Faculty of Graduate Studies

Summary of Changes for 2008-2009 Graduate Calendar - Third Edition

Changes as of February 18, 2009

PLEASE NOTE: Page numbers for insertions and deletions refer to page numbers in the June 2008 / hard copy version of the 2008-2009 Graduate Calendar.

Faculty of Graduate Studies
Staffing Update (updated January 5, 2009)
• Page 1
  o Deleted "Valerie Haines", inserted "Brian MacIntosh"

Academic Regulations
Removed duplicated section (updated February 18, 2009)
• Page 17
  o Column 3, paragraph 4, "General Faculties Council's Committee to Hear and Determine Student Academic Appeals" section
  o Section appears on both pages 17 (column 3, paragraph 4) and 18 (column 2, paragraph 5)
  o Deleted duplicated section is as follows:

General Faculties Council’s Committee to Hear and Determine Student Academic Appeals

This committee hears appeals of decisions made by Faculty Appeals Committees on matters of academic concern to students. The General Faculties Council’s Committee will hear an appeal only if there is reason to believe that the Faculty Appeals Committee showed bias, unfair procedures, or if there is substantial new evidence that could not have been presented to a Faculty Appeals Committee. Before the General Faculties Council’s Committee will accept an appeal, the chair of that committee must be satisfied that departmental and Faculty appeals procedures have been fully utilized.

Students wishing to make an appeal to the Committee to Hear and Determine Student Academic Appeals must do so within fifteen days of the unfavourable decision from the Faculty Appeals Committee. A letter of appeal shall be sent to the Secretary to General Faculties Council (Administration Building, Room 127), and must indicate the decision being appealed, the grounds for appeal (i.e., alleged bias, alleged unfair procedures or substantial new information) and the remedies sought by the student, together with all supporting documentation. The appeal letter shall also state the levels of appeal that have already been utilized.

The General Faculties Council’s Committee will not hear the appeal if the chair decides that sufficient grounds do not exist.

A student whose appeal is to be heard by the General Faculties Council’s Committee is entitled to obtain from the Secretary to General Faculties Council the principles and procedures governing the General Faculties Council’s Committee. These procedures will detail the composition of the committee, the right of the student to have an advocate, how the hearing will be conducted and other information.
The committee will normally give fifteen days written notice of a hearing to the appellant and to the head of the academic unit against whose office the appeal is being made. Normally, the General Faculties Council’s Committee will hear an appeal within thirty days of its acceptance. The chairperson of the General Faculties Council’s Committee will convey the committee’s findings in writing to the appellant, the respondent, the Secretary to General Faculties Council and the Registrar.

For more specific information and other principles governing student academic appeals, the Secretary to General Faculties Council should be consulted.

**Fees and Expenses**

Revision (updated February 11, 2009)

- Page 43
  - "Doctor of Education (distance delivery)" section
  - Deleted [http://www.ucalgary.ca/~distdoc/](http://www.ucalgary.ca/~distdoc/)
  - Inserted [http://www.educ.ucalgary.ca/gder/](http://www.educ.ucalgary.ca/gder/)

Revision (updated January 27, 2009)

- Page 43
  - "General Fees" section
  - Column 4, row 5, "UPASS" item
  - Deleted "and optional only to students living outside the Calgary area*"
  - Column 4, row 7, "Campus Recreation" item
  - Deleted "Optional only to students living outside the Calgary area*"

**Haskayne School of Business**

Addition (updated Feb. 6, 2009)

- Page 128
  - Column 2, "Degrees and Specializations Offered" section, paragraph 3
  - Inserted details for "Combined programs, offered with professional societies":

  **Combined programs, offered with professional societies:**
  
  **MBA-CMA Program**
  
  This is a joint initiative between the Haskayne School of Business and the Certified Management Accountants of Alberta. This program is intended for those with a strong undergraduate background and several years of relevant work experience. Students must complete the CMA pre-requisites and the CMA national entrance exam before being admitted to the MBA-CMA program. Students can complete the requirements for the Haskayne MBA and the CMA designation in three years of part-time study. For information and application materials for this program, please visit cma-alberta.com

Revision (updated Feb. 6, 2009)

- Page 128
  - Column 3, "Admission Requirements" section, bullet point d)
  - Deleted bullet point d):
    - d) Completion of the Graduate Management Admission Test (GMAT*) with a recommended minimum score of 550 for the Haskayne MBA and a minimum score of 600 for the thesis program
o Inserted bullet point d):
   d) Completion of the Graduate Management Admission Test (GMAT*) with a recommended minimum score of 550 for the Haskayne MBA with high scores on both verbal and quantitative subcomponents. Where GMAT is unavailable, the program will accept equivalent results on the Graduate Record Exam (GRE). It is recommended that students should place above the 70th percentile on overall test scores. A minimum GMAT score of 600 or an equivalent GRE is required for the thesis program.

Correction (updated Dec. 17, 2008)
   • Page 129
      o Formatting correction in column 3, paragraph 4
      o Deleted heading formatting for "Director MBA (Thesis) Program"
      o Inserted "(b) Approval of each individual's program by the Director MBA (Thesis) Program"

Interdisciplinary Specializations
Addition (updated February 11, 2009)
   • Page 186
      o Inserted details for "Environmental Engineering Interdisciplinary Specialization" as follows:

ENVIRONMENTAL ENGINEERING INTERDISCIPLINARY SPECIALIZATION
Contact Info
Location: Information & Communications Technology Building, Room ICT248
Faculty number: (403) 210-9892
Fax: (403) 210-9892
E-mail address: ceere@ucalgary.ca
Web page URL: http://www.schulich.ucalgary.ca/CEERE/

The Centre for Environmental Engineering Research and Education (CEERE) in the Schulich School of Engineering (SSE) has the overall responsibility for the coordination and delivery of a comprehensive postgraduate program specialization in the multi-disciplinary field of environmental engineering. All five engineering departments participate in delivering this SSE-wide environmental engineering specialization.

Applications for admission to the Faculty of Graduate Studies should be submitted to the engineering department that best matches the applicant’s undergraduate and/or postgraduate academic training.

