Graduate Education Options in Energy Systems
May 16, 2014

Applications for admission to the Master of Engineering degree program with a Concentration in Energy Systems can be submitted to www.grad.illinois.edu/admissions
From April 29 to June 1, to start in Fall 2014
From June 2 to October 2, 2014, to start in Spring 2015 or Summer 2015
From June 2, 2014 to June 1, 2015, to start in Fall 2015
Submission early in the application period can facilitate planning, particularly for students planning to choose a practicum course.

CONTACTS FOR MORE INFORMATION:

Energy and Sustainability Engineering Graduate Certificate:
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Master of Engineering in Energy Systems
Clifford Singer <csinger@illinois.edu>

WHICH IS THE RIGHT OPTION?

There are three University of Illinois at Urbana-Champaign (UIUC) Options

1. Students Already Admitted to a UIUC Graduate Program: Graduate Certificate

   The Graduate Certificate in Energy and Sustainability Engineering (EaSE) is available to any UIUC graduate student who completes their degree requirements and includes within their graduate study program:

   • ENG 471—Seminar in Energy and Sustainability (1 hour)
   • ENG 571—Theory of Energy and Sustainability Engineering (3 hours)
   • 6 hours from one of the course lists below
   • 3 hours from a different course list below

   Students who plan to complete the EaSE Graduate Certificate requirements should fill out the registration form that can be found under the “Download the registration form” link at http://ease.illinois.edu/students.

2. UIUC undergraduates interested in a Master of Engineering in Energy Systems

   Students who have at least a 3.25 grade point average in UIUC courses should contact Professor Clifford Singer to be assigned an advisor to help plan a program for a combined undergraduate and Master of Engineering degrees. Advisors can be assigned to students at
any point from their sophomore to senior years. The Energy Systems masters degree is designed to allow students to complete that degree and an undergraduate degree in at most ten semesters. The requirements for the Energy Systems masters are listed below.

3. Other Prospective Master of Engineering in Energy Systems Candidates

Students who have expect to at least a 3.0 grade point average for the last two years of their undergraduate work at UIUC or another institution may apply starting with Graduate College website [www.grad.illinois.edu/admissions](http://www.grad.illinois.edu/admissions) “Start your Application Now” link. The application deadline for admission starting in the Fall of 2014 is February 28, 2014. The Graduate Record Exam is not required for admission for the Fall 2014 semester, but it may be decided that it will be required for admissions in subsequent semesters. Prospective applicants should examine the admissions and degree requirements and course lists given below and ensure that they have the necessary prerequisites listed in the UIUC course catalogue to complete the Energy Systems masters degree requirements within a time consistent with their financial resources. It is helpful if applicants include a Statement of Purpose with their application that indicates an example set of courses from the lists below that satisfy the requirements for the degree and suit their interests, and indicate how long they expect to take to complete the degree program. This information will be used only to help assess whether the applicants background is suitable. Students can choose a different set of courses once admitted, as their interests and available course offerings evolve.

The EaSE Graduate Certificate is designed primarily for students in Masters and PhD degree programs that normally require a research thesis for completion. Many such programs provide student opportunities for tuition and other support through the university. This approach is suitable for students who want to spend more than one full time equivalent year on graduate study and have career goals where exercising research capability is particularly important. The Graduate Certificate allows such students to demonstrate that they have educational background broader than specialization within a particular discipline.

The Energy Systems masters degree is designed for students who do not expect to pursue a PhD and who are self-supporting financially or who have outside sources of financial support. Degree requirements can be met with academic work correlated with an internship or outside employment, which may provide a potential avenue for financial support for some students. UIUC students can count 400 level course work excess to their undergraduate degree requirements towards the Energy Systems masters degree. This may in some cases allow completion of undergraduate and Master of Engineering degree requirements in less than ten semesters of on-campus study. The Energy Systems masters degree allows for a broader interdisciplinary education than is compatible with many Master of Science programs. The Energy Systems masters can be an appropriate choice for students who find such a background useful for pursuit of their career goals.

