuits;
- explain magnetism and analyze magnetic circuits;
- discuss electrical equipment; and
- explain characteristics of electronic components and their applications.

DOES THIS COURSE CONTAIN ANY INDIGENOUS CONTENT? ☐ **Yes** ☒ **No**

If yes, please ensure the consultation below includes the Indigenous Education Advisory Circle

CONSULTATION AND FINANCIAL IMPLICATIONS, WHERE APPROPRIATE

N/A

EFFECTIVE SEMESTER (Specify First Active Term e.g. Fall 2017)

Fall 2020

APPROVAL DATES

Faculty Curriculum Committee approval	
Faculty Council approval	
Reported to CPRC	

COURSE CHANGE TEMPLATE

For new courses see New Course Template

Faculty: Energy Systems & Nuclear Science	
Program: Bachelor of Technology Sustainable Energy Systems	
Subject Code and Course Number: ENSY 4400U	**Current Full Course Title:** Electric Power Systems
☒ **Core** ☐ **Elective**	**Current Short-Form Course Title (max. 30 characters):** Electric Power Sys

COURSE CHANGES (check all that apply)

☐	Course title (include new short form title)	☐	Credit weighting
☒	Course description	☐	Contact hours
☐	Course number	☐	Prerequisites
☐	Subject code	☐	Co-requisites
☐	Grade Mode (N – alpha grade, P – Pass/Fail)	☐	Cross-listings
☐	Learning outcomes	☐	Credit restrictions
☐	Course Instructional Method (CLS, HYB, WB1, WEB)	☐	Delete course from Program only (attach this form to program modification)
☐	Delete course from Academic Calendar	☐	Teaching and assessment methods
☐	Supplementary Fees	☐	Term Change
☐	Other (please specify)		

DESCRIPTION AND/OR REASON FOR CHANGE AND WAYS IN WHICH IT MAINTAINS/ENHANCES COURSE/PROGRAM OBJECTIVES

Minor updates to course description to enhance coverage of topics, to better align with the program learning outcomes.

CHANGE TO CALENDAR DESCRIPTION (if required)

Current	**Proposed**
Power system overview: generation, transmission, and distribution. Active and reactive power, power factor, single and three phase circuits. Elements of power systems: inductors, transformers, generators, circuit breakers, transmission lines; single and three-phase systems; equivalent circuits, operating modes; network calculations: power flow, fault analysis and protection, power system stability. Introduction to DC, AC and synchronous machines.	Power system overview: generation, transmission, and distribution. Distributed Generation (DG), energy conversion, conservation, and efficiency. Active and reactive power, power factor, harmonics, power quality, single and three phase circuits. Elements of power systems: inductors, transformers, generators, circuit breakers, transmission lines; single and three-phase systems; equivalent circuits, operating modes; network calculations: power flow, fault analysis and protection, power system stability. Introduction to DC AC, synchronous, and asynchronous machines. Substations, switchboards and panel boards. Power

	protection and safety codes.

CHANGE TO CONTACT HOURS (if applicable, indicate changes to total contact hours; changes to frequency (e.g. 1x3 hours to 2X1.5 hours) not required):

Lecture	Lab
Tutorial	Other

OTHER CHANGES (if applicable)

Prerequisites	☐ **With concurrency?**
Co-requisites	
Credit restrictions	☐ **Equivalency***
Grading scheme	☐ **letter grade** ☐ **pass/fail**

***Equivalency:** If it is equivalent, students can retake either course. If it is not equivalent, students are not allowed to register in the restricted course.

CHANGES TO LEARNING OUTCOMES (if applicable)

DOES THIS COURSE CONTAIN ANY INDIGENOUS CONTENT? ☐ **Yes** ☒ **No**

If yes, please ensure the consultation below includes the Indigenous Education Advisory Circle

CONSULTATION AND FINANCIAL IMPLICATIONS, WHERE APPROPRIATE

N/A

EFFECTIVE SEMESTER (Specify First Active Term e.g. Fall 2017)

Fall 2021

APPROVAL DATES

Faculty Curriculum Committee approval	
Faculty Council approval	
Reported to CPRC	