1. Degrees and Specializations Offered

Degrees with an interdisciplinary specialization in Environmental Engineering:
Doctor of Philosophy (PhD)
Master of Science (MSc)
Master of Engineering (MEng)
2. Admission Requirements

In addition to the Faculty of Graduate Studies, SSE, and home department requirements, the Environmental Engineering specialization requires:

Master of Engineering and Master of Science
A Bachelor’s degree in engineering

*Note: Applicants with applied science degrees may be considered, but additional undergraduate engineering courses may be required.*

Doctor of Philosophy
A Master’s degree in engineering, preferably in environmental engineering or equivalent

*Note: Transfer to the doctoral program without completing the Master’s degree may be approved for exceptional students.*

3. Application Deadline

See departmental and program sections in this Calendar for deadlines regarding submission of complete applications for students with international transcripts or with Canadian and US transcripts.

4. Advanced Credit

See “Engineering Programs” in this Calendar.

5. Program/Course Requirements

Master of Engineering (Courses Only Route)
10 half-courses. ENEN 603 and 605 are normally required, together with at least one of ENEN 621, 623, 625 or 627. ENEN 601 is not required.

Students with non-engineering undergraduate degrees may be required to take additional prerequisite courses at the undergraduate level.

Master of Engineering (Thesis Route)
A minimum of five half-courses. ENEN 603 and 605 are normally required, together with at least one of ENEN 621, 623, 625 or 627. ENEN 601 is not required.

Students with non-engineering undergraduate degrees may be required to take additional prerequisite courses at the undergraduate level.

Master of Science
A minimum of five half-courses plus ENEN 601. ENEN 603 and 605 are normally required, together with at least one of ENEN 621, 623, 625 or 627.

Students with non-engineering undergraduate degrees may be required to take additional prerequisite courses at the undergraduate level.
Doctor of Philosophy
For applicants with Bachelor of Science and Master of Science degrees in Environmental Engineering:

A minimum of three half-courses plus ENEN 601. One of ENEN 621, 623, 625 or 627 is normally required.

For applicants with Bachelor of Science and Master of Science degrees in Engineering, but not Environmental Engineering:

A minimum of four half-courses and ENEN 601. ENEN 603 and 605 are normally required, together with at least one of ENEN 621, 623, 625 or 627.

For applicants with a Bachelor’s degree in Engineering, but without a completed Master’s degree:

A minimum of eight half-courses plus ENEN 601. ENEN 603 and 605 are normally required, together with at least two of ENEN 621, 623, 625 or 627.

6. Additional Requirements
All full-time Master of Science and Doctor of Philosophy students are required to register and participate in the Research Seminar course, Environmental Engineering 601, in each of the Fall and Winter terms.

7. Credit for Undergraduate Courses
Not applicable.

8. Time Limit
Expected completion time is two years for the Master of Science degree, and three years for the Doctor of Philosophy. Maximum completion time is four years for the Master of Science and Master of Engineering (Thesis) degrees and six years for the Master of Engineering (Courses Only) and Doctor of Philosophy degrees.

9. Supervisory Assignments
All students are required to have a thesis supervisor before the second annual registration. For students in the Master of Science and Doctor of Philosophy degree programs, a supervisor is normally appointed at the time of admission.

10. Required Examinations
All final thesis oral examinations involve a public seminar/presentation before a closed oral examination.

11. Research Proposal Requirements
None.

12. Special Registration Information
None.

13. Financial Assistance
See “Engineering Programs.”

14. Other Information
See “Engineering Programs.”

15. Faculty Members/Research Interests

The current research interests of the faculty members can be found at http://www.schulich.ucalgary.ca/CEERE/ or from engineering departments.

### Graduate Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Description</th>
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<tbody>
<tr>
<td>Environmental Engineering 601</td>
<td>E(0-3S)</td>
<td>Research Seminar</td>
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<td>Oral presentations consisting of reports on studies of the literature or of current research. Required of all full-time graduate students registered in MSc and PhD degree programmes in Environmental Engineering (in each of Fall and Winter terms). MAY BE REPEATED FOR CREDIT NOT INCLUDED IN GPA</td>
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<tr>
<td>Environmental Engineering 603</td>
<td>H(3-0)</td>
<td>Principles of Environmental Engineering</td>
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<tr>
<td>Environmental Engineering 605</td>
<td>H(3-0)</td>
<td>Environmental Chemistry and Microbiology</td>
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<td>Chemistry of organic and inorganic contaminants in the environment. Natural chemical cycles in the biosphere, geosphere, hydrosphere and atmosphere, and consequences of anthropogenic disturbances. Aquatic, atmospheric and soil chemistry. The fate of hazardous, refractory and heavy metal pollutants in the environment. Introductory toxicological chemistry and atmospheric chemistry. Analytical techniques for contaminants in air, water, energy and soil. Introductory microbiology: characteristics and classification of microorganisms, kinetics and mathematical models of microbial growth, applications in environmental engineering. Introduction to ecology. Note: Credit for both Environmental Engineering 605 and Chemical Engineering 619.19 will not be allowed.</td>
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<tr>
<td>Environmental Engineering 619</td>
<td>H(3-0)</td>
<td>Special Topics</td>
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<td>New courses on specialized topics relevant to environmental engineering. It may also be offered to doctoral degree students to enable them to pursue advanced studies in particular areas under the direction of a faculty member, which must be arranged and approved prior to registration. MAY BE REPEATED FOR CREDIT</td>
</tr>
</tbody>
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MAY BE REPEATED FOR CREDIT
Environmental Engineering 621    H(3-0)  (Chemical Engineering 701)

**Experimental Design and Error Analysis**
Statistical analysis and design of engineering experiments. Random variables and sampling distributions; estimation and hypothesis testing; concepts of central tendency, variability, confidence level; correlation, regression and variation analysis; robust estimation; experiments of evaluation; experiments of comparison; factorial experiments (analysis of variance); experimental designs (involving randomization, replication, blocking and analysis of covariance).  
Note: Credit for both Environmental Engineering 621 and Chemical Engineering 619.45 will not be allowed.