**ADMISSION TO THE ENERGY SYSTEMS MASTERS DEGREE PROGRAM**

Students with bachelors or masters degrees in the natural sciences or engineering will be considered for admission if they have a grade point average of at least 3.00 (A = 4.00) for the last two years of undergraduate study. Admission is possible for the spring term, but most admissions are for the fall term.

All applicants whose native language is not English must submit a minimum TOEFL score of 103 (iBT), 257 (CBT), or 613 (PBT); or minimum International English Language Testing System (IELTS) academic exam scores of 7.0 overall and 6.0 in all subsections. Applicants may be exempt from the TOEFL if certain criteria are met. Full admission status is granted for those meeting the minimum requirements and having taken the TOEFL or IELTS, since the scores required for admission to a Masters
of Engineering program are above the minimum scores demonstrating an acceptable level of English language proficiency. Applicants should include Graduate Record Exam (GRE) scores if those are available. Prospective applicants should not delay application if GRE scores are not available, but they should arrange to take the GRE at the earliest available date and be ready to provide scores upon request.

DEGREE REQUIREMENTS FOR THE MASTER OF ENGINEERING IN ENERGY SYSTEMS

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Credit for the Degree</strong></td>
<td>32</td>
</tr>
<tr>
<td><strong>Course Work</strong></td>
<td>32</td>
</tr>
<tr>
<td>ENG 471 and ENG 571</td>
<td>4</td>
</tr>
<tr>
<td>Professional Development (One of three options):</td>
<td>4</td>
</tr>
<tr>
<td>• Practicum: ENG 572 as approved by an advisor</td>
<td></td>
</tr>
<tr>
<td>• Project: ENG 573 as approved by an advisor</td>
<td></td>
</tr>
<tr>
<td>• 4 credit hours of course work approved by an advisor</td>
<td></td>
</tr>
<tr>
<td>Primary Field courses from an approved list</td>
<td>12</td>
</tr>
<tr>
<td>Area of Specialization</td>
<td>6</td>
</tr>
<tr>
<td>from the approved list in a field different than the Primary Field</td>
<td></td>
</tr>
<tr>
<td>Topical Breadth course from an approved list or approved by an advisor</td>
<td>3</td>
</tr>
<tr>
<td>Electives courses – chosen in consultation with an advisor</td>
<td>3</td>
</tr>
</tbody>
</table>

**Other Requirements and Conditions (may overlap):**

ENG 572 or ENG 573 may be taken for variable credit up to a maximum of 8 credit hours subject to advisor approval. Additional credit hours exceeding the 4 credit hour requirement may be applied toward the Primary Field course work requirement or the Area of Specialization requirement.

A minimum of 16 500-level credit hours applied toward the concentration; 8 of which must be in some combination of ENG and the Primary Field.

A maximum of one 1-credit-hour course may be applied toward the minimum 16 500-level credit-hour requirement.

The minimum program GPA is 3.0.
APPENDIX B: Course Requirements

The Energy Systems Concentration for the Master of Engineering degree requires a total of 32 hours of graduate credit, consisting of courses in core material, a Primary Field area, an Area of Specialization, individually tailored work in a practicum or project, and topical breadth. The program structure is designed to give students a solid grounding in the fundamentals of one or more energy-related technical areas as well as a broader exposure to the related economic, social, or political context in which energy systems operate. The application of what is learned toward a practicum or project is an important element of the program.

I. CORE COURSES:
ENG 471—Seminar on Energy and Sustain Engineering (1 hour)
ENG 571—Theory of Energy and Sustain Engineering (3 hours)

II. PRIMARY FIELD
At least three courses for at least 12 hours of credit from one of the subcategories in the 10 main categories listed below. A maximum of 4 additional credit hours from ENG 572 or ENG 573 which exceed the 4 credit hour requirement may be applied toward this requirement.

III. AREA of SPECIALIZATION
At least two courses for at least 6 hours of credit from a subcategory in a different main category from that chosen for the Primary Field.

IV. PRACTICUM OR PROJECT (Professional Development)
Each student will be assigned a faculty program advisor. Subject to advisor approval, students may complete either ENG 572—Energy Systems Practicum or ENG 573—Energy Systems Project. In lieu of ENG 572 or ENG 573, students may opt to complete 4 credit hours of additional course work if approved by an advisor in order provide greater depth in the Primary Field or Area of Specialization.

