Environmental Conservation Graduate Program

Building Systems Concentration

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A. Concentration Description

This concentration leads to both Master of Science (MS) and Doctor of Philosophy (PhD) degrees in Environmental Conservation (ECo) and is designed for students who want scientific training in the multi-disciplinary field of building systems. The focus of this concentration is broadly on building systems but encompasses specialized training in fields such as green building, structural timber design, energy systems, material strength modeling and management/marketing of building materials. The diverse nature of the concentration is intended to allow students from different backgrounds to shape their own education.

Faculty affiliated with this concentration (see below) have expertise in environmentally sensitive building materials & systems (green building); wood-concrete composite systems; innovative connection systems for timber structures; computational modeling of bio-based composites; energy modeling and systems design; forest products marketing and economics; computer applications in building design; and structural optimization. A major strength of our program is the unique interdisciplinary and official tie of both faculty and students to related departments and programs of building on campus; building systems faculty serve as core faculty of the Architecture + Design program on campus as well as adjunct faculty with the Department of Civil and Environmental Engineering. The interdisciplinary culture encourages joint research and funding as well as instruction. Students and faculty with backgrounds of material science, planning, architecture and engineering share research projects, labs and valuable expertise.

The research projects of the current graduate students in the Building Systems Concentration are varied, ranging from computational modeling of structural composite lumber to energy auditing and building diagnostics to forest product economics. Through their research projects, graduate students often employ or provide volunteer opportunities for interested
undergraduates (about 100 in the Building and Construction Technology program). Graduate students are also encouraged to participate in projects and activities of their colleagues to broaden their experience and to provide and receive ideas and suggestions for improvements.

At the MS level, students have the option of pursuing either a professional degree or thesis degree. The thesis/dissertation degree leads to the MS or PhD degree and centers around the completion of a major independent research project in addition to a modest coursework requirement. The professional degree leads to the MS degree and centers around a professional paper based on an internship/practicum in addition to a more substantial coursework requirement. Both degree options provide students a strong foundation in three core topic areas: environmental science (biology, ecology, conservation and environmental building systems), 2) quantitative science (statistics, GIS and modeling), and 3) human dimensions (environmental policies, economics, politics, administration, management and values). The MS thesis degree is intended to prepare students for the option of pursuing a PhD and an eventual career in conservation science. The MS professional degree is meant to be a terminal degree for students seeking graduate-level training in a particular field of study and a career as a professional conservation scientist. Overall, the academic requirements of this concentration in combination with the research/practicum experience provide students the professional training for sustainable building positions within academia, non-governmental building organizations, and private industry (e.g., environmental design consulting firms). In addition, MS thesis degree students completing this program are well prepared to meet the challenges of any PhD program.

B. The MS Professional Degree

Prerequisites

Candidates for an MS professional degree in this concentration will be admitted on the basis of their academic training, work experience, statement of intent and letters of recommendation. At a minimum, candidates will be expected to possess:

1) a Bachelor’s degree in:
   • a related engineering discipline (e.g., structural, mechanical)
   • architectural or urban studies
   • a technical degree with a focus on building technology, planning or construction
   • business administration with an emphasis in real estate or construction
• any field with a strong background in the physical or environmental sciences and professional experience working as a building professional.

Note, prerequisites exist for many of the required courses. Students are expected to have satisfied these prerequisites prior to commencing the program or in addition to the curriculum requirements outlined below.

Requirements

Students in this concentration are expected to meet all of the requirements for an MS degree in ECo, as outlined in the student handbook, including the following:

1) A minimum of 35 credits is required, 21 of which must be in the major (defined broadly), 8 of which must be at the 600 level or above, and 6 of which must be an internship/practicum specific to this concentration and approved by the student's advisory committee; up to 6 graduate credits can be transferred from previous course work from UMass or another university;
2) Successful completion of a comprehensive exam based upon the student’s academic training in environmental conservation, encompassing three “core” topic areas (environmental science, quantitative science, and human dimensions) in addition to the required ECo core courses; and
3) Successful final defense of a publishable-quality professional paper resulting from the internship/practicum.

Curriculum

Note, all courses ending in 97 have an additional letter designation (e.g., 697A) not specified below because it is subject to change; check SPIRE online for the current course number listing.