Environmental Engineering 623    H(3-0)

**Air Dispersion Modelling**

Environmental Engineering 625    H(3-0)

**Computational Methods for Environmental Engineering**
Taylor series, numerical integration. Linear and nonlinear algebraic equations and solvers. Ordinary and partial differential equations. Finite difference methods: explicit, implicit and Crank-Nicholson methods. Finite difference, finite element or finite volume numerical approximations. Initial and boundary value problems. Boundary conditions, discretization considerations, and design of approximations, accuracy and error reductions. Applications in environmental engineering, such as pollutant dispersion and transport, will be discussed.  
Note: Credit for Environmental Engineering 625 and any of Chemical Engineering 639, Civil Engineering 743 or Mechanical Engineering 631 will not be allowed.

Environmental Engineering 627    H(3-0)

**Contaminant Transport**

Environmental Engineering 631    H(2-2)

**Remote Sensing for Environmental Modelling**
Application of geomatics technologies to monitoring, modelling and mitigation of environmental engineering problems. Remote sensing (RS) and Geographic Information Systems (GIS) for estimating parameters in earth systems modelling and land based processes including evapotranspiration, precipitation, snowmelt, temperature, and effects of El Nino. Monitoring of climate change and impacts of anthropogenic activities such as farming induced erosion and desertification. Science and engineering of water quality in inland, coastal and deep ocean environments and the use of RS and GIS to monitor and model eutrophication, sediment levels and temperature.
<table>
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<tr>
<th>Course Code</th>
<th>Title</th>
<th>Notes</th>
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<tbody>
<tr>
<td>Environmental Engineering 633 H(3-0)</td>
<td><strong>Fuzzy Logic for Environmental Engineering</strong>&lt;br&gt;Complex, nonlinear, or ambiguous system models. Fuzzy set theory, fuzzy logic operations, fuzzification and de-fuzzification. Development of membership functions, fuzzy system simulation, Rule-based reduction methods, Fuzzy classification and pattern recognition, Fuzzy arithmetic and extension principle, Fuzzy Control and Fuzzy cognitive mapping, applications in environmental engineering.&lt;br&gt;Note: Credit for Environmental Engineering 633 and any of Civil Engineering 619.30 or 619.91 will not be allowed.</td>
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<tr>
<td>Environmental Engineering 635 H(2-2)</td>
<td>(Geomatics Engineering 583) <strong>Environmental Modelling</strong>&lt;br&gt;Nature and purpose of environmental modelling; the top-down and the bottom-up approaches; typology of environmental models; definition of fundamental concepts; steps involved in designing and building a model; calibration, verification and validation of models; scale dependency; sensitivity analysis; characteristics, architecture and functioning of selected environmental models.</td>
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<tr>
<td>Environmental Engineering 641 H(3-0)</td>
<td>(Chemical Engineering 643) <strong>Air Pollution Control Engineering</strong>&lt;br&gt;Introduction to air quality and air pollution. Impact of air pollution and greenhouse gases on health and climate change. Energy and air pollution. Fundamentals of fossil fuel combustion and related air pollution. Pre-combustion air pollution control strategies: fossil fuel cleaning/refinery, renewable energy (wind, solar, biomass, etc.), and alternative energy sources (hydrogen, etc). In-combustion air pollution control. Post-combustion air pollution control. Industrial air pollution control. Control of particulate matter. Control of VOCs, SOx, and NOx. Adsorption and absorption of air pollutants. GHG emission control. Indoor air quality engineering. Recent advances on related topics.</td>
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<tr>
<td>Environmental Engineering 643 H(3-0)</td>
<td><strong>Air Pollutant Sampling and Characterization</strong>&lt;br&gt;Fundamentals and principles of air pollutant sampling and characterization. Kinematics of gases. Principles of gaseous pollutant sampling. Aerosol technology. Isokinetic sampling. Statistics and data analyses for airborne particulate matter. Particle size and concentration measurements. Indoor air quality assessment.&lt;br&gt;Note: Credit for Environmental Engineering 643 and any of Mechanical Engineering 619.19 or 619.56 will not be allowed.</td>
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<tr>
<td>Environmental Engineering 651 H(3-0)</td>
<td><strong>Geo-Environmental Aspects of Landfill Design</strong>&lt;br&gt;Soil-chemical interactions and implications. Waste disposal system design. Leachate migration in unsaturated/saturated zones. Analytical and numerical solution of flow and transport equations. Case studies of groundwater contamination. Design and construction of barrier systems. Leachate collection systems. Landfill closure issues. Landfill gas issues and control systems.&lt;br&gt;Note: Credit for both Environmental Engineering 651 and Civil Engineering 619.80 will not be allowed.</td>
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Environmental Engineering 653  H(3-0)  (Civil Engineering 747)

**Contaminated Soil Remediation**
Overview of soil remediation engineering. Contaminant partitioning in air, water and gas phases. Phases of site assessments, Physical and chemical treatment processes, soil vapour extraction, air sparging, soil washing, soil flushing, thermal desorption and incineration, solidification and stabilization, vitrification, biological treatment processes, bioremediation kinetics, ex situ and in situ techniques. Liquid phase bioremediation as it pertains to soil remediation. Note: Credit for both Environmental Engineering and Civil Engineering 747 or 619.62 will not be allowed.

Environmental Engineering 655  H(3-0)  (Civil Engineering 745)

**Hazardous Waste and Contaminated Site Management**

Environmental Engineering 661  H(3-0)  (Chemical Engineering 645)

**Industrial and Produced Wastewater Treatment**
Sources and characterization of industrial wastewater. Treatment objectives and regulations. Unit and process design. Physical/chemical treatment including sedimentation, coagulation, filtration, absorption, adsorption, ion exchange, membrane processes and pH adjustment.

Environmental Engineering 663  H(3-0)  (Civil Engineering 741)

**Biological Processes for Wastewater Treatment**
Specialized biological wastewater treatment processes for removal of impurities not effectively removed by conventional secondary wastewater treatment systems, such as nutrients (e.g. nitrogen and phosphorus), residual organics, residual solids, bacteria and viruses. Wetlands. Activated sludge modelling. Biological nutrient removal. Sludge management. Disinfection. Note: Credit for both Environmental Engineering 663 and Civil Engineering 619.21 will not be allowed.