ENG 572—Energy Systems Practicum

The Energy Systems Practicum course involves reporting on how experience in an internship or design project relates to pertinent reading material. Reflecting the importance of developing good communication skills beyond written papers, this course will require additional reporting via Web site development and oral presentation. This course includes a half-day orientation session and a half-day debriefing session. It also requires review of periodic reports, and a cumulative report, which shall be thesis length if the course is taken for 8 hours of credit. Each student participant must have a mentor at the site of the practicum and a faculty member to provide oversight.

ENG 573—Energy Systems Project

For the Energy Systems Project (ENG 573) students will consult with a faculty member approved by their program advisor, select a project, get the topic and general scope approved, survey associated literature and state-of-the art, and then conduct, as appropriate, system-level or conceptual design studies, design-and-build activities, feasibility studies, experimental work, detailed numerical simulations, or detailed theoretical analyses of physical phenomena.
Potential sources of special project problems include Illinois engineering and science faculty, industrial organizations, federal research laboratories and regulatory agencies (e.g., Nuclear Regulatory Commission, EPA, Lawrence Berkeley National Laboratory, Army Construction Engineering Research Laboratory, National Renewable Energy Laboratory), state and regional planning, regulatory, and coordination authorities (e.g., California Energy Commission, Illinois EPA, South Coast Air Quality Management District, Western North Carolina Air Quality Management Agency), or the Facilities and Services Division at Illinois. In any case, a faculty member appointed by the Energy Systems concentration director will be required to approve the topic and general scope, and to evaluate and grade the overall effort. The grade for ENG 573 will be a DF (deferred) until the project is completed.

The main output of the project will be a final report that describes in detail what was done, why it was done, what avenues were not pursued and why, and makes appropriate recommendations, and as appropriate, suggestions for further work.

V. BREADTH AREA COURSE
At least 3 credit hours focusing on scientific, economic, political, or other subjects relevant to either energy or to energy-producing areas of the world, from the courses listed under a different main category than that of the Primary Field if not used for the Area Specialization requirement, from the Topical Breadth Course list below, or an advisor-approved alternative.

VI. ELECTIVES
Up to 3 credit hours of course work qualified for graduate credit from the course lists below (not used to fulfill other requirements), or courses for graduate credit taken as prerequisite for required courses. Additional practicum or project hours (not used to fulfill Primary Field course work and exceeding the 4 credit hour requirement) may be applied toward this requirement.

APPROVED COURSE PRIMARY FIELD AND AREA OF SPECIALIZATION LISTS

Primary Field courses must be chosen one of the subcategories under the numbered field categories listed below. Area of Specialization courses must be chosen from one of the subcategories under a different numbered field category listed below. ABE 436, Renewable Energy Systems, is included in more than one subcategory and in such cases may be used to satisfy either a Primary Field or Area of Specialization requirement. Some of the prerequisites approved for graduate credit are listed after the course titles. Energy Systems masters candidates may satisfy their elective course requirements by taking such prerequisites. Such prerequisite courses will not count towards the Primary Field or Area of Specialization requirements unless listed in the same Primary Field or Area of Specialization subcategory, respectively. The Topical Breadth Requirement may be satisfied by such a prerequisite course not listed under the Topical Breadth Requirement only with approval by a student’s program advisor. Special topics courses (sometimes but not always numbered 498 or 598) may be used to satisfy any requirement with program advisor approval of compatibility with that requirement. A partial list of special topics course suitable for subcategory approval by the program advisor is given below. The notation “< 400” below indicates that there are other prerequisites that are not approved for graduate credit and thus do not count towards the Energy Systems masters degree. Students planning to apply for admission to the Energy Masters degree program must either take care that their undergraduate education covers the material required as a prerequisite to their planned Energy Masters courses or that they can take or audit the necessary prerequisite course work in a timely manner once admitted. Equivalent courses counted towards an undergraduate degree cannot be repeated and counted towards the Energy Systems degree. Prospective students should note in the online campus course catalogue the semesters in which courses are normally offered when allocated time for completion of degree requirements. Obtaining consent of instructors where that is needed for course enrollment until a student has first been admitted and then verified that such consent will be forthcoming.
1. Electrical Energy Conversion, Transmission, and Distribution
   A. Electric Conversion and Control
   ECE 431 (4 hrs)—Electric Machinery (<400)
   ECE 432 (4 hrs)—Advanced Electric Machinery (ECE 431)
   ECE 464 (3 hrs)—Power Electronics (<400)
   ECE 496 (4 hrs)—Control Systems (<400)
   ECE 515 (4 hrs)—Control System Theory and Design (ECE 486)
   ECE 568 (4 hrs)—Modeling and Control of Electromechanical Systems (ECE 431 and ECE 515)