1. Required Core Courses (8 credits) (take all of the following)

   ECO 601 Research concepts (fall, 3cr)
   ECO 697(602) Analysis of environmental data (fall, 3cr)
   ECO 791A(602) Communicating science (spr, 1cr)
   ECO 691A(604) Current research in environmental conservation (both, 1cr)

2. Core Topic Areas (21 credits) (including a minimum of one 500-level or above 3-4 credit course in each core topic area below, plus a minimum of three additional courses approved by student's committee; note, students may take courses other than those listed here to fulfill the core topic area requirements if they are approved by the students advisory committee and the Graduate Concentration Coordinator; course numbers are subject to change)

   a. Environmental Science (take one or more of the following)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARCHDES 520</td>
<td>Building physics I: energy efficient housing (fall, 3cr)</td>
</tr>
<tr>
<td>ARCHDES 550</td>
<td>Tectonics I (fall, 3cr)</td>
</tr>
<tr>
<td>ARCHDES 620</td>
<td>Building physics II: architectural lighting (fall, 3cr)</td>
</tr>
<tr>
<td>BCT 530+597BM</td>
<td>Mechanics of building materials (spr, 4cr)</td>
</tr>
<tr>
<td>BCT 521</td>
<td>Building energy &amp; environmental systems (spr, 3cr)</td>
</tr>
<tr>
<td>BCT 597F</td>
<td>Bio-Based Building Lab (spr, odd yrs, 3cr)</td>
</tr>
<tr>
<td>BCT 597P</td>
<td>Peeking over the Fence of a Construction Site (both, 1cr) NRC</td>
</tr>
<tr>
<td>590GC</td>
<td>Global change ecology (fall, 3cr)</td>
</tr>
<tr>
<td>ECO 621</td>
<td>Landscape ecology (spr even yrs, 4cr)</td>
</tr>
<tr>
<td>ECO 697</td>
<td>Conservation biology (fall odd yrs, 3cr)</td>
</tr>
<tr>
<td>ECO 697(627)</td>
<td>Urban ecology (fall, 4cr)</td>
</tr>
<tr>
<td>ENVIRSCI 504</td>
<td>Air pollution &amp; climate change biology (fall, 3cr)</td>
</tr>
<tr>
<td>PUBHLTH 590N</td>
<td>Indoor environment &amp; health (fall, 3cr)</td>
</tr>
<tr>
<td>PUBHLTH 562</td>
<td>Air quality assessment (spr, 3cr)</td>
</tr>
<tr>
<td>PLNTSOIL 555</td>
<td>Urban plant biology (fall, 3cr)</td>
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**b. Quantitative Science** (take one or more of the following)