Environmental Engineering 665  H(3-0)  (Chemical Engineering 665)

**Wastewater Issues for the Oil and Gas Industry**
Note: Credit for both Environmental Engineering 665 and Chemical Engineering 619.79 will not be allowed.

Environmental Engineering 671  H(3-0)

Energy and Environment
A graduate seminar course. Lectures will alternate with discussion based on assigned reading. Topics will be selected to satisfy the interests of students from the following list. Energy overview from primary energy to end use including, quantities, fuels and prices; energetics of natural systems; formation, extraction, and transformations of fossil fuels; physics and engineering of nuclear power; modern renewables: biomass, solar and wind; electricity generation, transmission and economics; building energy systems; heat and power integration; overview of climate science: paleo-climatology, processes that determine climate, predictions and observations of anthropogenic climate change; technical options for reducing CO₂ emissions.
Note: Credit for both Environmental Engineering 671 and Chemical Engineering 619.61 will not be allowed.

Environmental Engineering 673  H(3-0)  (Mechanical Engineering 637)

Thermal and Cogeneration Systems
Fundamentals of thermodynamics, fluid mechanics and heat transfer. Thermal and energy systems, heat exchangers, co-generation, etc. Second law of thermodynamics and concept of entropy generation and thermo-economics. Environmental issues and pollution control. Renewable energy system. Co-generation design, heat exchanger design, energy storage systems. Optimization process.
Note: Credit for both Environmental Engineering 673 and Mechanical Engineering 619.13 will not be allowed.

Environmental Engineering 681  H(0-6)

Project in Environmental Engineering I
A one-term half-course which allows course-based MEng degree students with the opportunity of pursuing advanced studies or a design project in environmental engineering under the direction of one or more faculty members, which must be arranged and approved prior to registration. A written proposal, progress reports, and a final report are required.
Note: Credit for Environmental Engineering 681 and any of Engineering 683, Engineering 685 or Environmental Engineering 682 will not be allowed.
Note: Available to course-based MEng degree students only. Cannot be taken following the completion of Environmental Engineering 682.

Environmental Engineering 682  F(0-6)

Project in Environmental Engineering II
A two-term full-course which allows course-based MEng degree students with the opportunity to work on a comprehensive research or design project under the supervision of one or more faculty members, which must be arranged and approved prior to registration. A written proposal, progress reports, and a final report are required.
Note: Credit for Environmental Engineering 682 and any of Engineering 683, Engineering 685 or Environmental Engineering 681 will not be allowed.
Note: Available to course-based MEng degree students only. Cannot be taken following the completion of Environmental Engineering 681.
Environmental Engineering 691  H(3-0)

*Environmental Policy Analysis*


Environmental Engineering 693  H(3-0)

*Life Cycle Assessment*

Concepts of life cycle assessment. Consideration of environmental and economic impacts from the extraction of resources to the disposal of unwanted residuals. Review and evaluation of tools and frameworks (e.g. process, input-output, hybrid life cycle assessment). Relative merits of various methods for interpreting and valuing the impacts. Examples of applications in environmental engineering and the energy industry.

Revisions (updated February 10, 2009)

- Page 185
  - Revised details for "Engineering, Energy & Environment Interdisciplinary Specialization" as follows:

**ENGINEERING, ENERGY & ENVIRONMENT INTERDISCIPLINARY SPECIALIZATION**

Contact Info
Location: Information & Communications Technology Building, Room ICT248
Faculty number: (403) 210-9892
Fax: (403) 210-9892
E-mail address: ceere@ucalgary.ca
Web page URL: [http://www.schulich.ucalgary.ca/CEERE/](http://www.schulich.ucalgary.ca/CEERE/)

The Centre for Environmental Engineering Research and Education (CEERE) in the Schulich School of Engineering (SSE) has the overall responsibility for the coordination and delivery of a comprehensive postgraduate program specialization in the multi-disciplinary field of energy & environment. All five engineering departments participate in delivering this Faculty SSE-wide specialization.

Applications for admission to the Faculty of Graduate Studies should be submitted to the engineering department that best matches the applicant’s undergraduate and/or postgraduate academic training.

**1. Degrees and Specializations Offered**

Degrees with an interdisciplinary specialization in Energy & Environment

- Doctor of Philosophy (PhD)
- Master of Science (MSc)
- Master of Engineering (MEng)
2. Admission Requirements

In addition to the Faculty of Graduate Studies, SSE, and home department requirements, the Energy & Environment specialization requires:

Master of Engineering and Master of Science

A Bachelor’s degree in engineering

Note: Applicants with applied science degrees may be considered, but additional undergraduate engineering courses may be required.

Doctor of Philosophy

A Master’s degree in engineering

Note: Transfer to the doctoral program without completing the Master’s degree may be approved for exceptional students.

3. Application Deadline

See departmental and program sections in this Calendar for deadlines regarding submission of complete applications for students with international transcripts or with Canadian and US transcripts.

Deadlines for submission of complete applications for students with international transcripts:

- 15 May for September admission
- 15 September for January admission
- 15 December for May admission

Deadlines for submission of complete applications for students with Canadian and US transcripts:

- 15 June for September admission
- 15 October for January admission
- 15 March for May admission

4. Advanced Credit

See “Engineering Programs,” in this Calendar.

5. Program/Course Requirements

Master of Engineering (Courses Only Route)

10 half-courses of which a minimum of six must be graduate half-courses. At least four courses must be selected from a list of courses related to Energy & Environment available from CEERE.

Students with non-engineering undergraduate degrees may be required to take additional prerequisite courses at the undergraduate level.
**Master of Engineering (Thesis Route)**
A minimum of four graduate half-courses. At least two courses must be selected from a list of courses related to Energy & Environment available from CEERE.

Students with non-engineering undergraduate degrees may be required to take additional prerequisite courses at the undergraduate level.

**Master of Science**
A minimum of four graduate half-courses. At least two courses must be selected from a list of courses related to Energy & Environment available from CEERE.