   B. Electric Power Transmission and Distribution
   ECE 476 (3 hrs)—Power System Analysis (<400)
   ECE 530 (4 hrs)—Large-Scale System Analysis (ECE 464 + ECE 476)
   ECE 573 (4 hrs)—Power System Control (ECE 530, may be taken concurrently, and ECE 476)
   ECE 576 (4 hrs)—Power System Dynamics (ECE 530, may be taken concurrently, and ECE 476)
   ECE 588 (4 hrs)—Electricity Resource Planning (Math 415 + ECE 313 + ECE 476)
   GE 424 (3 hrs)—State Space Design for Control (Math 415 + GE 320)
   GE 525 (4 hrs)—Control of Complex Systems (GE 424)

2. Thermal Energy Systems and Combustion Engines
   A. Thermal Systems
   AE 412 (3 or 4 hrs)—Viscous Flow and Heat Transfer (<400)
   ME 400 (4 hrs)—Energy Conversion Systems (<400)
   ME 401 (4 hrs)—Refrigeration and Cryodynamics (<400)
   ME 402 (3 or 4 hrs)—Design of Thermal Systems (<400)
   ME 404 (4 hrs)—Intermediate Thermodynamics (<400)
   ME 412 (4 hrs)—Numerical Thermo-fluid Mechanics (<400)
   ME 420 (4 hrs)—Intermediate Heat Transfer (<400)
   ME 502 (4 hrs)—Thermal Systems (ME 402)
   ME 504 (4 hrs)—Heat Conduction (ME 404)
   ME 521 (4 hrs)—Convective Heat Transfer (ME 403)

   B. Combustion Engines
   ABE 466 (3 hrs)—Engineering Off-Road Vehicles (<400)
   ME 403 (3 or 4 hrs)—Internal Combustion Engines (ME 400 or ABE 466)
   ME 410 (4 hrs)—Intermediate Gas Dynamics (<400)
   ME 501 (4 hrs)—Combustion Fundamentals (AE 311 or ME 410)
   ME 503 (4 hrs)—Design of Internal Combustion Engines (ME 403)
   UP 441 (4 hrs)—Urban Transportation Planning

3. Chemistry and Chemical and Materials Engineering
   A. Chemistry and Materials Science
   Chem 460 (3 hrs)—Green Chemistry (<400)
   Chem 524 (4 hrs)—Electrochemical Methods (Chem 442)
   MSE 401 (4 hrs)—Thermodynamics of Materials (<400)
   MSE 403 (3 hrs)—Synthesis of Materials (MSE 401, may be taken concurrently)
   MSE 487 (4 hrs)—Materials for Nanotechnology (MSE 401)
   MSE 488 (4 hrs)—Optical Materials (<400)
   MSE 489 (4 hrs)—Materials Selection for Sustainability
   MSE 500 (4 hrs)—Statistical Mechanics of Materials (MSE 401)
   MSE 501 (4 hrs)—Kinetic Processes in Materials (MSE 500)
3. Chemistry and Chemical and Materials Engineering (continued)