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>BCT 540</td>
<td>Design of wood structures (fall, 3cr)</td>
</tr>
<tr>
<td>BCT 550</td>
<td>Construction Project Management (both, 3cr)</td>
</tr>
<tr>
<td>BCT 597D</td>
<td>Sustainable building &amp; LEED certification (fall, 3cr)</td>
</tr>
<tr>
<td>BCT 597SD</td>
<td>Solar Energy Systems and Building Design (fall, 3cr)</td>
</tr>
<tr>
<td>BCT 697</td>
<td>Studies in building information modeling (spr, 3cr)</td>
</tr>
<tr>
<td>BCT 697</td>
<td>Analytic methods in building performance (fall, 2cr)</td>
</tr>
<tr>
<td>CE-ENGIN 590A</td>
<td>Sustainable aspects of civil &amp; environ. eng. (spr, 3cr)</td>
</tr>
<tr>
<td>M&amp;I-ENG 570</td>
<td>Solar &amp; dir energy conversion (spr, 3cr)</td>
</tr>
<tr>
<td>PUBHLTH 565</td>
<td>Environmental health practices (both, 3cr)</td>
</tr>
<tr>
<td>REGIONPL 591B</td>
<td>Sustainable cities (spr, 3cr)</td>
</tr>
<tr>
<td>NRC 577</td>
<td>Ecosystem modeling &amp; simulation (fall odd yrs, 3cr)</td>
</tr>
<tr>
<td>NRC 587</td>
<td>Digital remote sensing (spr odd yrs, 3cr)</td>
</tr>
<tr>
<td>NRC 592</td>
<td>GIS for natural resource management (both, 3cr)</td>
</tr>
<tr>
<td>ECO 697</td>
<td>Multivariate statistics for environmental cons. (spr odd yrs, 4cr)</td>
</tr>
<tr>
<td>ECO 697</td>
<td>Intermediate statistics for environmental cons. (spr, 4cr)</td>
</tr>
<tr>
<td>ECO 697</td>
<td>Advanced statistics for environmental cons. (fall even yrs, 4cr)</td>
</tr>
<tr>
<td>ECO 697</td>
<td>Analysis of environmental data - lab (fall, 2cr)</td>
</tr>
<tr>
<td>GEO-SCI 595A</td>
<td>Advanced GIS (spr, 3 cr)</td>
</tr>
<tr>
<td>PLNTSOIL 661</td>
<td>Intermediate biometry (fall, 3 cr)</td>
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**c. Human Dimensions** (take one or more of the following courses)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>NRC 597</td>
<td>Water resources management &amp; policy (fall even yrs, 3 cr)</td>
</tr>
<tr>
<td>ECO 597</td>
<td>Ecological economics and sustainability (spr odd yrs, 3cr)</td>
</tr>
<tr>
<td>ECO 697</td>
<td>Federal environmental law &amp; regulation (spr even yrs, 3cr)</td>
</tr>
<tr>
<td>ECO 697</td>
<td>Natural resources policy &amp; administration (tbd, 3cr)</td>
</tr>
<tr>
<td>LANDARCH 691E</td>
<td>People &amp; the Environment (fall, 2-3 cr)</td>
</tr>
<tr>
<td>POLSCI 784</td>
<td>Environmental policy (tbd, 3 cr)</td>
</tr>
</tbody>
</table>
REGIONPL 591F Green urbanism (spr, 3cr)
REGIONPL 553 Resource policy and planning (spr even yrs, 3 cr)
REGIONPL 575 Environmental law & resource management (tbd, 3 cr)
RES-ECON 720 Environmental & resource economics (fall even yrs, 3 cr)
RES-ECON 721 Advanced natural resource economics (fall, 3 cr)

3. Practicum (6 credits)

ECO 698 Practicum

All students in the MS professional degree option are required to complete at least a 3-month long professional internship or equivalent. There is a wide range of internship opportunities for students with local agencies and companies depending on student background. Some positions are salaried and others are unpaid. The responsibility for seeking out an appropriate organization with whom to work lies with the student, although your major advisor can often provide assistance. The advisory committee and the concentration coordinator may exempt some students with prior professional experience from this internship requirement. Each student will develop a publishable professional paper (based on the practicum) and defend it to their examination committee.

C. The MS Thesis Degree

Prequisites

Candidates for an MS thesis degree in this concentration will be admitted on the basis of their academic training, work experience, letter of intent and letters of recommendation. At a minimum, candidates will be expected to possess:

1) a Bachelor's degree in:
   • structural or mechanical engineering
   • architectural or urban studies
   • a technical degree with an emphasis in building technology, construction or wood science
   • business administration with an emphasis in real estate or construction
   • any field with a strong background in the physical sciences and professional experience working as a building professional.

Note, prerequisites exist for many of the required courses. Students are expected to have satisfied these prerequisites prior to commencing the program or in addition to the curriculum requirements outlined below.

Requirements

Students in this concentration are expected to meet all of the requirements for an MS degree
in ECo, as outlined in the student handbook, including the following:

1) A minimum of 35 credits is required, 21 of which must be in the major (defined broadly), 8 of which must be at the 600 level or above, and 12 of which must be a thesis specific to this concentration and approved by the student's advisory committee; up to 6 graduate credits can be transferred from previous course work from UMass or another university;
2) Successful completion of a comprehensive exam based upon the student's academic training in environmental conservation, encompassing three “core” topic areas (environmental science, quantitative science, and human dimensions) in addition to the required ECo core courses;
3) Successful final defense of the thesis; and
4) A minimum of one publishable-quality scientific paper resulting from the thesis research project.

Curriculum

Note, all courses ending in 97 have an additional letter designation (e.g., 697A) not specified below because it is subject to change; check SPIRE online for the current course number listing.