Students with non-engineering undergraduate degrees may be required to take additional prerequisite courses at the undergraduate level.

**Doctor of Philosophy**
For applicants with Bachelor of Science and Master of Science degrees in Engineering:
A minimum of two graduate half-courses. At least one course must be selected from a list of courses related to Energy & Environment available from CEERE.

For applicants with a Bachelor’s degree in Engineering, but without a completed Master’s degree:
A minimum of six graduate half-courses. At least three courses must be selected from a list of courses related to Energy & Environment available from CEERE.

Students with non-engineering undergraduate degrees may be required to take additional prerequisite courses at the undergraduate level.

6. **Additional Requirements**
Not applicable.

7. **Credit for Undergraduate Courses**
Not applicable.

8. **Time Limit**
Expected completion time is two years for the Master of Science degree, and three years for the Doctor of Philosophy. Maximum completion time is four years for the Master of Science and Master of Engineering (Thesis) degrees and six years for the Master of Engineering (Courses Only) and Doctor of Philosophy degrees.

9. **Supervisory Assignments**
All students are required to have a thesis supervisor before the second annual registration. For students in the Master of Science and Doctor of Philosophy degree programs, a supervisor is normally appointed at the time of admission.

10. **Required Examinations**
All final thesis oral examinations involve a public seminar/presentation before a closed oral examination.

11. **Research Proposal Requirements**
None.
12. Special Registration Information
None.

13. Financial Assistance
See “Engineering Programs.”

14. Other Information
See “Engineering Programs.”

15. Faculty Members/Research Interests
The current research interests of the academic staff can be found at http://www.schulich.ucalgary.ca/CEERE/ or from the various engineering departments.

Academic Regulations - Master's Thesis Handbook
Revisions (updated Feb. 6, 2009)

- Page 28
  - Revised Articles 1.0 through 8.0 to include all revisions approved by Graduate Council on July 21, 2008 as follows:

Supervisors and Supervisory Committees

1.0 Selection of a Supervisor

1.1 General Advice to Students
All students must have either an interim advisor or an approved supervisor at the time of first registration, and a permanent supervisor no later than the second annual registration. It would help the student in program planning if the selection of a supervisor were completed as quickly as possible. Students are encouraged to think about and select their areas of specialization as early as possible, and preferably before beginning the program.

For further information, review the Guidelines Governing the Supervisory Relationship at http://www.grad.ucalgary.ca > Policies and Procedures > Supervision.

1.2 Supervisor Selection
The selection of a supervisor should be by mutual agreement between student and faculty member, and approved by the Graduate Coordinator. Difficulties or conflicts in selecting or recommending a supervisor should be referred promptly to the Dean by any of the persons involved.

1.2.1 Supervisor Eligibility Requirements
Continuity of supervision throughout a graduate program is important to a student’s success. Normally, faculty members with full-time teaching and research Board appointments are chosen as supervisors. However, there are occasions when it is to the student’s advantage for a program to recommend the appointment of a supervisor who does not have a full-time Board appointment. For example, an individual who holds an appointment that is term certain, specific term, part-time, clinical or adjunct, or honorary, or has emeritus status, or is from outside the University, may be appointed supervisor. In cases such as these, the Faculty of Graduate Studies requires assurance that the proposed supervisor will be able to provide continuity.
The proposed supervisor must understand the commitment expected in terms of time and funding and be familiar with graduate program and Faculty of Graduate Studies regulations. The Graduate Coordinator must ensure that supervision will be provided for the probable time period required for the completion of the degree program.

There must be provision, in the form of a co-supervisor, for backup if the proposed supervisor is someone from outside the graduate program who does not have a full-time Board appointment, or is from outside the University of Calgary. If the proposed supervisor is someone from outside the graduate program who does not have a full-time Board appointment a Co-supervisor must be appointed.

The supervisor should be currently active in research in an area related to the student's interest. Faculty members working on their own graduate degrees cannot be approved in any supervisory capacity without special dispensation from the Dean. For detailed policy and the required forms, see [http://www.grad.ucalgary.ca/policies/supervision](http://www.grad.ucalgary.ca/policies/supervision).

### 1.2.2 Conflict of Interest

The relationship between supervisor and student is an academic one. Where other relationships exist or develop that might give the appearance of conflict of interest they must be immediately reported to the Graduate Coordinator and to the Dean who can consult with an Associate Dean or the Dean if the Coordinator is unable to resolve the situation. (See Graduate Studies Conflict of Interest Policy: [http://www.grad.ucalgary.ca/policies/conflictofinterest](http://www.grad.ucalgary.ca/policies/conflictofinterest)).

### 1.3 Appointment of Co-supervisor

In addition to those cases noted above in which it is required that a Co-supervisor be appointed, a Co-supervisor may be appointed by the Graduate Coordinator upon the written recommendation of the supervisor and agreement of the student. The role of the Co-supervisor is to provide supplementary guidance, instruction and research stimulation on a regular or extensive basis.

### 1.4 Supervisor from Outside the Department, Program, or Faculty

A supervisor may be from a department, program, or faculty other than the student's home department, program, or faculty. The recommendation must be endorsed by the student. Such an "external" supervisor must agree to be responsible to the Graduate Coordinator of the student's home department in all matters related to the supervisory responsibilities.

### 1.5 Continuity of Supervision

Students are entitled to continuity of supervision. In the case of the resignation from the University, illness or death of the supervisor, the Graduate Coordinator must make immediate arrangements to provide continuity of supervision pending the appointment of a new supervisor.

### 1.6 Supervisor Selection and Approval Deadlines

Regular students are required to have approved supervisors within twelve months of initial registration. A student admitted as a special case admission must have an approved supervisor before admission.
1.7 — Special Case Graduate Admission

When there are resources within a department/graduate program available for a student to undertake graduate studies, but no appropriate formal graduate degree program exists, the student may be admitted as a Special Case Graduate Admission. The Dean must be satisfied that the student is worthy of special consideration and that the department/graduate program recommending admission can offer a viable program of studies with specialization in the student's field of interest. Requests for the admission of special case students should not be frequent.