B. Chemical Engineering

CHBE 422 (4 hrs)—Mass Transfer Operations (CHBE 421)
CHBE 424 (3 hrs)—Chemical Reaction Engineering (CHBE 422, may be taken concurrently)
Chem 444 (4 hrs)—Physical Chemistry II (Chem 442)
CHBE 431 (4 hrs)—Process Design (CHBE 424, may be taken concurrently, and CHBE 422)
CHBE 452 (3 hrs)—Chemical Kinetics and Catalysis (Chem 442 or CHBE 321)
CHBE 453 (2 or 3 hrs)—Electrochemical Engineering
CHBE 553 (4 hrs)—Surface Chemistry (Chem 444)
CHBE 551 (4 hrs)—Chemical Kinetics and Catalysis (<400)
NPRE 470 (3 hrs)—Fuel Cells and Hydrogen Sources (<400)

4. Nuclear Power Generation

A. Nuclear Power Generation

NPRE 402 (4 hrs)—Nuclear Power Engineering
NPRE 431 (3 hrs)—Materials in Nuclear Engineering
NPRE 448 (4 hrs)—Nuclear Systems Engineering and Design (NPRE 455 + Math 285 + Math 285)
NPRE 455 (4 hrs)—Neutron Diffusion and Transport (<400)
NPRE 501 (4 hrs)—Fundamentals of Nuclear Engineering (NPRE 446, may be taken concurrently)
NPRE 531 (4 hrs)—Nuclear Materials (NPRE 431)
NPRE 555 (4 hrs)—Reactor Theory I (NPRE 455)
NPRE 556 (4 hrs)—Reactor Theory II (NPRE 455)

With Nuclear Power Generation as a Primary Field, only one NPRE course, can be counted towards the Area of Specialization requirement (and that course cannot be one of the courses listed in the Nuclear Power Generation category).

5. Wind Energy

A. Wind Energy

AE 410 (3 or 4 hrs)—Computational Aerodynamics (<400)
AE 416 (3 or 4 hrs)—Applied Aerodynamics (<400)
AE 451 (3 or 4 hrs)—Aeroelasticity (<400)
AE 514 (4 hrs)—Boundary Layer Theory (AE 412)
AE 515 (4 hrs)—Wing Theory (AE 416)
NPRE 475 (4 hrs)—Wind Power Systems (<400)
TAM 428 (3 hrs)—Mechanics of Composites (<400)
TAM 470 (3 or 4 hrs)—Computational Mechanics (<400)

6. Solar Energy and Climate Change

A. Solar Energy

ABE 436 (4 hrs)—Renewable Energy Systems (<400); or TSM 438—Renewable Energy Applications
ATMS 504 (4 hrs)—Physical Meteorology
ATMS 510 (4 hrs)—Precipitation Physics (ATMS 504 or consent of instructor)
ATMS 511 (4 hrs)—Atmospheric Radiation (ATMS 504 or consent of instructor)
ME 522 (4 hrs)—Thermal Radiation (ME 420)
PHYS 402 (3 or 4 hrs)—Light (<400)
6. Solar Energy and Climate Change (continued)

B. Climate Change
ATMS 421 (4 hrs)—Earth Systems Modeling
ATMS 449 (4 hrs)—Biogeochemical Cycles (consent of instructor)
ATMS 507 (4 hrs)—Climate Dynamics
ATMS 512 (4 hrs)—Clouds and Climate (ATMS 504 or consent of instructor)
CSPC 431 (3 hrs)—Plants and Global Change (<400)
Geog 496 (4 hrs)—Climate and Social Vulnerability (Geog 410 or 466 or 471 or 520 or consent)
NRES 426 (4 hrs)—Renewable Energy Policy

7. Environmental Engineering for Energy Applications

A. Water Quality
CEE 437 (3 hrs)—Water Quality Engineering (<400)
CEE 442 (3 hrs)—Environmental Engineering Principles, Physical (CEE 437)
CEE 443 (4 hrs)—Environmental Engineering Principles, Chemical (CEE 437)
CEE 444 (4 hrs)—Environmental Engineering Principles, Biological (CEE 443)
CEE 457 (3 hrs)—Groundwater (<400)
CEE 537 (4 hrs)—Water Quality Control Processes I (CEE 442 and 443, may be taken concurrently)
CEE 538 (4 hrs)—Water Quality Control Processes II (CEE 444, may be taken concurrently, and
CEE 442 and 443)
CHLH 461 (4 hrs)—Environmental Toxicology
GEOL 470 (4 hrs)—Introduction to Hydrogeology (<400)
GEOL 570 (4 hrs)—Hydrogeology (Geol 470 or CEE 457 or consent of instructor)