1. Required Core Courses (8 credits) (take all of the following)

   ECO 601     Research concepts (fall, 3cr)
   ECO 697(602) Analysis of environmental data - lecture (fall, 3cr)
   ECO 791A(602) Communicating science (spr, 1cr)
   ECO 691A(604) Current research in environmental conservation (both, 1cr)

2. Core Topic Areas (15 credits) (including a minimum of one 500-level or above 3-4 credit course in each core topic area below, as approved by the students advisory committee; note, students may take courses other than those listed here to fulfill the core topic area requirements if they are approved by the students advisory committee and the Graduate Concentration Coordinator; course numbers are subject to change)

   a. Environmental Science (take one or more of the following)

      ARCHDES 520  Building physics I: energy efficient housing (fall, 3cr)
      ARCHDES 620  Building physics II: architectural lighting (fall, 3cr)
      ARCHDES 550  Tectonics I (fall, 3cr)
      BCT 530+597BM Mechanics of building materials (spr, 4cr)
      BCT 521 Building energy & environmental systems (spr, 3cr)
      BCT 597F Bio-Based Building Lab (spr, odd yrs, 3cr)
      BCT 597P Peeking over the Fence of a Construction Site (both, 1cr)
      NRC 597590GC Global change ecology (fall, 3cr)
      ECO 621 Landscape ecology (spr even yrs, 4cr)
      ECO 697 (622) Conservation biology (fall odd yrs, 3cr)
b. Quantitative Science  (take one or more of the following)

ARCH-DES 653  Tectonics III (fall, 3cr)
BCT 540  Design of wood structures (fall, 3cr)
BCT 550  Construction Project Management (both, 3cr)
BCT 597D   Sustainable building & LEED certification (fall, 3cr)
BCT 597SD  Solar Energy Systems and Building Design (fall, 3cr)
BCT 697  Studies in building information modeling (spr, 3cr)
BCT 697  Analytical methods in building energy performance (spr, 2cr)
CE-ENGIN 590A  Sustainable aspects of civil & environ. eng. (spr, 3cr)
M&I-ENG 570  Solar & dir energy conversion (spr, 3cr)
PUBHLTH 565  Environmental health practices (both, 3cr)
REGIONPL 591B  Sustainable cities (spr, 3cr)
NRC 577  Ecosystem modeling & simulation (fall odd yrs, 3cr)
NRC 587  Digital remote sensing (spr odd yrs, 3cr)
NRC 592  GIS for natural resource management (both, 3cr)
ECO 631  Multivariate statistics for environmental cons. (spr odd yrs, 4cr)
ECO 697  Intermediate statistics for environmental cons. (spr, 4cr)
ECO 697  Advanced topics in GIS (fall odd yrs, 3cr)
ECO 697  Advanced statistics for environmental cons. (fall even yrs, 4cr)
ECO 697  Analysis of environmental data - lab (fall, 2cr)
PLNTSOIL 661  Intermediate biometry (fall, 3 cr)

c. Human Dimensions  (take one or more of the following courses)

ECO 597  Ecological economics and sustainability (spr odd yrs, 3cr)
ECO 697  Federal environmental law & regulation (spr even yrs, 3cr)
ECO 697  Natural resources policy & administration (tbd, 3cr)
LANDARCH 691  People & the environment (fall, 2-3 cr)
NRC 697  Water resources management & policy (fall even yrs, 3 cr)
POLSCI 784  Environmental policy (tbd, 3 cr)
REGIONPL 591F  Green urbanism (spr, 3cr)
REGIONPL 553  Resource policy and planning (spr even yrs, 3 cr)
REGIONPL 575  Environmental law and resource management (tbd, 3 cr)
RES-ECON 720  Environmental and resource economics (fall even yrs, 3 cr)
RES-ECON 721  Advanced natural resource economics (fall, 3 cr)

3. Practicum (6 credits)

ECO 699  Thesis
D. The PhD Degree

Prerequisites

Candidates for a PhD degree in this concentration will be admitted on the basis of their academic training, work experience, and letters of recommendation. At a minimum, candidates will be expected to possess:

1) a Master’s degree in:
   • structural or mechanical engineering
   • architecture
   • wood or material science
   • business administration with an emphasis in real estate or construction
   • any field with a strong background in the physical sciences and professional experience working as a building professional.