Guidelines for the preparation of a request for special case admission are available at http://www.grad.ucalgary.ca/policies/specialcase.

1.7.1 — Supervision for Special Case Admissions

A supervisor for a special case admission must be recommended and approved by the Dean before the admission is approved. Graduate Coordinators should recommend only experienced supervisors whose areas of research closely match those of the students.

2.0 Responsibilities of Supervisors

2.1 Knowledge of Rules and Procedures

Supervisors should be familiar with the rules and procedures of the Faculty of Graduate Studies (see also flowcharts at the end of this document). A supervisor should be fully informed of the academic schedule in the University calendars at http://www.ucalgary.ca/pubs/calendar. Both student and supervisor are responsible for ensuring compliance with all Faculty of Graduate Studies and program regulations and requirements.

2.2 Meetings between Student and Supervisor

A student and supervisor have a shared responsibility to meet on a regular basis.

2.3 The Role of the Supervisor

The supervisor should act both as a general academic-tutor-mentor, with emphasis on guidance, instruction, and encouragement of scholarship and research, and as a judge of the student's performance. Because of their own involvement in research and related professional activities, supervisors should provide professional guidance and research stimulation to their students. A fundamental duty of the supervisor is to impart to the student the skills necessary to plan and conduct original research.

Specifically, the supervisor should:

Advise — Work with the student on the establishment of a realistic timetable for the completion of the various requirements of the program of study;
Develop a relationship with the student conducive to research and intellectual growth;
Guide the student in the pursuit of knowledge and provide constructive criticism in support of the highest standards of research and professional development.

2.4 Participation of Supervisor in Thesis Preparation

The supervisor should be involved during the preparation of the draft thesis, but should not impose any particular orientations on the student. The supervisor is expected to provide frequent and prompt comments on drafts of the thesis and should attempt to be critically
constructive and encouraging but the thesis must be the creation of the student.

2.5 Supervisory Provision for Leave of Absence

A program and supervisor must ensure that the student is provided with adequate supervision during extended periods of a supervisor's leave, potentially through the appointment of an interim supervisor. Faculty members should plan an appropriate reduction in their supervisory responsibilities prior to and during leaves of absence. Students should be informed well in advance about the supervisor's plans for forthcoming leaves of absence. Supervisors granted research leave under certain programs, such as Killam Resident Fellowships, but not Sabbatical Fellowships, are expected to continue to supervise their students. With current means of communication, continued supervision while on leave is the expectation for faculty members. These arrangements must be communicated in writing to the Graduate Coordinator, who bears the responsibility for ensuring continuity of supervision for students in his/her graduate program.

2.5.1 Supervision During Absence of Supervisor

Faculty members are responsible for the continued supervision of their students. When planning leaves of absence of any kind they must, in consultation with their students and the Graduate Coordinator, make satisfactory arrangements for the continuation of each student's supervision. These arrangements must be communicated in writing to the Graduate Coordinator, who bears the responsibility for ensuring continuity of supervision for students in his/her graduate program.

2.5.2 Interim Supervisory Arrangements

When an interim supervisor is appointed to cover a period of a supervisor's absence, the regular supervisor retains final responsibility for the adequate supervision of the student. Faculty members approved as interim supervisors must indicate in writing to the Graduate Coordinator their willingness to accept responsibility for the day-to-day supervision of such students.

2.6 The Supervisor and Setting up Examinations

The supervisor is responsible for setting up and scheduling the thesis oral examination.

2.7 Suggested Procedures in the Event of Problems between Graduate Students and Their Supervisors

Students should first try to resolve problems with supervisors by talking to the supervisor. Supervisory committee members might be able to give helpful advice in this situation. Problems that are not resolved in this fashion should be discussed with the Graduate Coordinator, and then the Department Head or equivalent. If it appears that a solution cannot be reached, the student and/or the Graduate Coordinator may consult the Faculty of Graduate Studies for advice about the correct route to follow to bring a resolution to the matter.

2.8 Procedures for the Curtailment of Supervisory Duties

The Dean of Graduate Studies approves the initial appointment of a faculty member to supervisory duties. If a complaint is made against a supervisor, the Dean will first discuss the matter with the Department Head or equivalent, and then with the faculty member concerned. The issue may be resolved informally. If the Dean decides that a more formal approach is needed to resolve the dispute, the Dean will inform both the Head and the faculty member of his/her conclusions in writing. If the result of the Dean’s investigation is curtailment of the supervisory duties of the faculty member, the Dean will inform the
2.9 Requirements for a Master’s Supervisory Committee

A supervisory committee at the Master’s level is not normally appointed. When such a committee is deemed necessary, the Dean’s approval must be obtained. The Dean of the Faculty of Graduate Studies will recognize a formal supervisory committee at the Master’s level only when there is an established need for active participation in the supervisory process by more than one faculty member, or where such a committee is an integral part of the program itself. Program Calendar entries refer to this requirement. When such a committee is required by the program, the program must file an Appointment of Supervisor/Supervisory Committee form with the Faculty of Graduate Studies. Justification for a supervisory committee must be supplied in writing to the Dean. A Master’s supervisory committee will be governed by the rules applying to doctoral supervisory committees (see Article 3.0 in Handbook of Supervision and Examination Part III: Doctor of Philosophy / Doctor of Education Degree).

Members of a Supervisory Committee should provide support to both the student and the Supervisor by expanding the range of expertise and experience available to advise and assess the student. Members should provide constructive criticism and discussion of the student's ideas, methods and performance as the program develops; should be accessible to the student for consultation and discussion; should suggest other sources of information to the student; and must participate in examinations and in periodic meetings with the student and provide regular assessment of the student's progress as required by the program regulations.

THE MASTER’S THESIS

3.0 Thesis Quality Requirements

The thesis should demonstrate that the candidate is acquainted with the published literature in the subject of the thesis; that appropriate research methods have been used; and that appropriate levels of critical analysis have been applied. To the extent possible, the research embodied in the thesis should make some original contribution to knowledge in the field.