B. Air Quality
ATMS 420 (3 hrs)—Atmospheric Chemistry
CEE 445 (4 hrs)—Air Quality Modeling (<400)
CEE 446 (4 hrs)—Air Quality Engineering (CEE 445)
CEE 447 (4 hrs)—Atmospheric Chemistry
CEE 546 (4 hrs)—Air Quality Control (CEE 442 and CEE 446)
CEE 545 (4 hrs)—Aerosol Sampling and Analysis (CEE 446 and Math 285)

C. Environmental Management and Human Environments
ACE 555 (2 hrs)—Economic Impact Assessment
CEE 434 (3 hrs)—Environmental Systems I (<400)
CEE 440 (4 hrs)—Fate and Cleanup of Environmental Pollutants (<400)
CEE 535 (4 hrs)—Environmental Systems II (CEE 434)
Geog 466 (4 hrs)—Environmental Policy
LA 550 (4 hrs)—Environmental Impact Assessment
UP 446 (4 hrs)—Sustainable Planning Seminar
UP 466 (4 hrs)—Energy, Planning, and the Built Environment
UP 546 (4 hrs)—Land Use Planning and Policy
UP 547 (4 hrs)—Growth Management and Regional Planning (consent of instructor)
8. Biomass Energy Resources
A. Bioenergy
ABE 436 (4 hrs)—Renewable Energy Systems (<400)
ABE 446 (4 hrs)—Biological Nanoengineering (<400)
ABE 488 (3 hrs)—Bioprocessing Biomass for Fuel (<400)
ACES 501 (2 hrs)—Advanced Bioenergy Topics
ACES 509 (3 hrs)—Advanced Bioenergy Systems
CPSC 415 (3 hrs)—Bioenergy Crops (<400)
IB 421 (3 hrs)—Photosynthesis (IB420 or MCB 354 or MCB 450 or BIOP 401, or consent)
IB 532 (4 hrs)—Sustainability and Global Change

B. Biosphere
ATMS 421 (4 hrs)—Earth Systems Modeling
Geog 410 (4 hrs)—Geography of Development and Underdevelopment (ATMS446 or Soc 451)
Geog 496 (4 hrs)—Climate & Social Vulnerability (Geog 410 or consent)
NRES 516 (4 hrs)—Ecosystem Biogeochemistry

C. Agribusiness
ACE 435 (3 hrs)—Global Agribusiness Management (<400)
ACE 446 (2 hrs)—Modeling Applications in Financial Planning (<400)
ACE 455 (3 hrs)—International Trade in Food and Agriculture (<400)
ACE 520 (4 hrs)—Food Commodity Markets (ACE 562 + ACE 563 + Econ 500)
ACE 562 (2 hrs)—Applied Regression Models I (<400)
ACE 563 (2 hrs)—Mathematical Programming for Applied Economics I (<400)

9. Geologic Energy Resources
A. Petroleum
ME 472 (4 hrs)—Tribology
Geol 411 (4 hrs)—Structural Geology and Tectonics (< 400)
Geol 440 (4 hrs)—Sedimentology and Stratigraphy (< 400)
Geol 470 (3 hrs)—Introduction to Hydrogeology (< 400)
Geol 540 (4 hrs)—Petroleum Geology (Geol 440 + Geol 441)

B. Geochemistry
Geol 460 (3 hrs)—Geochemistry (< 400)
Geol 560 (4 hrs)—Physical Geochemistry (< 400)
Geol 562 (4 hrs)—Isotope Geology (consent of instructor)
Geol 563 (4 hrs)—Analytic Geochemistry (consent of instructor)

C. Pipeline Properties
TAM 424 (3 hrs)—Mechanics of Structural Materials (< 400)
TAM 435 (4 hrs)—Intermediate Fluid Mechanics (< 400)
TAM 445 (4 hrs)—Continuum Mechanics (< 400)
TAM 532 (4 hrs)—Viscous Flow (<400 + TAM435)
AE 529 (4 hrs)—Viscoelasticity Theory (TAM 451 or AE321)