*Note, students wishing to pursue a PhD with only a BS degree must enroll in the MS degree program and successfully complete the requirements of the MS degree before being admitted into the PhD program.

Requirements

Students in this concentration are expected to meet all of the requirements for a PhD degree in ECo, as outlined in the student handbook, including the following:

1) A minimum of 18 dissertation credits is required, based on a research project specific to this concentration and approved by the student's advisory committee; no other course credits are required other than those determined by the student's advisory committee;
2) Successful completion of a comprehensive exam based upon the student's academic training in environmental conservation, encompassing three “core” topic areas (environmental science, quantitative science, and human dimensions);
3) Successful final defense of the dissertation; and
4) A minimum of three publishable-quality scientific papers resulting from the dissertation research project.

E. Resources & Facilities

Students have access to three interdisciplinary teaching and research laboratories that serve the Building and Construction Technology (BCT) program. The laboratories house state-of-the-art equipment for structural material testing and energy diagnostics as follows: 3 universal testing systems with computerized data acquisition, temperature/humidity chamber, drying equipment and an industrial size dry kiln, thermal imaging camera, blower-door tester. Students also have access to computing laboratories (PC and Mac) and library in Holdsworth 110A which contains current collections of field-relevant peer-reviewed scientific and trade
journals, texts and research proceedings. All BCT and ECo computers and most of the campus’ OIT computers have discipline-relevant software installed (CAD/BIM, structural design, estimating, energy analysis etc.). Faculty and students frequently conduct collaborative research with fellow international researchers from Canada, Germany and Austria. Industry contract work is also common for which students are often integrally involved. Companies draw on the expertise of the faculty and students to serve as consultants for various research enquiries.

F. Matriculation & Financial Aid

This program typically takes a full-time MS professional degree student 3-4 semesters to complete, a full-time MS thesis degree student 4-5 semesters to complete, and a full-time PhD student 8-10 semesters to complete, including the completion of a practicum/thesis/dissertation. However, some students may be able to complete the degree in less time and some take longer depending on their academic preparedness and the dictates of the practicum or thesis/dissertation research project.

Funding opportunities are limited, yet financial assistance is provided to virtually all of our MS thesis and PhD students through teaching or research assistantships (at Graduate Employee Organization bargained wage rates), University fellowships, or hourly wages. Tuition is waived during semesters in which at least a 10-hour assistantship or fellowship is awarded, but the student is responsible for most fees. Research assistantships are available through faculty members who have grant-supported research, and many faculty only accept students if they are able to provide grant-supported assistantships. Limited University fellowships are awarded by the Graduate School in open competition for those (including foreign applicants) who are endorsed by the Department.

Funding opportunities are more limited for students in the MS professional degree option. Some teaching assistantships and University fellowships may be available, or internship institutions may be able to provide some assistance, but most professional degree students are self-funded. Again, tuition is waived during semesters in which at least a 10-hour assistantship or fellowship is awarded (or the equivalent from an internship employer), but the student is responsible for most fees.

G. Concentration Coordinator & Faculty Affiliates

The following on-campus faculty (both regular and adjuncts), including the Graduate Concentration Coordinator, are principally affiliated with this concentration and regularly serve in the role of the student’s advisory committee chair or member and instructor for core courses; other faculty are occasionally involved in this concentration. See departmental website for information about the faculty (http://eco.umass.edu/index.php/people/) and the program website for more information on the graduate program (http://bct.eco.umass.edu/index.php/academics/graduate-program/).

Graduate Concentration Coordinator:
Peggi Clouston, P.Eng, Ph.D.
University of Massachusetts
Dept. of Environmental Conservation
160 Holdsworth Way
Amherst, MA 01003-4210
Tel: 413-545-1884
Fax: 413-545-4358
Email: clouston@umass.edu

Principal Faculty Affiliates:
• Peggi Clouston (clouston@umass.edu)
• Simi Hoque (simih@umass.edu)
• Ho-Sung Kim (kimhs@umass.edu)
• Alexander Schreyer (schreyer@umass.edu)
• Benjamin Weil (bweil@umass.edu)
• Chao “Luna” Xiao (chaoxiao@umass.edu)