The general form and style of thesis may differ from program to program, but a thesis should be a coherent document. This means that if a thesis contains separate manuscripts, there needs also to be an introductory and concluding chapter that explain how these separate manuscripts fit together into a unified body of research. If previously published materials are included, it should be made clear what exactly is the student's own work and what is the contribution of other researchers.

While it is expected that a portion of the thesis could be the basis for a publication, the supervisor and examiners should recognize that even an excellent thesis may not be perfect in all respects. “Perfection” is not a prerequisite for acceptance of the thesis as a “partial fulfillment of the requirements for the degree.” The thesis is an academic exercise, which, like all such exercises, may vary in quality. The thesis may vary in quality from passable to outstanding.

EXAMINING COMMITTEES, EXAMINATIONS AND STANDARDS

4.0 Standards of Performance
4.1 Performance in Course Work

Standards of performance in course work are the responsibility of individual departments and Faculties. However, to remain in good standing in a program of graduate study, a student must maintain the minimum grade point average (GPA) required by the Faculty of Graduate Studies (see the Graduate Grading System in the Calendar.)

4.2 Judgment of Student Performance

Supervisors and Graduate Coordinators must inform students on a regular basis about their academic progress. If a student's performance is judged to be below an acceptable level, this judgment should be expressed to the student formally and in writing at as early a stage in the program as possible. A student may be required to withdraw from the Faculty of Graduate Studies for reasons of "unsatisfactory progress." (See also section 5.3).

4.3 Annual Progress Report

The Supervisor and each continuing student must jointly submit an annual progress report on the student's performance. This form must be signed by the Supervisor, the Graduate Coordinator, and the student, and must be made available forwarded to the Faculty of Graduate Studies upon request. The student must sign the report after the supervisor and the Graduate Coordinator have completed their comments to acknowledge that he/she has reviewed these comments.

5.0 Faculty of Graduate Studies Examinations

5.1 Faculty Examination Requirements

Care should be taken to distinguish between Faculty of Graduate Studies examinations and Departmental or Program examinations. The Faculty of Graduate Studies requires a final oral examination of theses. Any requirement for a written comprehensive examination is at the discretion of the department.

Since the thesis oral examination is an examination of the Faculty of Graduate Studies, it must be conducted in accordance with Faculty rules. No changes in approved timetables, composition of examination committees, sequences of events, etc., may be introduced without prior approval from the Dean.

5.2 Faculty Regulations for Thesis Examinations

The thesis oral examination is an examination of the Faculty of Graduate Studies. No changes in the composition of examination committees may be introduced without prior approval from an Associate Dean of Graduate Studies or the Dean of Graduate Studies. The Faculty of Graduate Studies must be informed of minor changes in the scheduling of the examination (e.g., for illness or weather). Changes of more than two weeks will need prior approval by the Faculty of Graduate Studies.

5.3 Program Examination Requirements and Standards

Program requirements may include examinations that are in addition to the Faculty of Graduate Studies requirements. Programs are entitled to set their own standards of adequate performance in such examinations, provided these are not in conflict with Faculty of Graduate Studies standards. When a student fails to meet either Faculty or program standards, the program may recommend to the Dean that the student be required to withdraw (see also section 4.2).
5.34 Communication of Examination Requirements to Students
Programs should provide their students, as early as possible, with information about the precise nature and form of program examinations and tests.

6.0 Thesis Oral Examinations

6.1 Right of Student to Submit and Defend Thesis
A student who has successfully completed all Faculty of Graduate Studies and program requirements has the right to submit and defend a thesis even if doing so may be contrary to the advice of the Supervisor.

6.2 Composition of the Thesis Oral Examination Committee
The thesis oral examination committee shall consist of the student’s Supervisor and at least two other examiners, one of whom shall be external to the student’s home department or program. If there is a Co-supervisor but not a formal Supervisory Committee, two other examiners are still required, one of whom shall be external to the program. If there is a formal Supervisory Committee, only one additional examiner external to the program is required. The composition of the committee must be recommended by the Graduate Coordinator and approved by the Dean of Graduate Studies.

6.2.1 The External Examiner
The external examiner must meet the following criteria:

If from within the University of Calgary, must have a Board appointment outside the student’s program but within the professorial ranks, and have expertise in the student’s research area or a closely related field

If external to the University of Calgary, must have a well-established research reputation, expertise in the area of the student’s research, and experience in evaluating theses at a graduate level

In addition, the external examiner must:

Not have collaborated with the supervisor in the last five years
Not be related to the student, nor have worked with the student
Not have been a supervisor in the student’s department or program for the last three years

An external examiner who does not meet all the criteria is not necessarily precluded from serving on the examining committee, but the Graduate Coordinator must provide the Dean of Graduate Studies with a memo explaining the circumstances. Non-Board appointees to examination committees may be designated as external examiners with the approval of the Dean of Graduate Studies.
6.2.2 Non-Board Appointees on Examination Committees

Persons who are not Board appointees of the University of Calgary may be approved to serve on thesis oral examination committees. A recommendation to the Dean of Graduate Studies by the Graduate Coordinator for such an appointment must be accompanied by a curriculum vitae.

6.2.3 The Neutral Chair

The examination is chaired by a neutral member of the academic staff appointed by the Dean of Graduate Studies upon the recommendation of the Graduate Coordinator. He/she is not a member of the examining committee and is non-voting.

6.2.4 Responsibilities of the Chair and the Supervisor and the Neutral Chair

The Supervisor arranges the scheduling of the examination. The Neutral Chair chairs presides over the thesis oral examination and reports the results to the Dean and the student. The supervisor should initiate all arrangements related to the scheduling of the examination. The Neutral Chair gives the report to the Graduate Coordinator who ensures that it is submitted to the Faculty of Graduate Studies within 24 hours of the examination.

6.3 Composition of Examination Committee for Re-take of Thesis Oral Examination

The examination committee formed to re-examine a student should not be identical to the examination committee of the first examination. At least one member should be replaced. Normally, the composition of the examination committee will remain the same. Upon the recommendation of the Graduate Coordinator and approval of the Faculty of Graduate Studies, an examiner may be replaced.

The deadlines for the recommendation of the examination committee are as for the original examination.