D. Energy Networks
Geog 473 (4 hrs)—Map Compilation and Construction
Geog 479 (3 hrs)—Advanced Geographic Information Systems (< 400)
Geog 489 (4 hrs)—Programming for GIS (Geog 473 or Geog 379)
Geog 570 (4 hrs)—Advanced Spatial Analysis
9. Geologic Energy Resources (continued)
   E. Dams
   CEE 452 (3 hrs)—Hydraulic Analysis and Design (< 400)
   CEE 483 (4 hrs)—Soil Mechanics and Behavior (< 400)
   CEE 484 (4 hrs)—Applied Soil Mechanics (CEE 483)
   CEE 581 (4 hrs)—Earth Dams (CEE 484, may be taken concurrently)

   F. Surface Water
   ABE 456 (4 hrs)—Land and Water Resources Engineering (< 400)
   NRES 401 (3 hrs)—Watershed Hydrology (< 400)
   Geog 406 (4 hrs)—Hydraulic Analysis and Design (< 400)
   Atms 421 (4 hrs)—Earth Systems Modeling
   CEE 450 (3 hrs)—Surface Hydrology (< 400)
   CEE 550 (4 hrs)—Hydroclimatology (CEE 450)
   CEE 551 (4 hrs)—Open-channel Hydraulics (CEE 451)

    A. Econometrics
    Econ 506 (4 hrs)—Economic Statistics (<400)
    Econ 507 (4 hrs)—Economic Analysis (Econ 506)
    Econ 508 (4 hrs)—Econometrics I (Econ 507 or Econ 574)
    Econ 576 (4 hrs)—Time Series Analysis in Economics (Econ 507 or Stat 578)
    B. Resource Econometrics Modeling
    ACE 562 (2 hrs)—Applied Regression Models I (<400)
    ACE 563 (2 hrs)—Mathematical Programming Applications in Economics I (<400)
    ACE 564 (2 hrs)—Applied Regression Models II (ACE 562)
    ACE 565 (4 hrs)—Modeling Dynamic Economic Systems (ACE 562 or ACE 563)
    ACE 566 (4 hrs)—Mathematics for Applied Economics
    ACE 567 (4 hrs)—Mathematical Programming Applications in Economics II (ACE 563)
    C. Microeconomics
    Econ 500 (4 hrs)—General Microeconomic Theory (<400)
    Econ 502 (4 hrs)—Microeconomic Theory I (<400)
    Econ 580 (4 hrs)—Industrial Organization
    D. International Economics
    Econ 420 (2 or 4 hrs)—International Economics (<400)
    Econ 522 (4 hrs)—International Financial Economics (<400)
    Econ 550 (4 hrs)—Economics of Development and Growth (<400)
    E. Environmental Economics
    ACE 411 (4 hrs)—Environment and Development (<400)
    ACE 510 (4 hrs)—Advanced Natural Resource Economics (<400)
    Econ 516 (4 hrs)—Environmental Economics (<400)
F. Reliability
CEE 460 (3 hrs)—Steel Structures I (<400)
CEE 462 (3 or 4 hrs)—Steel Structures II (CEE 460)
CEE 463 (3 or 4 hrs)—Reinforced Concrete II (<400)
CEE 575 (4 hrs)—Fracture and Fatigue (CEE 471 or TAM 451 or TAM 551)
GE 411 (3 or 4 hrs)—Reliability Engineering (<400)
GE 523 (3 or 4 hrs)—Discrete Event Dynamic Systems (Math 415 + Math 461 + <400)
GE 524 (4 hrs)—Data-Bases Systems Modeling (GE 414+IE 300)
GE 530 (4 hrs)—Multiattribute Decision Making (<400)
NPRE 457 (3 or 4 hrs)—Safety Analysis of Nuclear Reactor Systems (NPRE 402 or NPRE 427)

G. Environmental Safety
ABE 455 (2 hrs)—Erosion and Sediment Control (<400)
CHLH 469 (3 or 4 hrs)—Environmental Health (<400)
CEE 457 (3 hrs)—Groundwater (<400)
CEE 557 (4 hrs)—Groundwater Modeling (CEE 457)
NPRE 441 (4 hrs)—Radiation Protection (NPRE 446)
NPRE 442 (3 hrs)—Radioactive Waste Management (<400)

H. Security
NPRE 480 (3 hrs)—Energy and Security
NPRE 481 (3 hrs)—Writing on Technology and Security
PS 455 (3 or 4 hrs)—Political Economic Societal Welfare, and Democracy (consent of instructor)
PS 580 (4 hrs)—Proseminar on International Relations I
PS 581 (4 hrs)—International War (PS 580)

I. Information Technology
CS 438 (3 hrs)—Communications Networks (Math 461 or Math 463 or ECE 313, and <400)
CS 461 (3 hrs)—Computer Security I (<400)
CS 463 (3 or 4 hrs)—Computer Security II (CS 461)
CS 465 (3 or 4 hrs)—User Interface Design (<400)
CS 565 (4 hrs)—Human-Computer Interaction (CS 465)

EXAMPLES OF SPECIAL TOPICS COURSES

Listed here are examples of special topics courses and the above subcategories for which program advisors might approve their use. Also listed is the most recent semester, working back from Spring 2014, in which the indicated section has been offered. The notation * indicates courses that are planned to be offered regularly under a different course number and do not require program advisor approval.

Information on other courses that are planned to be offered regularly and on new course numbers will be expected to be added to this document at least annually.

1A. Electric Conversion and Control
ECE 464RPP (4 hrs)—Advanced Power Electronics (Spring 2014)

5A. Solar Energy
*ME 498EEG (4 hrs)—Fundamentals of Modern Photovoltaics (Fall 2013)

7A. Water Quality
*CEE 498EWS (4 hrs)—Energy and Water Sustainability (Spring 2014)
*CEE 498WTP (4 hrs)—Water Technology and Policy (Spring 2014)
EXAMPLES OF SPECIAL TOPICS COURSES (continued)
7C. Environmental Management and Human Environments
*CEE 498SIS (4 hrs)—Sustainable Construction Methods (Spring 2014)
*CEE 498MEA (3 hrs)—Multi-Lateral Environmental Agreements (Spring 2014)
*CEE 598SUS (4 hrs)—Sustainable Urban Systems (Fall 2013)
ARCH 594BCS (3 hrs)—Building Energy Case Studies (Spring 2014, requires consent of instructor)
ARCH 594GDS (3 hrs)—Assessment of Green Design Strategies Using Computer Simulation (Spring 2014, requires consent of instructor)

TOPICAL BREADTH COURSE LIST
ACE 406—Environmental Law
ACE 448—Rural Real Estate Appraisal
ACE 454—Economic Development of Tropical Africa
ACE 471—Consumer Economic Policy
ACE 474—Economics of Consumption
ACE 500—Applied Economic Theory
ACE 501—Risk and Information: Theory and Applications
ACE 527—Advanced Price Analysis
ACE 553—Topics in Regional Development
ANTH 467—Cultures of Africa
ARCH 538—Economic Issues in Architectural Development
BADM 403—Principles of Business Law
BADM 533—Sustainable Production and Business Plans
CHLH 469—Environmental Health
ECON 411—Public Sector Economics
ECON 420—International Economics
ECON 450—Development Economics
ECON 452—The Latin American Economies
ECON 462—Macroeconomic Policy
ECON 481—Government Regulation of Economic Activity
ECON 483—Economics of Innovation and Technology
ECON 484—Law and Economics
ECON 501—Quantitative Analysis for Economists
ECON 503—Macroeconomic Theory I
ECON 516—Environmental Economics
ECON 517—Political Economy
ECON 523—Business International Economics
ECON 581—Government Regulation of Industry
GEOG 466—Environmental Policy
GEOG 520—Political Ecology
IB 452—Ecosystem Ecology
LA 441—Land Resource Evaluation
NRES 427—Modeling Natural Resources
NRES 439—Environment and Sustainable Development
SOC 447—Environmental Sociology
TE 565—Technology Innovation and Strategy
UP 445—Economic Development Planning