7.0 Scheduling the Thesis Oral Examination

7.1 Supervisor Responsibility

The supervisor is responsible for setting up scheduling the thesis oral examination.

7.2 Notice of Thesis Oral Examination

The original Notice of Thesis Oral Examination form, indicating the title of the thesis, the time and place of the examination, and the names of the recommended examiners, and confirming that the candidate has completed all program requirements, endorsed by the Graduate Coordinator, must be received in the Faculty of Graduate Studies office at least four weeks prior to the time of the examination. The membership of the examination committee will not be approved earlier than three months before the planned examination date must be approved by the Faculty of Graduate Studies.

7.2.1 Posting the Notice of Thesis Oral Examination

The Notice of Thesis Oral Examination form, bearing the names, but not signatures of the student, the Supervisor, the Graduate Coordinator and the Dean of Graduate Studies, or designate, must be posted at least two weeks before the date of the examination. The Graduate Coordinator must ensure that copies of the Notice are sent to the student and to members of the examination committee.

7.2.2 Student Approval of Designated Area of Specialization

The format of the University degree parchment presented to successful candidates shows
the degree, the department or area of study, and the approved area of specialization. Students should ensure that the proposed area of specialization identified on the Notice of Thesis Oral Examination form is correct, before it is sent to the Faculty of Graduate Studies.

7.3 Form of Thesis

The thesis submitted to the members of the examination committee for final examination must be in all respects a final, complete copy and not a draft.

7.4 Thesis to Examiners

The student must ensure that the thesis is in the hands of the examiners at least three weeks prior to the proposed date of the oral examination. The examination begins when the thesis is distributed. If, after reading the thesis, the examiner thinks that the student will fail the examination, the examiner shall not contact the supervisor or any other examining committee member before the oral examination to discuss the possible outcome of the examination. The examiners should not discuss the thesis or their evaluation of it with each other (or anyone else) prior to the oral examination. The Examiner's Report is considered a confidential document and must not be shared with the candidate or the other examining committee members before the final decision of the examining committee.

7.5 Format of Final Thesis Oral Examination

Final thesis oral examinations are designated "open" or "closed". Such determination is made by the Department/Graduate Program and is described in program listing in the Graduate Calendar.

Attendance at a closed examination is limited, but may be preceded by a public presentation on the same day. What transpires at the public presentation is not considered part of the examination.

Normally, final thesis oral examinations are open to the public, but only the examiners may question the student. If a program has opted to hold open examinations, a student has a right to choose, without prejudice, a closed examination and no public presentation.

In both open and closed examinations, the examiners' deliberations are private and confidential. Only the Neutral Chair, the examining committee, and, if present, the Department/Program Head and the Dean of Graduate Studies or Dean's Representative may be present.

7.5.1 Attendance at Closed Thesis Oral Examinations

No more than ten people may be present at a closed examination. This number includes the chair, voting or non-voting, the examining committee, the Department/Program Head and any such additional persons as are approved by the Dean. The Dean and/or Dean's representative may attend any oral examination without prior notice. The names of the people in attendance, with the exception of the Dean and/or Dean's representative and the Department/Program Head or designate must appear on the Notice of Thesis Oral Examination form.

7.5.2 Attendance at Open Thesis Oral Examinations

Open examinations are open to the public.

8.0 Conduct of Thesis Oral Examination
8.1 Examiner’s Report on Thesis

Before the oral examination, each examiner is required to prepare an assessment of the thesis on the official Examiner's Report on Thesis form. These assessments are to be submitted to the Neutral eChair of the examination committee before the oral examination begins. The assessments are CONFIDENTIAL: they are not to be made available to the student or to the examination committee before the final decision recommendation of the examination committee. After the examination, the Neutral eChair should transmit the reports to the Dean with copies to the Graduate Coordinator who ensures that they are forwarded to the Faculty of Graduate Studies. After the examination, the graduate program must make the Examiners' Reports available to the student, upon request.

8.2 Examination Regulations

8.2.1 Formal Examination

The oral examination is a formal examination, not an informal discussion with the candidate.

8.2.2 Questioning of the Candidate

No one other than an examiner (as identified on the Notice of Thesis Oral Examination form) is allowed to question the candidate. All examiners must be given an opportunity to question the candidate early in the examination, e.g., by rounds of questioning.

8.2.3 Length of Examination

The oral examination should not exceed two hours. If the examination is properly conducted, within this time period examiners should have as good an assessment of the student as they will ever have. This does not include deliberation time of the committee.

8.2.4 Editorial Comments on Thesis

Examiner's editorial comments on the thesis should not be discussed at the oral examination. It is recommended that each examiner hand the student a list of any such comments for post-examination final thesis revisions.

8.3 Suggested Examination Procedures

8.3.1 Opening Summary

It is common practice to ask the student to present a brief (up to fifteen minutes) opening summary of the thesis. Although this is not mandatory, students may appreciate the opportunity to introduce their research work and summarize its significance.

8.3.2 Background Questioning

General background questioning, not relevant to the subject matter of the thesis, should be avoided during the early stages of the examination.

8.3.3 Questions to the Candidate

Questions to the candidate should be relevant to the subject matter of the thesis, and should be clearly and succinctly phrased in order to minimize doubt in the candidate's mind as to what is being asked. The student should be given reasonable time to answer. If the student has understood the question but cannot answer, the examiner should pass to another question and not attempt to extract an answer by prolonged interrogation. The Neutral eChair should guard against any tendency of examiners to interact with each other instead of concentrating on the examination of the candidate.
Revisions (updated February 9, 2009)

- Page 33
  - Revised Article 11.1 to include all revisions approved by Graduate Council on July 21, 2008 as follows:

<table>
<thead>
<tr>
<th>11.0 Transfers to Doctoral Programs</th>
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<tbody>
<tr>
<td>11.1 Transfer from Master’s to Doctoral Programs</td>
</tr>
<tr>
<td>Program Heads may recommend outstanding Master’s students for transfer to the doctoral program. Such recommendations must be endorsed by the student’s supervisor and accompanied by the names of members of the student’s doctoral supervisory committee for the Dean’s approval. The transfer must be approved by the Dean of Graduate Studies.</td>
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